Sustainable Development Insights
Vol. 01, No. 04, November 2025, pp. 106-117

Circular Economy and Plastic Waste Reduction: A Bibliometric Analysis

Loso Judijanto
IPOSS Jakarta, Indonesia

Article Info

Article history:

Received Nov, 2025
Revised Nov, 2025
Accepted Nov, 2025

Keywords:

Circular Economy
Plastic Waste
Plastic Recycling
Life Cycle Assessment
Environmental Impact
Bibliometric Analysis
Sustainable Waste Management
Recycling Technologies
Global Collaboration

ABSTRACT

This study performs a bibliometric analysis of the literature concerning circular economy and plastic waste management, delineating research trends, themes, and collaborative networks. The study utilizes data from Scopus and Web of Science to identify crucial themes, including plastic recycling, life cycle assessment, and environmental effect, underscoring the interdisciplinary essence of the area. The report underscores the increasing significance of circular economy techniques in mitigating plastic pollution, emphasizing new recycling technology and sustainable waste management practices. The United States, China, and the United Kingdom lead the area, however worldwide collaboration is apparent, with notable contributions from Europe, Asia, and Latin America. The study finds deficiencies in research, especially with the practical implementation of circular economy techniques across various regional contexts. This study provides valuable insights for policymakers, researchers, and practitioners aiming to tackle plastic waste with sustainable solutions.

Corresponding Author:

Name: Loso Judijanto
Institution: IPOSS Jakarta, Indonesia
Email: losojudijantobumn@gmail.com

1. INTRODUCTION

In recent decades, global plastic production and use have escalated at an unparalleled rate. Plastics have grown pervasive in contemporary life, utilized in packaging, building, electronics, transporta tion, and other consumer products. Their adaptability, lightweight characteristics, and economic efficiency render them appealing; nonetheless, these same benefits contribute to an escalating environmental and societal dilemma. Upon the conclusion of their functional lifespan, the durability of numerous plastics against degradation results in their persistence in landfills, oceans, soils, and even in the atmosphere as micro- and nano-plastics. This persistence leads to ecosystem disruption, damage to marine and terrestrial organisms, and possible human health risks. A recent bibliometric study revealed that worldwide plastic waste issues have garnered escalating scholarly interest from 1992 to 2022, indicating the increasing urgency of the situation [1].

In this challenging context, the circular economy (CE) has arisen as a possible alternative to the conventional 'take-make-dispose' linear manufacturing model. A circular economy seeks to retain resources in circulation for an extended duration, optimize their value throughout utilization, and thereafter recover and regenerate

products and materials upon the conclusion of their service life, rather than disposing of them. This entails innovative strategies for designing plastics with an emphasis on recyclability, reuse, reprocessing, and material recovery, including upstream modifications such material substitution, re-evaluating business models, and facilitating return systems. Research on circular economy issues has expanded significantly, with one study indicating an annual growth rate of approximately 17.6% in CE-related publications since the implementation of the United Nations Sustainable Development Goals (SDGs) in 2015 [2].

The application of the circular economy to plastic trash yields dual benefits. Initially, by reengineering systems and materials to promote reuse, recycling, and closed-loop processes, the amount of plastic waste may be substantially diminished. Secondly, transitioning from trash treatment and disposal to resource retention can alleviate the environmental constraints linked to plastic waste, including greenhouse gas emissions, pollution, and habitat damage. Life-cycle assessment (LCA) studies increasingly shown that circular economy solutions, such as improved sorting and recycling of plastics, can significantly de crease CO_2 equivalents [3]. These dynamics highlight the essential function of circularity in tackling plastic waste issues.

The expanding literature on plastic waste management and circular economy con cepts indicates that study is becoming increasingly interdisciplinary. Research encompasses environmental engineering, ma terials science, legislation and governance, business model innovation, consumer behavior, and waste management systems. A recent bibliometric analysis of articles on plastic waste management reveals almost 13,000 documents from 1992 to 2022, with sign ificant contributions from environmental science, engineering, marine and freshwater biology, and polymer research [4]. Bibliometric analyses of circular economy research have pinpointed essential themes like resource efficiency, waste management, sustainable business models, and circular supply chains [5].

Nevertheless, significant gaps persist despite these advancements. The interaction between circular economy theory and plastic waste practice necessitates further investigation: the operationalization of circularity in plastic systems and the evolution of study issues over time are not yet fully comprehended. Furthermore, although several bibliometric analyses concentrate on general plastic waste management or overarching circular economy themes, there is a scarcity of studies that specifically examine the relationship between the circular economy and plastic waste reduction. In light of the e scalating urgency surrounding plastic waste and the increasing institutional focus on circular economy strategies (such as policy i nitiatives, industry pledges, and design innovations), there is a pressing necessity to systematically delineate the academic lan dscape at this nexus: to ascertain prevailing themes, emerging collaborations, persistent g eographic or disciplinary voids, and the evolution of the research trajectory.

Notwithstanding the extensive study in circular economy and plastic waste management, the particular field inve stigating "circular economy and plastic waste reduction" is still fragmented and inadequately assessed from a bibliometric standpoint. This fragmentation hinders scholars, policymakers, and practitioners from obtaining a comprehensive understanding of existing studies, the focus of current efforts, and the significant gaps that p ersist, so constraining the strategic alignment of forthcoming research and policy initiatives.

This study intends to provide a thorough bibliometric analysis of the literature about the junction of circular economy and plastic waste reduction. The objectives are to chart the progression of research over time, identify principal themes, authors, institutions, countries, and collaboration networks, reveal research deficiencies and prospective future directions, and offer insights to guide both academic investigation and practical policy or industry responses in this significant domain.

2. METHODS

This study employs a bibliometric analysis to investigate the research landscape at the convergence of circular economy (CE) and plastic waste reduction. Bibliometric analysis employs quantitative approaches to examine patterns in publishing, citation, authorship, and other facets of scholarly literature. This study employs two principal data sources, the Scopus and Web of Science databases, to systematically identify patterns and gaps in the research, both of which are esteemed for indexing high-quality academic papers [6]. The search approach encompasses a blend of terms pertinent to both circular economy (e.g., "circular economy," "sustainable materials," "resource efficiency") and plastic waste reduction (e.g., "plastic waste management," "plastic recycling," "plastic pollution"). The search period extends from 1990 to 2023, including a broad timeframe to document both the progression of research and the latest advancements in the field. The collected data include articles, conference papers, reviews, and reports that meet the inclusion criteria pertaining to the circular economy and plastic waste reduction. The bibliometric analysis is conducted in two parts. The initial phase involves doing a descriptive study to examine overall trends in publication output, citation counts, and the leading authors and institutions contributing to the subject. This phase facilitates the identification of the historical distribution of research outputs, elucidating periods of rapid growth in the research domain and underscoring significant milestones [7]. The second phase emphasizes network analysis via tools like VOSviewer and CiteSpace, which facilitate the visualization of co-authorship, co-citation, and keyword co-occurrence networks. This phase offers i nsights into collaboration networks, main theme areas, and significant contributors to the field. The co-occurrence analysis of keywords identifies the predominant research themes, their interrelations, and the evolution of these themes over time [8].

The study performs a content analysi s of chosen seminal articles, concentrating on the methodology, concepts, and findings that have influenced the discourse on circular economy and plastic waste management. The study reveals the application of many research methodologies, including life-cycle assessments (LCA), case studies, and policy analyses, within the settings of circular economy (CE) and plastic waste reduction [9]. This method facilitates a comprehensive understanding of the practical intersection between the two domains, the obstacles recognized by researchers, and the options suggested for alleviating plastic waste through circular economy concepts. This study will reveal significant gaps in the current literature and inform future research approaches.

3. RESULTS AND DISCUSSION

3.1 Network Visualization

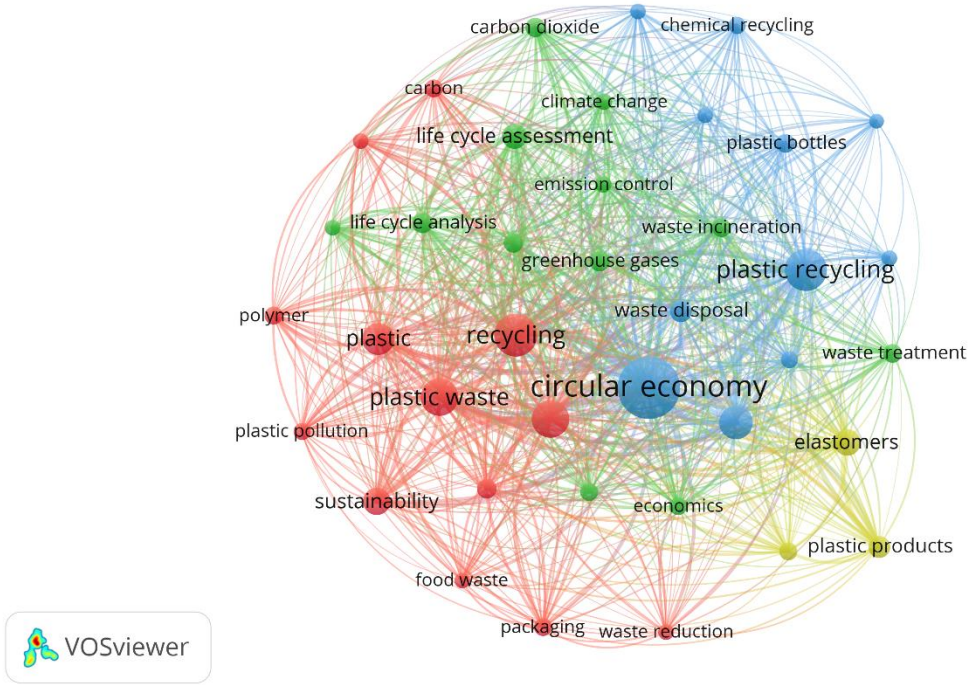

Figure 1. Network Visualization
Source: Data Analysis Result, 2025

Figure 1 presents the picture presented is a network map illustrating the interconnections among many subjects pertaining to circular economy and plastic waste management. This map is produced by bibliometric analysis utilizing software such as VOSviewer, which facilitates the visualiza tion of relationships among frequently occurring keywords in research literature. Each point on the map signifies a keyword, while the connections between points indicate the frequency with which two keywords co-occur in the same article. The map use various colors to categorize terms according to as sociated themes.

The crimson group on the map encompasses phrases associated with plastic trash, recycling, and sustainability. This group examines the application of plastic waste management within a circular economy framework to mitigate environmental effect, emphasizing methods such as plastic recycling. This group frequently examines the difficulties of sustainable plastic management and pursues creative strategies to mitigate plastic pollution.

The blue-colored group seems to prioritize plastic recycling and trash management, demonstrating considerable emphasis on advancing technologies and methodologies to enhance recycling efficiency. This group focuses on keywords like waste incineration and waste disposal, suggesting that the research mostly revolves around environmentally sustainable waste management and large-scale plastic recycling methods.

The green group emphasizes technical and scientific principles, including life cycle assessment and greenhouse gas emissions. This group emphasizes the significance of a life-cycle-oriented methodology for assessing the environmental effects of plastics and their recycling procedures. Investigations in this domain frequently employ analytical models to assess plastic's impact on climate change and to determine strategies for mitigating its carbon footprint over its lifecycle.

The smaller yellow category comprises keywords such as plastic items and trash reduction. This category of keywords

emphasizes the design and manufacturing of ecologically sustainable plastic items and solutions for waste reduction applicable at both consumption and production stages. The map depicts the robust interrelation among diverse concepts in the research of circular economy and plastic waste management, highlighting the necessity for investigations that encompass technological, scientific, and policy dimensions to attain more sustainable plastic management solutions.

3.2 Overlay Visualization

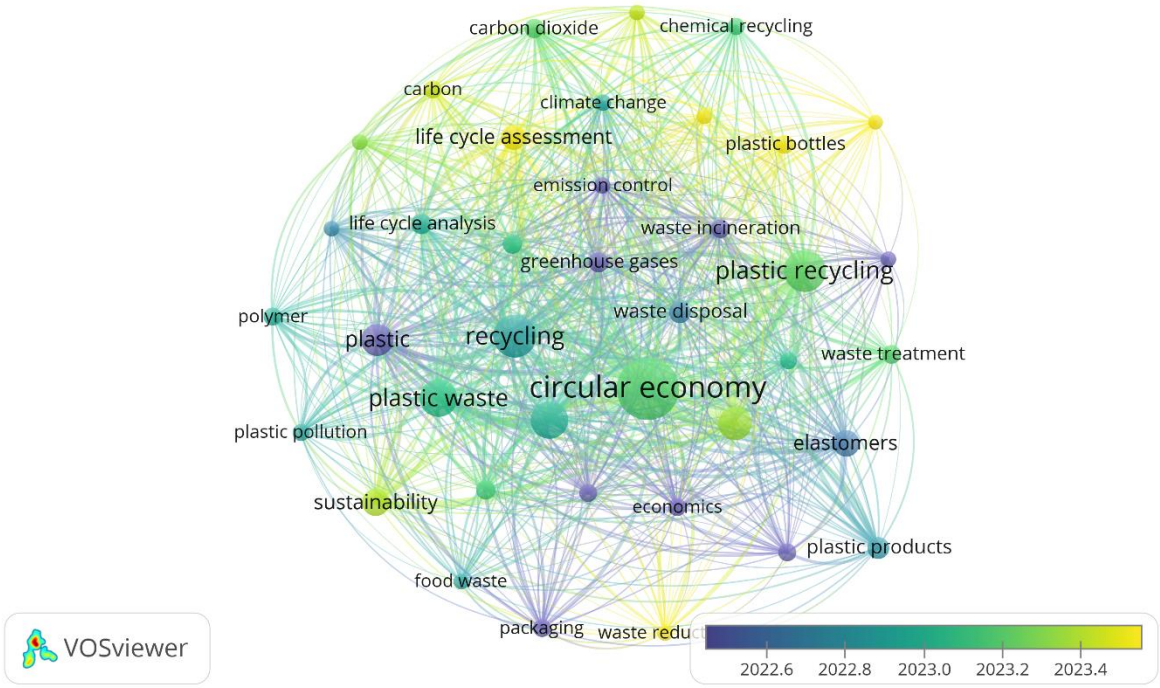

Figure 2. Overlay Visualization
Source: Data Analysis Result, 2025

Figure 2 illustrates The revised network map illustrates a bibliometric analys is of subjects pertaining to circular economy and plastic waste management, incorporating a temporal overlay that depicts the progression of these themes over time. The map employs color coding to denote several years, spanning from 2022 to 2023, accompanied with a gradient scale at the bottom. The color variation signifies the periods during which specific terms gained prominence in the literature. Keywords such as plastic recycling, circular economy, and plastic waste have continuously emerged as significant in recent study, indicating a trend towards these themes in recent years, particularly in 2023, as evidenced by the green and yellow tones.

The map displays groups of associated terms. In recent years (2023), the phrases related to plastic trash and recycling, which represent significant and interrelated nodes, have gained prominence. These terms are associated with various pertinent ideas, including life cycle assessment, plastic pollution, and sustainability. The rising frequency of these phrases in recent studies indicates an intensified emphasis on the environmental consequences of plastic waste and the possibility for circular economy strategies to alleviate plastic pollution. The keywords related to plastic recycling and the circular economy exhibit substantial links to new subjects such as emission control and greenhouse gases, highlighting a wider range of interdisciplinary study that amalgamates

environmental issues with techniques for managing plastic waste.

The purple cluster of terms, including life cycle analysis, carbon dioxide, and plastic products, is especially apparent in the earlier year of 2022. This indicates that preliminary research concentrated on evaluating the life-cycle effects of plastics, especially in relation to carbon emissions and product design. The developing yellow-green cluster surrounding trash disposal, plastic bottles, and plastic products underscores a growing focus on packaging and consumer-oriented products, further illustrating the evolving character of the study domain as it responds to rising issues and techniques. The temporal overlay on this map functions as a visual representation of the research trajectory, illustrating the recent shift in focus within the area towards more advanced and solution-oriented methodologies.

3.3 Citation Analysis

This table summarizes significant scholarly contributions concerning plastic waste management, recycling technology, and the overarching domain of the circular economy. These articles provide insights into the prevailing issues, innovations, and policy advancements in the management of plastic trash and the enhancement of recycling procedures. The chosen studies encompass several subjects, including mechanical and chemical recycling of plastics and sustainable food packaging solutions, emphasizing the environmental and economic consequences of plastic waste. The table encompasses authors, publication years, and article titles, offering a thorough overview of the literature in this domain.

Table 1. The Most Impactful Literatures

Citations	Authors and year	Title
1116	Schyns, Z.O.G., Shaver, M.P. (2021)	Mechanical Recycling of Packaging Plastics: A Review
776	Rissman, J., Bataille, C., Masanet, E., ... Dinkel, J., Helseth, J. (2020)	Technologies and policies to decarbonize global industry: Review and assessment of mitigation drivers through 2070
561	Vanapalli, K.R., Sharma, H.B., Ranjan, V.P., ... Dubey, B.K., Goel, S. (2021)	Challenges and strategies for effective plastic waste management during and post COVID-19 pandemic
497	Dogu, O., Pelucchi, M., Van de Vijver, R., ... Faravelli, T., Van Geem, K.M. (2021)	The chemistry of chemical recycling of solid plastic waste via pyrolysis and gasification: State-of-the-art, challenges, and future directions
494	Rhodes, C.J. (2018)	Plastic pollution and potential solutions
479	Geueke, B., Groh, K., Muncke, J. (2018)	Food packaging in the circular economy: Overview of chemical safety aspects for commonly used materials
466	Nizami, A.S., Rehan, M., Waqas, M., ... Ismail, I.M.I., Pant, D. (2017)	Waste biorefineries: Enabling circular economies in developing countries

Citations	Authors and year	Title
446	Guillard, V., Gaucel, S., Fornaciari, C., ... Buche, P., Gontard, N. (2018)	The Next Generation of Sustainable Food Packaging to Preserve Our Environment in a Circular Economy Context
379	Chen, D.M.-C., Bodirsky, B.L., Krueger, T., Mishra, A., Popp, A. (2020)	The world's growing municipal solid waste: trends and impacts
363	Stegmann, P., Daioglou, V., Londo, M., van Vuuren, D.P., Junginger, M. (2022)	Plastic futures and their CO2 emissions

Source: Scopus, 2025

These studies emphasize many facets of plastic waste management, encompassing technological innovations in recycling, the ecological consequences of plastic pollution, and the influence of legislation in promoting sustainable practices. [10] emphasize the tec hnical dimensions of mechanical recycling, which are essential for enhancing the efficiency and scalability of plastic recycling methods. [11] evaluate the impact of decarbonization strategies on managing industrial waste, particularly plastics. Other research, such those of [12] and [13] investi gates the impact of the COVID-19 pandemic on waste management techniques and analyzes the incorporation of food packaging into the circular economy, respectively. These papers collectively provide an extensive overview of the endeavors and obstacles in mitigating plastic waste via new recycling techniques and sustainable product designs.

3.4 Density Visualization

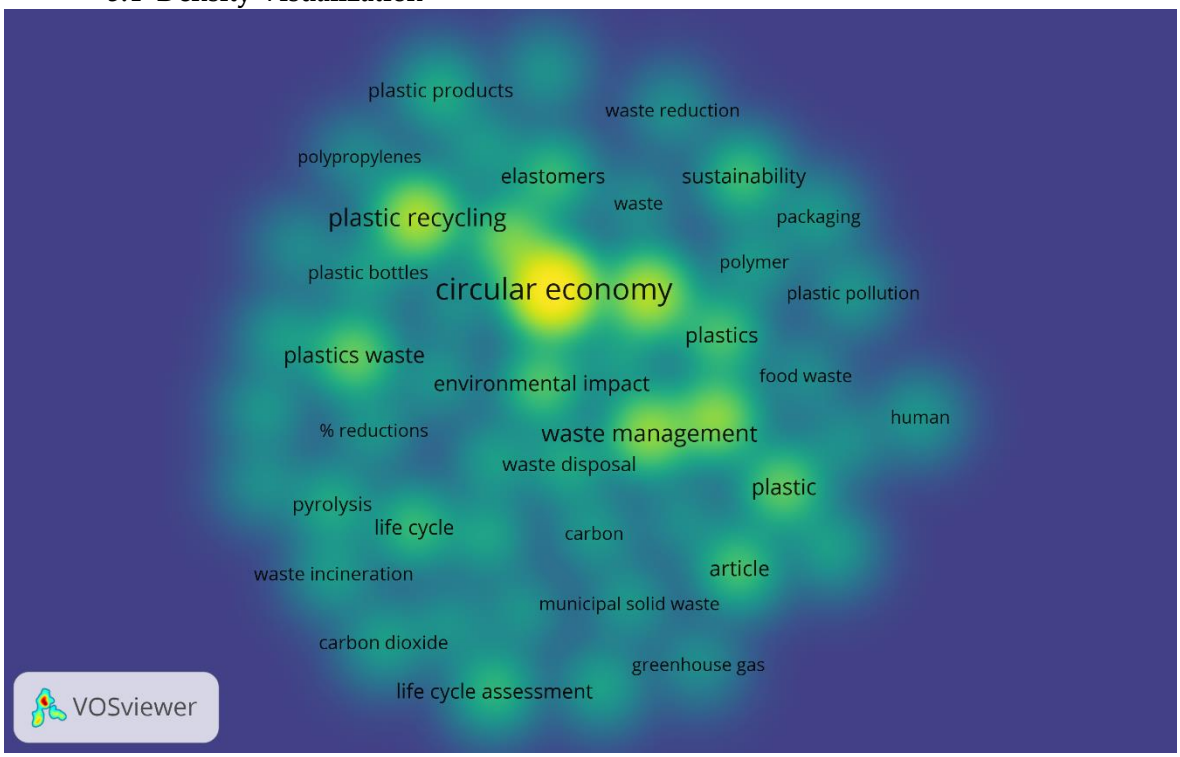

Figure 3. Density Visualization

Source: Data Analysis Result, 2025

The density map illustrates the concentration of research subjects in the domain of circular economy and plastic waste management. This image illustrates that the lighter areas signify a greater prevalence of associated terms and topics within the literature. The core set of concepts, encompassing circular economy, plastic recycling, plastic trash, and environmental effect, underscores the principal emphasis of contemporary research, accentuating the pressing necessity for sustainable plastic waste management and the significance of recycling in fulfilling circular economy objectives. These phrases indicate an increas ing scholarly focus on the management of plastics to mitigate environmental damage, emphasizing recycling techniques and waste reduction approaches.

Additional significant clusters on the map encompass topics such as plastic pollution, waste management, and life cycle assessment. These themes highlight the convergence of environmental issues with the pragmatic elements of waste management and lifecycle assessment. The inclusion of carbon dioxide, greenhouse gas, and pyroly sis in the map indicates an emphasis on the carbon footprint and environmental ramifica tions of diverse plastic recycling methods. Furthermore, concepts like food waste, packaging, and plastics illustrate the relationship between plastic waste management and overarching sustainability issues. The map offers critical insights into current research trends and identifies areas for further investigation and innovation to improve circular economy methods in plastic waste management.

3.5 Co-Authorship Network

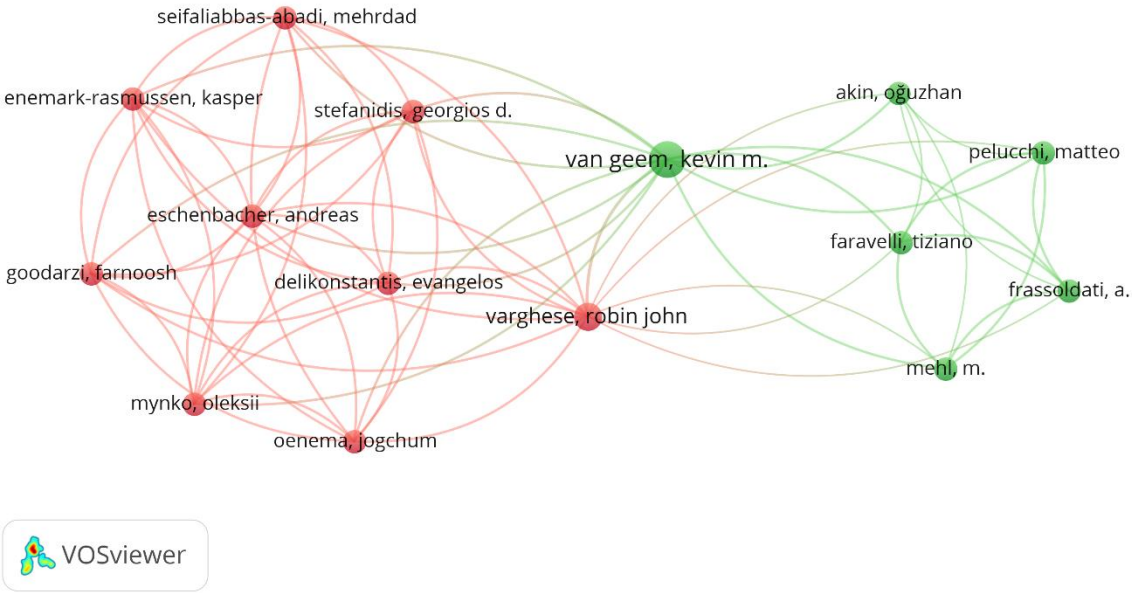

Figure 4. Author Visualization
Source: Data Analysis Result, 2025

The network map illustrates the co-auth orship connections among academics in chemical and environmental engineering, specifically emphasizing subjects like plastic recycling, waste management, and the circula r economy. The map employs nodes to signify authors, with the size of the nodes reflecting the centrality or impact of each researcher within the network. The lines linking the authors indicate co-authorship partnerships, while the color distinction between red and green nodes emphasizes two primary clusters of scholars engaged in similar fields.

Kevin M. Van Geem is the pivotal figure in the network, situated in the convergence of the green and red clusters, indicating substantial connections across several academic domains. He is intimately associated with authors such as Robin John Varghese and Tiziano Faravelli, who belong to the green cluster, indicative of their collaboration on subjects pertaining to chemical recycling and waste management. The red cluster include authors such as Andreas Eschenbacher, Georgios D. Stefanidis, and Mehrdad Seifaliabbas-Abadi, reflecting their emphasis on chemical engineering and environmental technologies. The relationships among these authors indicate a multidisciplinary methodology for tackling challenges in waste management, recycling technology, and circular economy initiatives.

This network visualization underscores the collaborative essence of research in the domain, showcasing numerous authors participating in co-authored publications and contributing to the progression of knowledge in sustainable waste management and recycling methodologies. Certain authors, such as Van Geem, bridge gaps between various academic domains, potentially promoting more cohesive strategies for addressing global issues with waste reduction and sustainability. The intimate collaborations within both clusters highlight the increasing significance of international cooperation in devising viable solutions to plastic waste and the wider ramifications of the circular economy.

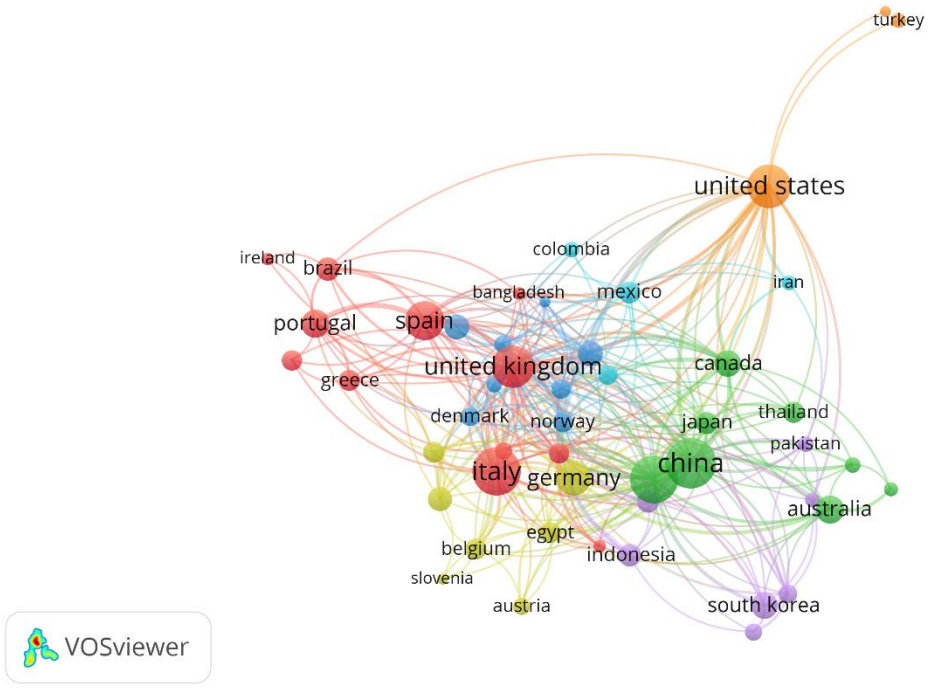

Figure 5. Country Visualization
Source: Data Analysis Result, 2025

Figure 5 The network map above illustrates the international collaboration and participation of many countries in studies concerning plastic waste management and the circular economy. The map employs a color-coded scheme to depict areas, where each node signifies a country and the node's size indicates the extent of research output or engagement in the topic. The thicker lines linking countries signify enhanced collaboration in research and publications.
From the map, we can observe that the United States, China, and United Kingdom are the central players in this research network, highlighted by their large and prominent nodes. These nations possess extensive collaboration networks with many others, indicating their leadership in the advancement of circular economy and plastic waste management solutions. European nations, including Spain, Germany, and Italy, exhibit considerable involvement in this domain, characterized by a substantial degree of interconnection. Simultaneously, nations from various areas, such as Brazil, India, South Korea, and Canada, are participating in the global research network, but with comparatively diminished significance. The image underscores the significance of international collaboration in tackling global plastic waste issues, as evidenced by the robust interconnections among nations across many continents.

Discussions

Practical Implications

This study provides substantial practical implications for governments, industrial stakeholders, and environmental or ganizations aiming to tackle the global issue of plastic waste management. The bibliometric analysis identifies significant trends, deficiencies, and interdisciplinary links in the research on circular economy and plastic recycling, offering critical insights into effective tactics and upcoming technologies. The emphasis on life cycle assessment and emission control in recent research highlights the necessity of assessing the environmental impact of different plastic recycling methods. This knowledge can guide the formulation of policies that promote sustainable practices,

such as rewarding the implementation of closed-loop recycling systems or fostering advancements in chemical recycling. The geographic concentration of research indicates areas where specific metho dologies are more prevalent, enabling stakeholders to customize solutions to local requirements and technology proficiencies.

Theoretical Contribution

This study theoretically enhances the existing literature on circular economy by of fering a detailed mapping of the academic discourse around plastic garbage. This study utilizes a bibliometric approach to identify major themes and research trajectories while clarifying the influence of interdisciplinary collaboration on the area. The findings enhan ce comprehension of the intersection of environmental science, engineering, economics, and policy-making in the realm of plastic waste management. The study unders cores the developing relationship between sustainability and recycling, accentuating the significance of life cycle analysis in evaluating the efficacy of circular economy methods. Furthermore, it enhances the theoretical framework of resource efficiency by demonstrating the application of the circular economy paradigm to alleviate environmental concerns via novel recycling methods.

Limitations

This study offers significant information, however it has limits. A signi ficant disadvantage is that the analysis relies exclusively on bibliometric data from Scopus and Web of Science, potentially excluding pertinent research, particularly from locations or journals not indexed in these databases. Consequently, certain nascent domains or novel methodologies in plastic recycling may remain inadequately represented. Furthermore, the study's emphasis on publication trends and citation patterns fails to consider the quality or effect of individual studies, thereby constraining its capacity to evaluate the real-world relevance of the research findings. Moreover, the map visualizations and thematic analysis emphasize just the most commonly addressed topics, thus neglecting specialized study area s that could also aid in addressing plastic waste issues. Ultimately, although the study examines the global collaborative network, it fails to investigate the particulars of how various areas implement circular economy practices within their local contexts, which would be beneficial for formulating region-specific policy suggestions.

4. CONCLUSION

This paper presents a thorough bibliometric analysis of the convergence between circular economy and plastic waste management, providing an overview of prevailing trends and a framework for future research. The study finds prevalent topics in the field by evaluating publishing trends, citation networks, and cooperation among significant academic institutions, emphasizing the increasing significance of circular economy concepts in tackling the global plastic waste challenge. The findings highlight the growing emphasis on plastic recycling, life cycle assessment, and envi ronmental effect, which have proven pivotal to the advancement of more sustainable plastic waste management strategies. The analysis demonstrates a robust interdisciplinary approach, incorporating insights from environmental science, material s engineering, economics, and policy research. The paper highlights the burgeoning significance of chemical recycling and technologies for plastic waste reduct ion, providing insights into prospective strategies for mitigating plastic pollution. The geographical distribution of research reveals that developed nations such as the United States, China, and the United Kingdom lead the field, while substantial interest is also evident from countries in Europe, Asia, and Latin America, indicating a worldwide dedication to tackling plastic waste.

Nonetheless, despite these achievements, research gaps persist, especially on the practical implementation of circular economy techniques across various regional and industrial contexts. Despite

significant attention on technology solutions and policy frameworks, additional research is required to investigate the effective implementation of circular economy concepts at the local level, particularly in low- and middle-income nations. The amalgamation of circular economy techniques with other environmental objectives, including climate change mitigation and sustainable consumption, necessitates further examination. This study underscores the necessity for ongoing collaboration among academics, industry, and government to promote innovation in plastic recycling and w aste management. It provides a basis for future study that can enhance policy decisions and technological advancements in the quest for a sustainable, circular economy for plastic waste.

REFERENCES

[1] D. Burdon, T. Potts, S. Barnard, S. J. Boyes, and A. Lannin, "Linking natural capital, benefits and beneficiaries: The role of participatory mapping and logic chains for community engagement," *Environ. Sci. Policy*, vol. 134, pp. 85–99, 2022.

[2] M. Geissdoerfer, P. Savaget, N. M. P. Bocken, and E. J. Hultink, "The Circular Economy–A new sustainability paradigm?," *J. Clean. Prod.*, vol. 143, pp. 757–768, 2017.

[3] V. Vandeginste, "Food waste eggshell valorization through development of new composites: A review," *Sustain. Mater. Technol.*, vol. 29, p. e00317, 2021.

[4] D. Klingelhöfer, M. Braun, D. Quarcoo, D. Brüggmann, and D. A. Groneberg, "Research landscape of a global environmental challenge: Microplastics," *Water Res.*, vol. 170, p. 115358, 2020.

[5] P. Gao, S. Yue, and H. Chen, "Carbon emission efficiency of China's industry sectors: From the perspective of embodied carbon emissions," *J. Clean. Prod.*, vol. 283, p. 124655, 2021.

[6] V. Pavlovic *et al.*, "How accurate are citations of frequently cited papers in biomedical literature?," *Clin. Sci.*, vol. 135, no. 5, pp. 671–681, 2021.

[7] I. Zupic and T. Čater, "Bibliometric methods in management and organization," *Organ. Res. methods*, vol. 18, no. 3, pp. 429–472, 2015.

[8] N. Van Eck and L. Waltman, "Software survey: VOSviewer, a computer program for bibliometric mapping," *Scientometrics*, vol. 84, no. 2, pp. 523–538, 2010.

[9] G. S. Dangayach and S. G. Deshmukh, "Manufacturing strategy: literature review and some issues," *Int. J. Oper. Prod. Manag.*, vol. 21, no. 7, pp. 884–932, 2001.

[10] Z. O. G. Schyns and M. P. Shaver, "Mechanical recycling of packaging plastics: a review," *Macromol. Rapid Commun.*, vol. 42, no. 3, p. 2000415, 2021.

[11] J. Rissman *et al.*, "Technologies and policies to decarbonize global industry: Review and assessment of mitigation drivers through 2070," *Appl. Energy*, vol. 266, p. 114848, 2020.

[12] K. R. Vanapalli *et al.*, "Challenges and strategies for effective plastic waste management during and post COVID-19 pandemic," *Sci. Total Environ.*, vol. 750, p. 141514, 2021.

[13] B. Geueke, K. Groh, and J. Muncke, "Food packaging in the circular economy: Overview of chemical safety aspects for commonly used materials," *J. Clean. Prod.*, vol. 193, pp. 491–505, 2018.