Vol. 5, No. 1, 2025, 1-11. DOI: 10.47909/ijsmc.1623

pro metrics

ORIGINAL ARTICLE

What topics are investigated in circular economy research? A co-word analysis using hierarchical clustering

José Luis Ausejo Sánchez[1,*], Patricia Elena Ramos La Rosa[1], Damaris Fabiola Medina Palma[1], Gleny Amelia Ching Campos[1], Yolanda Emperatriz Maguiña Poma[1]

[1] Universidad Nacional José Faustino Sánchez Carrión, Perú.
* Corresponding author
Email: jausejo@unjfsc.edu.pe. **ORCID:** https://orcid.org/0000-0003-4674-6150.

ABSTRACT

Objective. We analyzed the most researched topics related to the circular economy. To this end, we used a bibliometric approach, generating thematic maps that group the most used terms in the scientific literature.

Design/Methodology/Approach. The present study focused on hierarchical clustering analysis to identify and understand interrelated themes in circular economy research. Adopting Ward's method, the analysis was performed without predetermining the number of groups. The data set was extracted from the Scopus database. Author keywords and keywords plus were used for the study.

Results/Discussion. A hierarchical clustering analysis applied to the corpus of circular economy terms has revealed five main groups: (1) technological innovation and strategic planning, (2) adaptation and resilience in industrial processes, (3) reuse and advanced manufacturing, (4) safety and automation in the circular economy, and (5) material science and chemical sustainability. The interrelationship between the clusters identified in the analysis reflects an integrated thematic ecosystem within the circular economy, with each cluster complementing the others to address multifaceted challenges. Cluster 1, focused on the "circular economy" and "sustainable development," is the strategic core connecting all clusters' technological and policy approaches. This cluster establishes direct links with cluster 3, where concepts such as "recycling" and "additive manufacturing" are essential to materialize the reuse strategies proposed. Cluster 2, focused on adaptation and resilience, establishes a critical connection with cluster 4 since automation and safety require adaptive models to manage dynamic processes. In addition, cluster 5, focused on sustainable materials and chemical processes, complements the objectives of cluster 1 by providing innovative solutions to improve recyclability and manage waste such as plastic waste and carbon dioxide.

Conclusions. The synergies between the clusters show that progress toward a circular model depends on integrating multiple dimensions, from policy and technology strategies to advances in materials and industrial processes.

Received: 16-10-2024. **Accepted:** 20-12-2024. **Published:** 05-01-2025.

How to cite: Girón, D. C. A., La Rosa, P. E. R, Palma, D. F. M., Campos, G. A. C., & Poma, Y. E. M. (2025). What topics are investigated in circular economy research? A co-word analysis using hierarchical clustering. *Iberoamerican Journal of Science Measurement and Communication; 5*(1), 1-11. DOI: 10.47909/ijsmc.1623

Keywords: circular economy; co-word analysis; bibliometrics; hierarchical clustering; sustainable development; environmental economics.

1. INTRODUCTION

The last decades' economic, industrial, and technological development has had a high cost, leading to a depletion of natural resources. This has occurred under a linear production model based on the "take-make-waste" paradigm. Faced with this, a new circular economy paradigm has been established (Martinez & Porcelli, 2018). According to the Ellen MacArthur Foundation (n.d.):

> The circular economy is a system where materials never become waste and nature is regenerated. In a circular economy, products and materials are kept in circulation through processes like maintenance, reuse, refurbishment, remanufacture, recycling, and composting. The circular economy tackles climate change and other global challenges, like biodiversity loss, waste, and pollution, by decoupling economic activity from the consumption of finite resources.

The definition of circular economy is very diverse, but the common denominator in each definition is to make better use of resources (Velenturf & Purnell, 2021). According to Romero (2019), various concepts related to alternative production models have been proposed, such as ecological, blue, green economy, industrial ecology, low carbon economy, and eco-efficiency. Indisputably, the circular economy directly relates to sustainability (Prieto-Sandoval, Jaca-García, & Ormazabal-Goenaga, 2017). According to Carrillo González & Pomar Fernández (2021), the circular economy incorporates both costs and revenues associated with the flow of materials, in addition to valuing by-products and encouraging the creation of connections derived from an innovative approach to business. It also considers the regulatory framework, laws, and public policies that establish the necessary conditions for the emergence of new business models or the transformation of already consolidated companies.

Porcelli & Martinez (2018) express that the circular economy is founded on three key principles designed to address the challenges related to resources and systems faced by industrial economies. The first principle seeks to preserve and enhance natural capital by controlling finite reserves and balancing renewable resource flows. The second focuses on optimizing resource efficiency, ensuring that products, components, and materials are used efficiently and with maximum utility in both technical and biological cycles. Finally, the third principle promotes system efficiency, eliminating those external factors that generate negative impacts from the design. Stahel (2016) emphasizes that business models based on the circular economy fall into two main categories: those that promote reuse and extend the useful life of products through repairs, reconditioning, upgrades, and modernizations and those that transform old goods into practically new resources through the recycling of materials.

According to the European Parliament (2023), shifting to a circular economy is essential to protect the environment, reduce dependence on raw materials, and generate economic benefits by creating jobs and saving consumers money. Many government initiatives have been implemented to develop circular economy models, policies, and strategies. For example, in March 2020, the European Commission adopted a circular economy plan to reduce pressure on natural resources and create more sustainable jobs and growth (European Commission, n.d.). In the United States, on June 12, 2024, the White House, in conjunction with the EPA (Environmental Protection Agency), U.S. Department of Agriculture, and U.S. Food and Drug Administration, developed the "National Strategy for Reducing Food Loss and Waste and Recycling Organics." Its purpose is to build a more circular economy based on four strategic objectives that seek to prevent food loss and waste, increase organic waste recycling, and support policies that encourage these initiatives (United States Environmental Protection Agency, 2024). The implementation of public circular economy initiatives in Latin America and the Caribbean shows considerable inequality.

Countries such as Costa Rica and Panama have taken essential steps in establishing fundamental public policy instruments. In the meantime, most countries in the region have established roadmaps, national strategies, or other fundamental frameworks to guide their efforts in the southern part of the continent. Chile, Uruguay, Colombia, Ecuador, and Peru are leaders in transitioning to a more sustainable economic model (Turrión Barbero, 2023).

At the epistemic level, the circular economy is characterized by poorly defined conceptual boundaries, ambiguous theoretical bases, and structural challenges that hinder its implementation. Its development responds to an ideological agenda focused on technical and economic aspects, which generates doubts about its impact on sustainability and disconnects sustainable growth from broader political discussions (Corvellec, Stowell & Johansson, 2022). We are talking about a concept that "has been developed thanks to different approaches from disciplines such as ecology, economy, engineering, design and business" (Prieto-Sandoval, Jaca & Ormazabal, 2018, p. 609). It is an area that has gained attention, not only practical but also academic. There are more and more analyses around its concept, journals that publish on the subject, and conferences that address these issues. As a result, a significant volume of literature deals with this and other associated topics (Kirchherr, Urbinati & Hartley, 2023).

When we review the literature on the topic, we notice that what is most explored is related to its conceptual precisions and scope (Korhonen, Honkasalo & Seppälä, 2018; Kirchherr, Urbinati, & Hartley, 2023), implementation (Heshmati, 2017; Barreiro-Gen & Lozano, 2020), and policies, models and strategies (Bocken *et al.,* 2016; McDowall *et al.,* 2017; de Sousa Jabbour *et al.,* 2019). There is also a diversity of bibliometric studies that analyze the literature produced at the regional level, as is the case in the European Union (Türkeli *et al.,* 2018; Martinho & Mourão, 2020; Dragomir & Dumitru, 2023), Latin America (Ospina-Mateus *et al.,* 2023), Africa (Mhlanga, Haupt & Loggia, 2024), and Asia (Saidi & Radz, 2023). In another vein, other bibliometric studies target specific sectors, such as beauty (Vuc, 2024), e-waste (Çizer & Kırçova, 2024), automotive industry (Biancone *et al.,* 2021), agriculture (Banerjee, Singh & Kunja, 2024), construction (Otasowie *et al.,* 2024), manufacturing (Gundu *et al.,* 2024), oil and gas industry (Dua & Jain, 2024), and food industry (Rabbi & Amin, 2024).

In this study, we will analyze the most researched topics related to the circular economy. To this end, we will use a bibliometric approach, generating thematic maps that group the most used terms in the scientific literature.

2. METHODOLOGY

2.1. Methodological approach and search strategy

The present study focused on hierarchical clustering analysis to identify and understand interrelated themes in circular economy research. This approach grouped terms according to their semantic similarities and represented them in hierarchical structures, reflecting their internal relationships and connections with other concepts. The analysis was performed without predetermining the number of groups, adopting Ward's method. This method minimizes intragroup variance, generating well-defined and statistically robust clusters.

The data set analyzed was extracted from the Scopus database. For this purpose, the following search strategy was applied:

TITLE ("circular economy") AND PUBYEAR > 2003 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp") OR LIMIT-TO (DOCTYPE, "ch") OR LIMIT-TO (DOCTYPE, "re") OR LIMIT-TO (DOCTYPE, "cr")), which yielded a total of 8101 documents. This methodological approach identified thematic clusters and analyzed their internal relationships and interconnection.

2.2. Data processing and visualization

Author keywords and keywords plus were used for the analysis. Keyword entries were normalized, and only those with a frequency over ten were considered for analysis. Duplicate or irrelevant terms were eliminated, and two-dimensional coordinates were reviewed to ensure their suitability for hierarchical clustering analysis. This initial processing ensured the quality and accuracy of the data set before proceeding with the hierarchical analysis.

As mentioned above, we used Ward's method through advanced Python tools. The overall dendrogram generated showed the complete hierarchical structure of the terms, graphically representing the semantic relationships and allowing us to identify the optimal levels to divide the keywords into meaningful clusters. To facilitate interpretation and visualization, we generated sub-dendrograms of each cluster, focusing on each cluster's ten most frequent terms. This facilitated the thematic analysis.

3. RESULTS AND DISCUSSION

A hierarchical clustering analysis applied to the corpus of circular economy terms has revealed five main groups (See Figure 1 and Table 1). These results comprehensively overview how key concepts are clustered and related within the scientific literature. The identified clusters are described in depth below, including the most representative terms, their frequencies, and the existing relationships between words and between clusters.

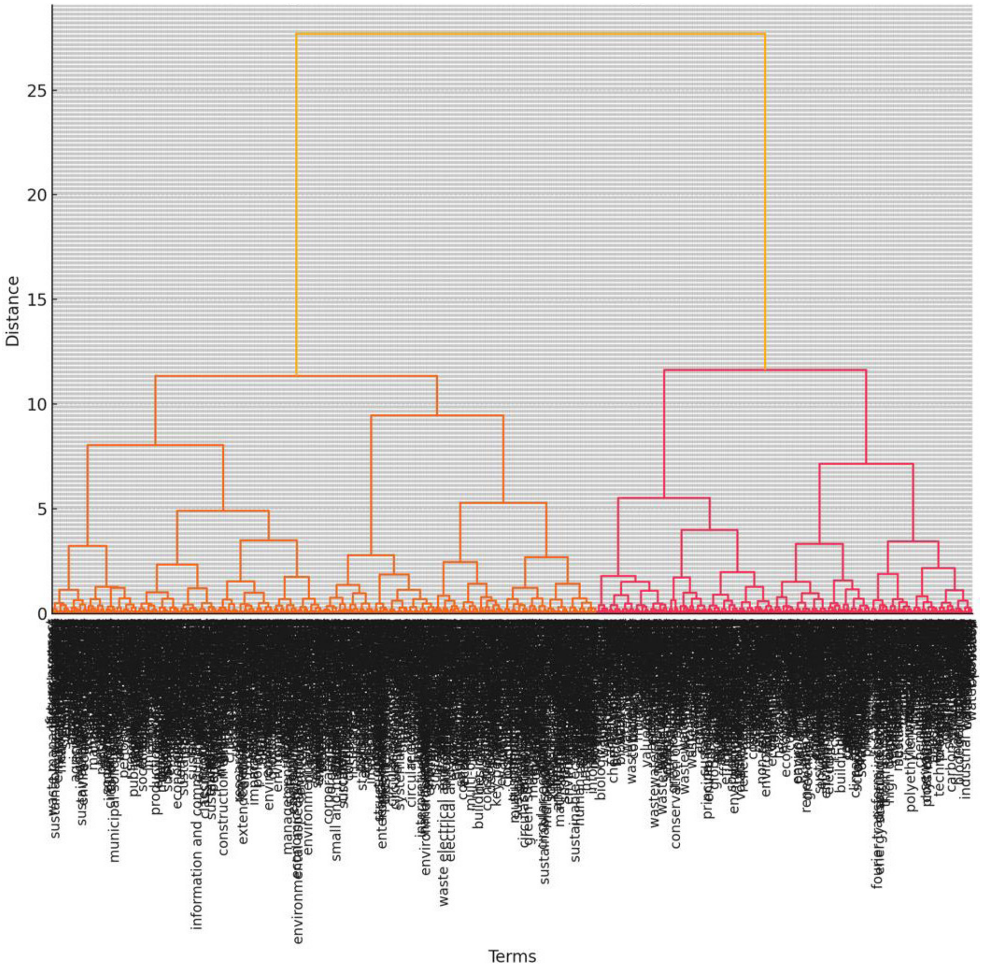

Figure 1. Dendogram of the hierarchical grouping of the topics associated with circular economy research.

Cluster 1, "Technological innovation and strategic planning," focuses on integrating advanced technologies and concrete strategies to foster the transition toward a circular economy (See Figure 2). This group includes terms such as "circular economy," "sustainable development," "recycling," and "action plan." With a frequency of 6180 mentions, "circular economy" emerges as the dominant conceptual axis of this cluster and, by extension, the overall analysis. This term is accompanied by "sustainable development," appearing 3420 times, and "recycling," with 2450 mentions, underlining the centrality of these practices in transitioning to more circular economic models. The presence of terms such as "action plan" reflects the importance of developing concrete strategies to implement sustainability and recycling initiatives. The relationships among these terms suggest a strong connection between technological innovation and the formulation of strategic policies to reduce waste and maximize resource efficiency.

Moreover, the interconnection between "circular economy" and "recycling" reinforces the notion that recycling is one of the cornerstones of adopting circular practices. The presence of "sustainable development" in this cluster indicates that the circular economy seeks to reduce environmental impact and promotes a balance between economic growth and environmental protection.

Cluster	Label	Top 10 Terms (Frequency)
1	Technological innovation and strategic planning	circular economy (6180), sustainable development (1680), sustainability (1410), recycling (1212), waste management (923), life cycle (638)', economics (586), environmental impact (475), environmental economics (424), industrial economics (423)
2	Adaptation and resilience in industrial processes	innovation (207), systematic literature review (149), conceptual framework (134), small and medium-sized enterprise (134), stakeholder (128), business (126), barrier (116), circularity (97), digitalization (96), internet of things (84)
3	Reuse and advanced manufacturing	supply chain management (592), decision making process (369), industry (346), manufacture (317), business model (299), construction industry (227), product design (215), circular business model (112), industrial research (109), design (105)
4	Safety and automation in the circular economy	economic aspect (475), climate change (249), waste disposal (215), greenhouse gases (206), waste (206), biomass (189), wastewater treatment (184), food waste (174), municipal solid waste (168), agriculture (160)
5	Material science and chemical sustainability	plastic waste (156), carbon dioxide (150), recovery (144), plastic recycling (139), energy utilization (129), plastic (117), carbon footprint (114), controlled study (110), environmental technology (110), gas emissions (109)

Table 1. Top ten terms per cluster.

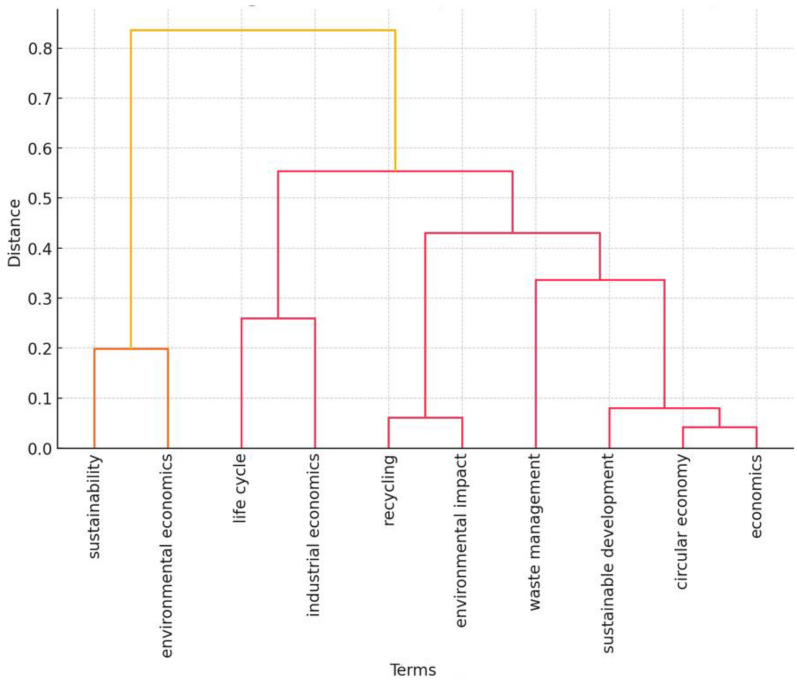

Figure 2. Sub-dendrogram of top ten terms in cluster 1.

Cluster 2, "Adaptation and resilience in industrial processes," highlights the capacity of systems to adapt to changing environments (See Figure 3). This cluster includes terms such as "innovation," "systematic literature review," "action research," and "adaptive management." With 207 mentions, "innovation" appears as a key term connecting theoretical and methodological approaches to practice in the field of circular economy. "Adaptive management," with 140 mentions, suggests that industrial systems are evolving toward more flexible and resilient models capable of adapting to dynamic and changing environments. This cluster reflects a convergence of research methodologies and practical applications, emphasizing the need for interdisciplinary approaches that integrate theory and practice to address complex challenges. The terms "action research" and "systematic literature review," with 152 and 190 mentions, respectively, evidence an academic focus oriented toward developing solid theoretical frameworks that guide practical applications in the circular economy. The connections between "adaptive management" and "innovation" suggest that adaptability is an essential element for the successful implementation of circular strategies in industrial contexts. This cluster is linked to cluster 4, which explores automation and safety in circular processes, underscoring the importance of resilience in highly technical systems.

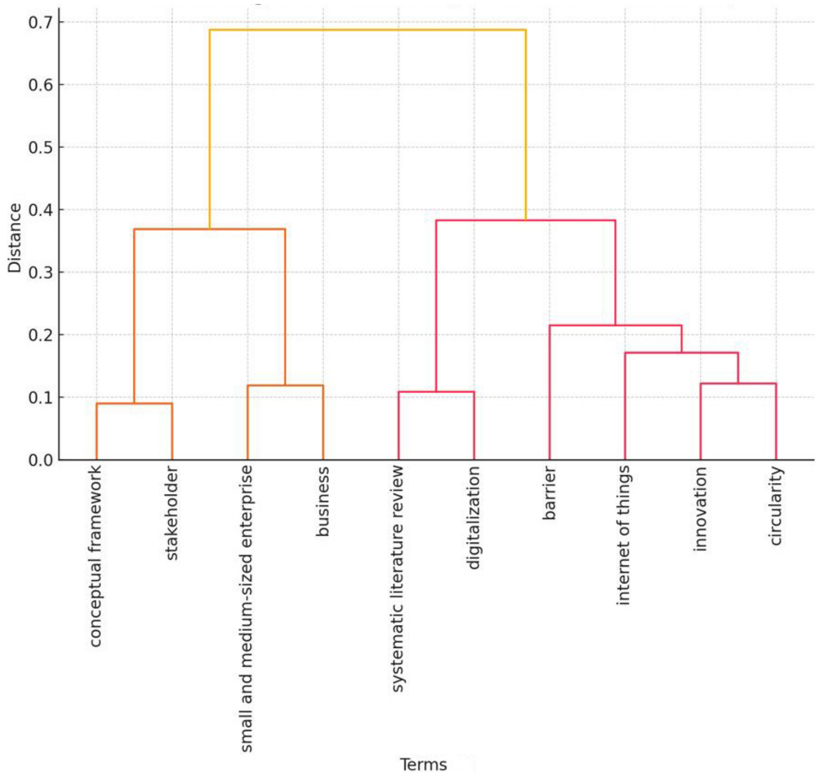

Figure 3. Sub-dendrogram of top ten terms in cluster 2.

Cluster 3, named: "Reuse and advanced manufacturing," encompasses terms that highlight the importance of optimizing resource use through reuse and advanced technologies (See Figure 4). In this group, key terms include "supply chain management," "decision making," "adaptive reuse," and "additive manufacturing." With a frequency of 592 mentions, "supply chain management" emerges as a critical concept, demonstrating that optimizing supply chains is fundamental to maximizing efficiency in circular systems. "Decision making," with 451 mentions, underscores the importance of analytical and methodological tools, such as the Analytic Hierarchy Process (AHP), to prioritize alternatives and improve the implementation of circular practices. "Adaptive reuse," mentioned 389 times, reinforces the need to redesign materials and products to extend their lifespan. This concept is closely related to “additive manufacturing,” which, with 320 mentions, reflects the growing interest in advanced technologies such as 3D printing to minimize waste and improve reuse. The interactions among these terms suggest that advanced technologies play a crucial role in the transition to circular models, enabling customization and resource optimization.

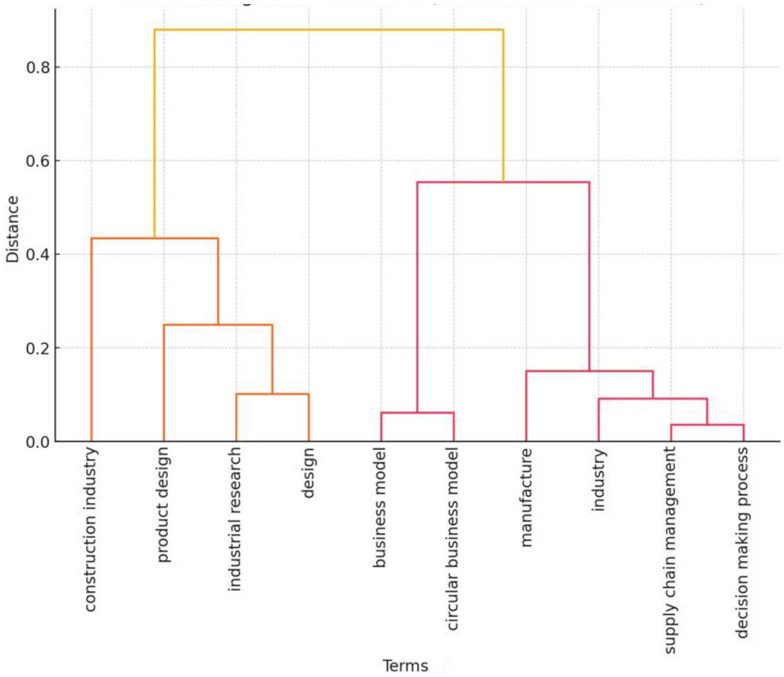

Figure 4. Sub-dendrogram of top ten terms in cluster 3.

Cluster 4, “Safety and automation in the circular economy,” focuses on how automation and safety measures transform productive and agricultural processes (See Figure 5). This cluster includes terms such as “economic aspect,” “climate change,” “agricultural robots,” and “accident prevention.” With a frequency of 475 mentions, “economic aspect” underscores the need to evaluate the financial viability of circular practices. In contrast, “climate change,” with 249 mentions, reflects environmental impact as a driving factor for adopting these strategies. “Agricultural robots,” mentioned 189 times, evidence of the growing automation in circular processes, particularly in the agricultural sector, where advanced technologies are helping optimize resource use. “Accident prevention,” with 165 mentions, highlights the need to ensure safety in industrial environments where circular practices are implemented. The connections between “economic aspect” and “climate change” suggest that environmental considerations heavily influence financial decisions in the circular economy.

Finally, cluster 5: “Material science and chemical sustainability,” is dedicated to developing advanced materials and chemical techniques that promote sustainability. This cluster includes terms such as “plastic waste,” “carbon dioxide,” “recyclability,” and “absorption.” “Plastic waste,” with 156 mentions, and “recyclability,” with 140 mentions, stand out as central themes in the research on new sustainable materials. These terms are closely related, reflecting a focus on designing more recyclable plastics and improving existing recycling processes. “Carbon dioxide,” mentioned 150 times, and “absorption,” with 130 mentions, indicate a growing interest in capturing and reusing CO_2 as part of circular processes. This cluster reflects a technical and chemical approach, exploring new ways to reduce environmental impact through advanced materials. The relationships between “recyclability” and “plastic waste” reinforce the idea that designing sustainable materials is a priority within the circular economy.

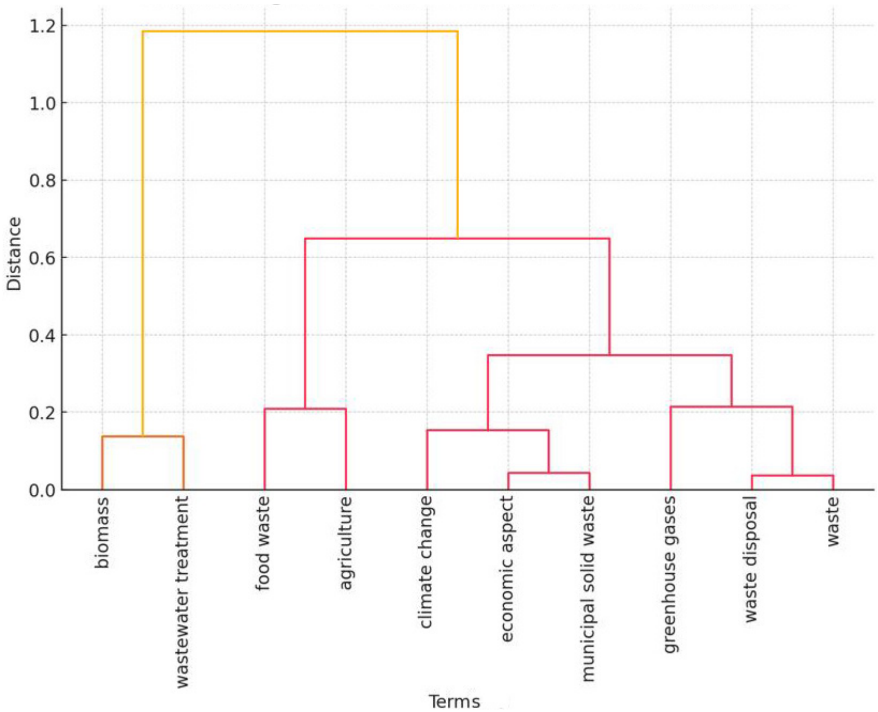

Figure 5. Sub-dendrogram of top ten terms in cluster 4.

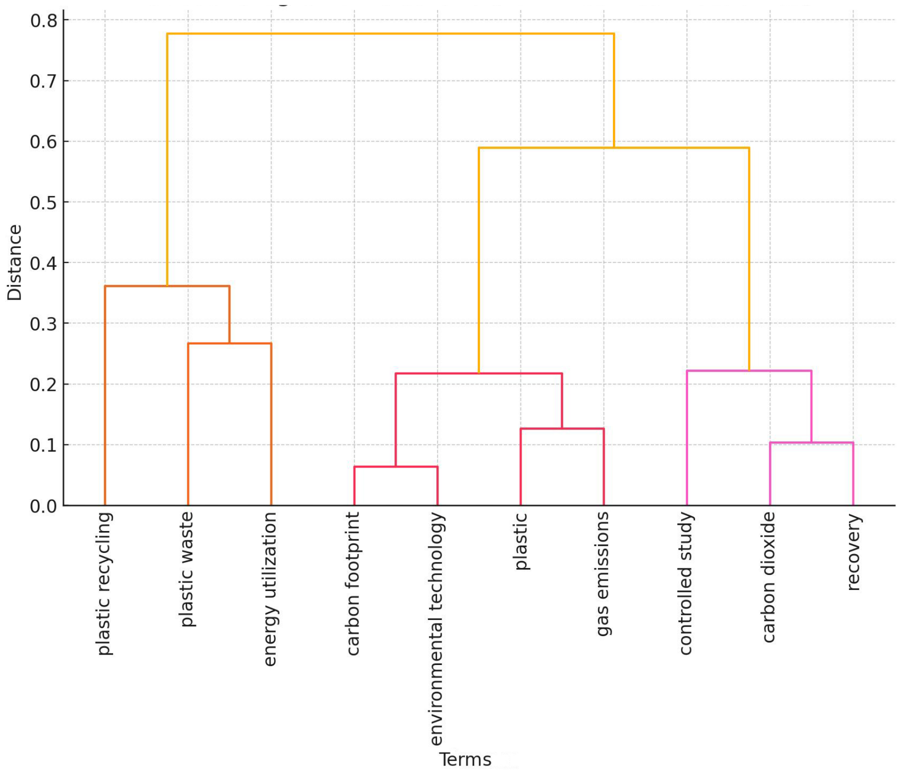

Figure 6. Sub-dendrogram of top ten terms in cluster 5.

The interrelationship between the clusters identified in the analysis reflects an integrated thematic ecosystem within the circular economy, with each cluster complementing the others to address multifaceted challenges. Cluster 1, focused on the "circular economy" and "sustainable development," acts as the strategic core that connects all clusters' technological and policy approaches. This cluster establishes direct links with cluster 3, where concepts such as "recycling" and "additive manufacturing" are essential to materialize the reuse strategies proposed. Cluster 2, focused on adaptation and resilience, establishes a critical connection with cluster 4 since automation and safety require adaptive models to manage dynamic processes. In addition, cluster 5, focused on sustainable materials and chemical processes, complements the objectives of cluster 1 by providing innovative solutions to improve recyclability and manage waste such as plastic waste and carbon dioxide. These interactions highlight the complementary approaches between technology, economics, and sustainability and underline that issues such as recycling, innovation, and adaptability are the most connected, serving as bridges between all clusters.

4. CONCLUSION

The results of the hierarchical clustering analysis of keywords in circular economy research reveal a deeply interconnected thematic structure encompassing key areas such as technological innovation, strategic planning, industrial resilience, automation, and materials science. The "circular economy" emerges as the central axis connecting these areas, while concepts such as "recycling," "sustainable development," and "adaptive management" stand out as fundamental elements in addressing sustainability challenges. The synergies between the clusters show that progress toward a circular model depends on integrating multiple dimensions, from policy and technology strategies to advances in materials and industrial processes. For example, the nexus between adaptive reuse and advanced manufacturing in cluster 3 and sustainable chemistry in cluster 5 suggests that practical solutions require technical innovation and the redesign of materials to maximize their useful life. At the same time, the relevance of terms such as "economic aspect" and "climate change" in cluster 4 highlights the need to balance environmental sustainability with economic viability. Overall, this analysis identifies priority issues within the circular economy and underscores the importance of integrative approaches, combining innovation, resilience, and adaptability to move towards a sustainable future. These findings provide a valuable conceptual framework for research and public policy in this field.

Conflict of interests

The authors should declare potential conflicts of interest or not.

Contribution statement

Conceptualization, investigation, validation, writing-original draft: José Luis Ausejo Sánchez, Yolanda Emperatriz Maguiña Poma.

Methodology, visualization: Damaris Fabiola Medina Palma, Gleny Amelia Ching Campos.

Data curation, formal analysis: José Luis Ausejo Sánchez, Gleny Amelia Ching Campos.

Writing-review & editing: José Luis Ausejo Sánchez.

Statement of data consent

The data generated during the development of this study has been included in the manuscript.

REFERENCES

Banerjee, P., Singh, D., & Kunja, S. R. (2024). Circular economy in agro food supply chain: Bibliometric and network analysis. *Business Strategy & Development, 7*(2), e360. https://doi.org/10.1002/bsd2.360

Barreiro-Gen, M., & Lozano, R. (2020). How circular is the circular economy? Analysing the implementation of circular economy in organisations. *Business Strategy and the Environment, 29*(8), 3484-3494. https://doi.org/10.1002/bse.2590

Biancone, P., Brescia, V., Calandra, D., & Lanzalonga, F. (2021). Circular Economy

In Car Industry-Learning From The Past To Manage Future Steps In Technology: A Bibliometric Analysis. *International Journal of Business & Management Science, 11*(1).

Bocken, N. M., De Pauw, I., Bakker, C., & Van Der Grinten, B. (2016). Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering, 33*(5), 308-320. https://doi.org/10.1080/21681015.2016.1172124

Carrillo González, G., & Pomar Fernández, S. (2021). La economía circular en los nuevos modelos de negocio. *Entreciencias: diálogos en la sociedad del conocimiento, 9*(23). https://doi.org/10.22201/enesl.20078064e.2021.23.79933

Çizer, E. Ö., & Kirçova, İ. (2024). Circular Economy Perspectives on E-Waste: A Bibliometric Analysis and Comprehensive Review. *Navigating the Circular Age of a Sustainable Digital Revolution,* 27-58. DOI: 10.4018/979-8-3693-2827-9.ch002.

Corvellec, H., Stowell, A. F., & Johansson, N. (2022). Critiques of the circular economy. *Journal of Industrial Ecology, 26*(2), 421-432. https://doi.org/10.1111/jiec.13187

de Sousa Jabbour, A. B. L., Luiz, J. V. R., Luiz, O. R., Jabbour, C. J. C., Ndubisi, N. O., de Oliveira, J. H. C., & Junior, F. H. (2019). Circular economy business models and operations management. *Journal of Cleaner Production, 235,* 1525-1539. https://doi.org/10.1016/j.jclepro.2019.06.349

Dragomir, V. D., & Dumitru, M. (2023). The state of the research on circular economy in the European Union: A bibliometric review. *Cleaner Waste Systems,* 100127. https://doi.org/10.1016/j.clwas.2023.100127

Dua, S., & Jain, N. K. (2024). Circular economy and innovation in oil and gas industry: A systematic literature review and bibliometric analysis. *International Social Science Journal, 74*(252), 657-686. https://doi.org/10.1111/issj.12474

Ellen MacArthur Foundation (n.d.). *What is a circular economy?* Available at https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

European Commission (n.d.). *Circular economy action plan.* Available at https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

European Parliament (2023). *Circular economy: definition, importance and benefits.* Available at https://www.europarl.europa.eu/topics/en/article/20151201STO05603/circular-economy-definition-importance-and-benefits

Gundu, K., Jamwal, A., Yadav, A., Agrawal, R., Jain, J. K., & Kumar, S. (2022). Circular economy and sustainable manufacturing: a bibliometric based review. In *Recent Advances in Industrial Production: Select Proceedings of ICEM 2020* (pp. 137-147). Springer Singapore. https://doi.org/10.1007/978-981-16-5281-3_13

Heshmati, A. (2017). A review of the circular economy and its implementation. International *Journal of Green Economics, 11*(3-4), 251-288. https://doi.org/10.1504/IJGE.2017.089856

Kirchherr, J., Urbinati, A., & Hartley, K. (2023). Circular economy: A new research field?. *Journal of Industrial Ecology, 27*(5), 1239-1251. https://doi.org/10.1111/jiec.13426

Korhonen, J., Honkasalo, A., & Seppälä, J. (2018). Circular economy: the concept and its limitations. *Ecological economics, 143,* 37-46. https://doi.org/10.1016/j.ecolecon.2017.06.041

Martínez, A. N., & Porcelli, A. M. (2018). Estudio sobre la economía circular como una alternativa sustentable frente al ocaso de la economía tradicional (primera parte). Lex: *Revista de la Facultad de Derecho y Ciencia Política de la Universidad Alas Peruanas, 16*(22), 301-334. http://dx.doi.org/10.21503/lex.v16i22.1659

Martinho, V. D., & Mourão, P. R. (2020). Circular economy and economic development in the European Union: A review and bibliometric analysis. *Sustainability, 12*(18), 7767. https://doi.org/10.3390/su12187767

McDowall, W., Geng, Y., Huang, B., Barteková, E., Bleischwitz, R., Türkeli, S., ... & Doménech, T. (2017). Circular economy policies in China and Europe. *Journal of Industrial Ecology, 21*(3), 651-661. https://doi.org/10.1111/jiec.12597

Mhlanga, J., Haupt, T. C., & Loggia, C. (2024). Shaping circular economy in the built environment in Africa. A bibliometric analysis. Journal of Engineering, *Design* *and Technology, 22*(2), 613-642. https://doi.org/10.1108/JEDT-03-2022-0175

Ospina-Mateus, H., Marrugo-Salas, L., Castilla, L. C., Castellón, L., Cantillo, A., Bolivar, L. M., ... & Zamora-Musa, R. (2023). Analysis in circular economy research in Latin America: A bibliometric review. *Heliyon,* e19999. https://doi.org/10.1016/j.heliyon.2023.e19999

Otasowie, O. K., Aigbavboa, C. O., Oke, A. E., & Adekunle, P. (2024). Mapping out focus for circular economy business models (CEBMs) research in construction sector studies – a bibliometric approach. *Journal of Engineering, Design and Technology.* https://doi.org/10.1108/JEDT-10-2023-0444

Porcelli, A. M., & Martínez, A. N. (2018). Análisis legislativo del paradigma de la economía circular. *Revista Direito GV, 14,* 1067-1105. https://doi.org/10.1590/2317-6172201840

Prieto-Sandoval, V., Jaca-García, C., & Ormazabal-Goenaga, M. (2017). Economía circular: Relación con la evolución del concepto de sostenibilidad y estrategias para su implementación. *Memoria Investigaciones en Ingeniería,* (15), 85-95.

Prieto-Sandoval, V., Jaca, C., & Ormazabal, M. (2018). Towards a consensus on the circular economy. *Journal of Cleaner Production, 179,* 605-615. https://doi.org/10.1016/j.jclepro.2017.12.224

Rabbi, M. F., & Amin, M. B. (2024). Circular economy and sustainable practices in the food industry: A comprehensive bibliometric analysis. *Cleaner and Responsible Consumption,* 100206. https://doi.org/10.1016/j.clrc.2024.100206

Romero, G. D. (2019). Progresando hacia un modelo de economía circular. *Economistas,* (162-163), 211-2015.

Saidi, N. A., & Radz, N. A. M. (2023). The Trend of Circular Economy Studies in Asian Countries: A Bibliometric Analysis. International *Journal of Academic Reserach in Economics and Management Sciences, 12*(4).

Stahel, W. R. (2016). The circular economy. *Nature, 531*(7595), 435-438. https://doi.org/10.1038/531435a

Türkeli, S., Kemp, R., Huang, B., Bleischwitz, R., & McDowall, W. (2018). Circular economy scientific knowledge in the European Union and China: A bibliometric, network and survey analysis (2006-2016). *Journal of cleaner production, 197,* 1244-1261. https://doi.org/10.1016/j.jclepro.2018.06.118

Turrión Barbero, P. (2023). *La economía circular en América Latina y el Caribe.* Available at https://intercoonecta.aecid.es

United States Environmental Protection Agency. (2024). *National Strategy for Reducing Food Loss and Waste and Recycling Organics.* Available at https://www.epa.gov/circulareconomy/national-strategy-reducing-food-loss-and-waste-and-recycling-organics

Velenturf, A. P., & Purnell, P. (2021). Principles for a sustainable circular economy. *Sustainable Production and Consumption, 27,* 1437-1457. https://doi.org/10.1016/j.spc.2021.02.018

Vuc, D. E. (2024). Current Challenges and Opportunities for Circular Economy in the Beauty Industry. A Bibliometric Analysis. In *Proceedings of the International Conference on Business Excellence* (Vol. 18, No. 1, pp. 185-197). Sciendo. DOI: 10.2478/picbe-2024-0016.