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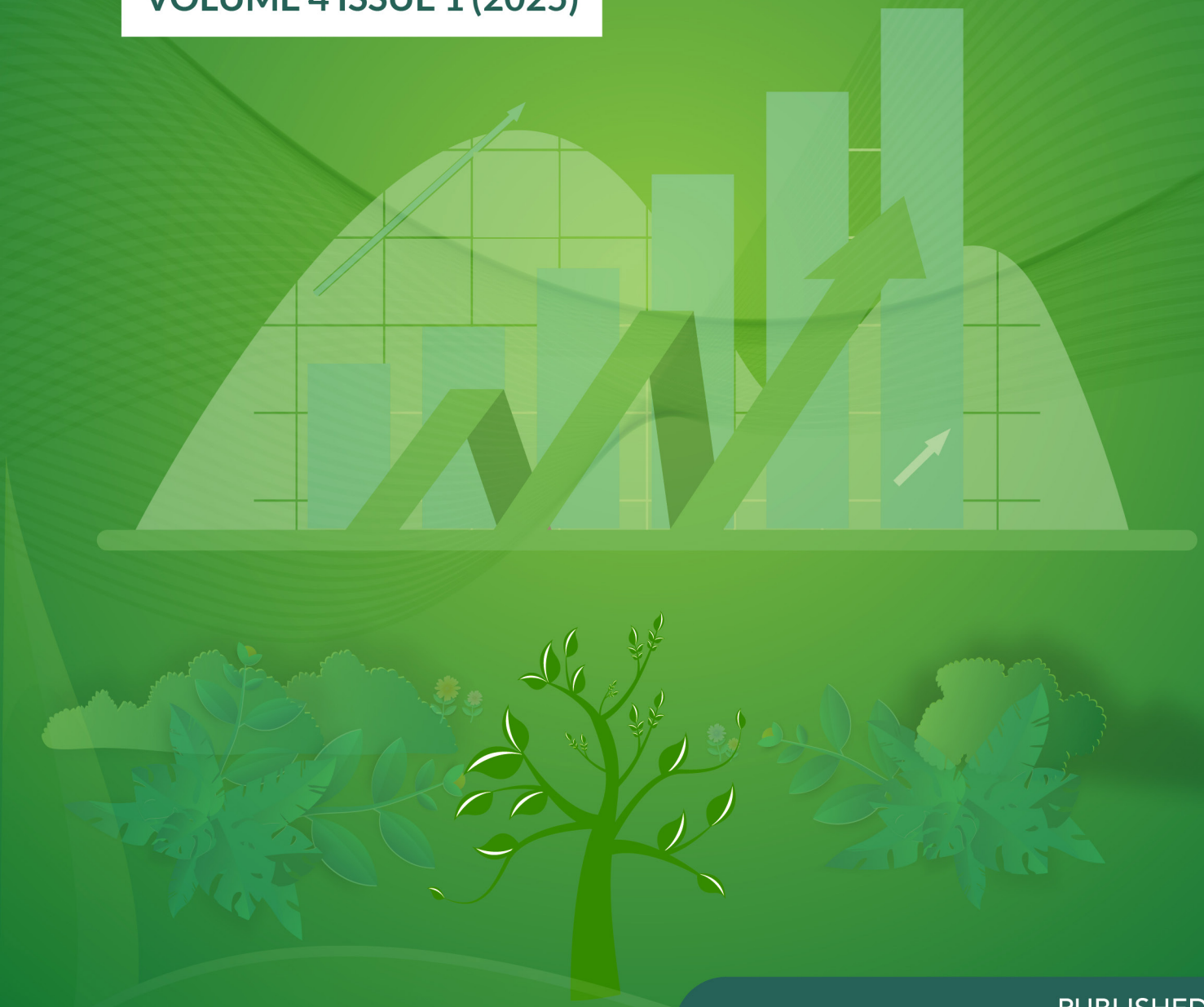

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Adoption of Circular Economy Developed: A Comparative Analysis between Developed and Developing Countries for Sustainable Waste Management

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ABSTRACT

Due to the rapid pace of industrialization worldwide, a considerable amount of waste has accumulated, which tends to compromise the sustainability of the environment and the availability of resources for future generations. As a countermeasure, the linear economy to a circular economy (CE) transition has evolved into an essential means for realizing sustainable development. We compared developed and developing countries' readiness to embrace the circular economy principles, particularly on sustainable waste management. Adopting a systematic review methodology, the study analyzed 70 relevant academic papers published on CE implementation in different industries and regions, particularly in developed economies, including Australia. The year of publication, research methodology, geographical contexts, and industrial applications were considered in the analysis. These results show that developed countries have made clear advances in Circularity in waste management, supported by mature policy frameworks, technological advances and multi-stakeholder contributions. On the other hand, in many developing countries, the adoption of CE practices is poor, owing to policy inadequacies, resource scarcity, and limited stakeholder involvement. This study's findings suggest that developing countries could gain from CE implementation through targeted approaches encompassing the government, the industry, and communities. The paper ends with policy suggestions and collaborative strategies to promote the integration of a circular economy for sustainable waste management in developed and developing country settings.

INTRODUCTION

Waste production is a challenge, especially for developing and developed nations in the world. The advent of consumer society, the age of rapid industrialization since the Industrial Revolution, has led to an increase in waste amounts due to increasing consumption (Sellappa, 2025). Combined with rapid population growth, global resource demand is still growing, putting stress on natural ecosystems and leading to extensive ecological deterioration.

Three The waste generated from industrial, agricultural, commercial, municipal and domestic sources has become critical problems such as land degradation, water pollution and ocean plastic buildup (Rajendran *et al.*, 2025). Submission This extraction rate is entirely unsustainable and is predominantly coming from the old linear economic model where we take, make and dispose of. This 'cradle to grave' model has resulted in far-reaching implications for both ecological sustainability and human health, as well as the sustainable supply of critical resources.

The linear economy has been seen as a driving force behind economic development and material affluence, especially in industrialized countries through the 20th century. But those limits have been exposed ever more glaringly in the twenty-first century, with widespread calls for systemic change. As a cornerstone of securing resources for the long term, safeguarding the environment and maintaining the economic position of generations to come, a change to a circular economy (CE) framework is imperative (Ali *et al.*, 2025).

The circular economy advocates for the perpetual use and replenishment of resources by enabling design which prioritizes reuse, recycling, remanufacturing and waste reduction. This is an economically viable and sustainable alternative to the linear model that disconnects economic growth from resource depletion and environmental degradation (Requena-i-Mora *et al.*, 2025). So, the concept of the CE model has now been widely accepted around the world, particularly by the government, academics and international organizations like the United Nations.

Although many industrialized countries, including Australia and other OECD members, have made an explicit effort to investigate, adopt and incorporate the principles of CE into national policy and industrial practice, for many low and middle-income countries, these principles are still being explored and implemented. Challenges in terms of poor infrastructure, weak policy, engagement of stakeholders, and inadequate awareness are affecting the adaptation of CE in these countries (Pittri *et al.*, 2025).

With the urgent need to find a new and sustainable approach for waste management, especially in resource and infrastructure-poor developing, rapidly urbanizing countries, making the shift towards the circular economy

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offers a prime opportunity to subscribe to worldwide sustainability plans, in particular, SDG 12 Responsible Production and Consumption. The successful application of CE in developing areas may drive broader social, economic, and environmental progress. This study, based on a systematic review method, focuses on:

1. Review the literature on circular economy approaches in Australia and other industrialized countries;
2. Discuss the 17 Regional Studies in detail and what trends, approaches and industrial applications you can find in these regions;
3. Assess the level of CE integration in low and middle-income countries and the available evidence gaps and
4. Examine practical approaches and stakeholder-led initiatives in the successful adoption of CE in developing countries to enhance sustainable waste management results.

Theoretical Background

Theoretical background the circular economy (CE) has emerged as a paradigm with the potential to respond to the issues of waste generation, resource depletion, and environmental degradation. Several definitions for circularity have been proposed over the years by different scholars and organizations. define CE to be an economy modeled after a spiral-loop system in a way that minimizes energy throughput, physical material throughput, and their associated consequences of waste and pollution without impacting social, technical and economic systems. Equally, focus on the closed-loop attitude of CE, especially the Contrary to the conventional linear economy of 'take-make-dispose', the circular economy promotes a more sustainable system of production and consumption. It encourages practices of reuse, repair, remanufacturing, recycling and material recovery (Psarommatis & May, 2025). The three connected principles of the circular economy, according to the Ellen MacArthur Foundation, consist of designing out waste and pollution keeping products and materials in use and regenerating natural systems' the closest much of resource management thinking has gotten to the 3R schema of reduce, reuse, recycle. This is about maintaining the utility of products by repairing, reusing or recycling, with a clear distinction between technical and biological materials. The circular approach aims to power without depletion, regenerate nature and allow biological materials to reenter safe, sustenance regions using decomposition or cascading of elements.

The circular model represented by the Ellen MacArthur Foundation is separated into two streams: a technical loop for products and a biological loop for biodegradable materials (Kowalski & Makara, 2025). The technical loop aims to recover nonrenewable materials like plastics and metals, circulating them back to the loop to be reused, remanufactured or recycled the recirculatory loop, meanwhile, takes care of the biodegradable substances that can be (Okafor *et al.*, 2025) returned to nature without any problem. A key to boosting circularity is ensuring these loops are "tight" in that materials remain in the system as long as possible and with as much of their original value intact as possible. An important sub-aspect of CE, and especially waste management, is cascading, where a product is used in successive rounds, with increasing value extraction over time. Inventory of material: considering how much and of what kind of recycled goods are present in the system.

Assessment of Material Quality

To know the status and lifecycle opportunity of the materials for reuse strategy counselling.

Product Lifespan Assessment

Assessing product durability to minimize resource exhaustion and environmental damage.

OECD and developed countries have achieved significant development in CE, such as advanced policy instruments, technological innovation and stakeholder collaboration, while developing countries face obstruction due to poor infrastructure, insufficient policy and poor awareness. Yet, the theoretical underpinnings of CE are germane and translatable in any context. By contextualizing these principles at local levels and promoting the involvement of all stakeholders, developing countries can improve their waste systems, making them greener and more resistant to changes in the economy. In short, the circular economy presents a strong conceptual basis for a sustainable approach to waste management via systems change. Comparison of developed and developing economies highlights difficulties and barriers, as well as prospects and potential for making theory a reality, reinforcing the need for national strategies to drive global implementation of CE (Qu & Kim, 2025).

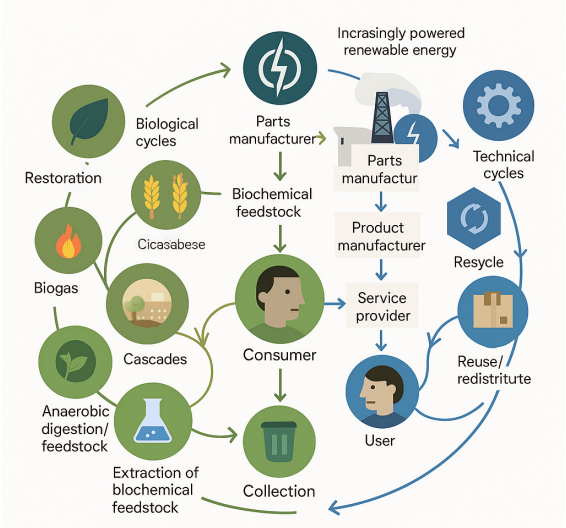

Figure 1: Ellen MacArthur Foundation illustration of circular economy

The circular economy (CE) has become a promising model for combating global environmental issues and

resource shortages. This model has been adopted more and more in rich countries, with the clothing, textile and durable goods industries often being pioneers. CE implementation is particularly intense in Europe. The European Commission has widely endorsed CE in terms of regulation and action plans (Jurczak *et al.*, 2025). European Commission Vice-President Frans Timmermans called for departing the throw-away culture and seeking instead safety through conservation and resource efficiency. The European Parliament has always been at the forefront, pressing for the re-industrialization of production based on re-design, which is also the core of CE. Germany, for instance, has made significant progress to the extent that companies such as Mercedes-Benz are rethinking product design for easy maintenance, servicing, renewal and redistribution (Pinyol Alberich & Hartley, 2024). A European Commission report from 2014 suggested that CE might mean annual economic benefits of 600 billion euros for the EU manufacturing sector.

Denmark presents a rather particular CE model and attaches to industrial symbiosis. In JVSC, firms collaborate on a joint venture basis to build symbiotic relationships which improve the efficiency of energy and material use. The Ka Lundborg Eco-Industrial Park in Denmark is one such model, which sees the by-product of one company serve as the raw material for its neighbor in a closed-loop system. Likewise, Scotland exhibits the kind of cutting-edge CE activity, for instance, MacRebur, which uses recycled plastic pellets in road construction rather than petroleum bitumen.

In Asia, CE was implemented at a fast pace in China. First, as China shifted from a planned to a market economy, production and consumption surged, bringing with them significant environmental problems. CE advancement in China has been included in the series of Five-Year Plans, indicating its strategic significance. It pushed both domestic industries and foreign waste-exporting nations to reconsider how they process their waste (Li *et al.*, 2024). Its capacity to make immediate compliance with such commands as Shanghai's use of free plastic bags demonstrates China's marked dedication to CE. South Korea, Singapore and Japan, the other Asian countries, have also incorporated CE principles in their industrial policies.

The path to CE in Australia has been more gradual. The country has historically depended on shipping its recyclables, especially plastics, to other countries like China. But with import bans and other tighter restrictions overseas, Australia has been forced to develop the capacity to recycle at home. This transition has resulted in massive infrastructure and technological investments required to transform them into valuable products (Van Der Vlist *et al.*, 2024). Sectors with a notable increase in the adoption of CE practices include agri-food, mining and construction. This reform reflects a nascent national consciousness and commitment to sustainably addressing waste.

Although progress in adopting CE occurs in developed countries, numerous developing nations within Africa, the Pacific Islands, Southeast Asia, and South America still face overwhelming challenges in its implementation. Among the barriers are inadequate infrastructure, lack of funds and absence of policy backing. In most of these places, waste is still mainly disposed of in landfills or open dumps, and recycling is minimal (Imam & Rafizul, 2025). Lack of good regulatory regimes and public awareness make progress even more difficult. Nevertheless, the potential for CE is highly relevant to developing countries. The regions have plenty of labour that could be used for repair, recycling and remanufacturing. Informal waste sectors, which are operating in many cities already, can be involved in the formal CE system to make the operations more efficient and regular. Also, by replicating the policy landscape and technological innovation potential of developed nations, developing countries learn to leapfrog away from traditional waste management models towards sustainable approaches based on a circular economy (Rataj *et al.*, 2024). The secret to successful CE delivery in the settings of developing nations is to use context-specific tactics (Tse *et al.*, 2024). For example, an emphasis on local resource cycles, fostering small-scale repair industries and providing incentives for eco-design for local manufacturing can lead to workable and scalable ways. Sharing of best practices and regional cooperation can also speed up progress. CE infrastructure can be created mainly by international collaboration, foreign investments and technology transfers.

In addition, mainstreaming CE into national development plans and climate action plans can ensure circularity is part of long-term economic strategies. Equally important are education and capacity building at all levels (Wang *et al.*, 2025). Community awareness and local expertise in CE practices will lead to more widespread participation and local ownership.

In short, if in industrialized countries, policy and innovation plus industry cooperation have made impressive progress in adopting CE, emerging countries also have a crucial role to play in enhancing global sustainability. Given the appropriate enabling environment, inclusive policies, and international cooperation, CE can act as a route to environmentally sustainable, economically viable and socially equitable development in the world. The shift to a circular economy is not only urgent from an environmental perspective; it is an unparalleled opportunity to build resilient, adaptable economies fit for the future (Chang *et al.*, 2024).

This research thus presents a comparative analysis of CE practice in developed and developing areas and pinpoints challenges, strategies, and possible trajectories. It provides a basis for more research and policy work that supports sustainable waste management worldwide.

LITERATURE REVIEWS

The importance of article content analysis is presented

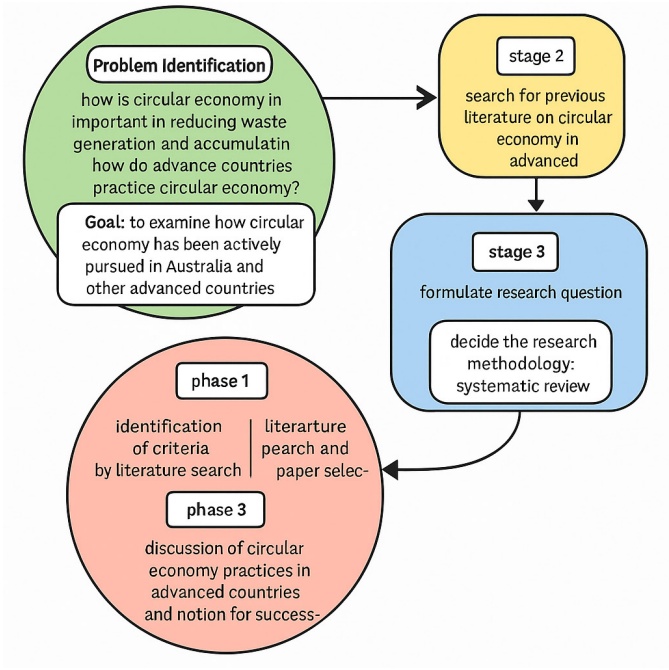

Figure 2: Research study

in this section by compiling the literature reviews related to the circular economy, focusing on sustainable waste management in developed and developing nations (Vann Yaroson *et al.*, 2024). Since the past 5–10 years, there has been a significant surge of scholarly interest in circular economy principles as a result of global issues associated with waste, limited resources and environmental degradation. These mounting challenges have driven both academia and the policy world to question the linear economic system and take a turn toward more sustainable, circular models.

The literature reviewed is presented about how some countries, especially in developed areas, adopted a circular economy model for waste management commitment. While these studies provide significant findings for policy design, industrial transformation, and life cycle perspective, they show some geographical gaps in intra-national comparison, in particular for developing countries (Cheng *et al.*, 2024). The first comparative analysis of the waste policy and the 3R (reduce, reuse, recycle) strategy in developing and developed countries, such as the European Union, the USA, Japan, Korea, China and Vietnam. This research was conducted as preliminary cross-national research. Yet there is little research on how countries such as Australia or the lower-income nations of Asia and Africa are incorporating concepts of a circular economy into their waste systems. Furthermore, most works focus on developed countries like Germany, Japan or the EU members, so there is also an obvious motivation to research and compare adoption cases in emerging and developing countries. Table 1 presents a summary of the related literature and establishes the basis for this study, which seeks to make up this gap by a comparative examination of the adoption of a circular economy between developed and developing countries in terms of sustainable waste management.

MATERIALS AND METHODS

To evaluate the adoption and practice of CE in developed and developing countries, with a focus on sustainable waste management, a systematic literature review was used as the primary research methodology. This methodology enabled a detailed analysis of academic and policy literature that captured the development and implementation of CE principles across multiple national contexts.

The Centre describes systematic reviews for Reviews and Dissemination as a focused piece of secondary research that has a four-part process to identify, assess, interpret, and synthesize all research evidence relevant to the research question, unlike traditional literature review, which can be based on qualitative and quantitative methods for investigation of some themes, synthesis, analyses in a way to use explicit, reproducible objective methods to minimize bias in the tested processes.

The Review Process for This Research Included a Four-Step Systematic Review

Identification of Criteria: There were clear and developed inclusion and exclusion criteria set to help pick the academic papers, reports and policy analyses showing how knowledge and circular economy practices in waste management were adopted in both developed and developing countries.

Database Search and Paper Collection

We systematically searched for peer-reviewed literature published present date in academic databases, including Scopus, ScienceDirect, SpringerLink, and Google

Scholar, using specific keywords (e.g., circular economy, waste management, developed countries, developing countries, sustainability, and keywords related to the objectives).

Screening and Assessment

Papers returned from the search results were screened according to the relevance to the research questions and consideration for geographic orientation, depth of analysis, methodological soundness and practical implications. Studies that lacked comparison and/or contextualization of waste management in cities from different countries or provided similar analysis but in a system of reuse or waste to new products in developing countries were excluded.

Data Extraction and Thematic Coding

Material was reviewed and coded based on year of publication, country/region that research was focused on, methodological approach undertaken, industry of application and key findings regarding waste management systems. This allowed us to compare advanced economies (EU countries, Japan, Germany) to developing or emerging countries (Bangladesh, India, Vietnam).

Finally, this approach to the data permits a balanced view of how the CE is being framed and enacted in different economic and social settings, with a view to discovering commonalities in approaches as well as thinking critically with and against the framings and practices of doing the CE in other places. Visual search is depicted in Figure 3.

Table 1: Summary of Literature Review

No.	Title	Reference	Summary	Country Context
1	European National Road Authorities and Circular Economy: An Insight into Their Approaches	(Abu-Bakar, Halidu, *et al.*,2024)	Reviews circular economy practices adopted by national road authorities in Europe, aiding in transitioning towards circular business models.	Developed (Europe)
2	End-of-Life Options for Bio-based Plastics in a Circular Economy: Status Quo and Potential from an LCA Perspective	(Mudersbach, Marina, *et al.*,2025)	Provides an environmental life cycle perspective on end-of-life strategies for bio-based plastics, assessing circular potential.	Developed (Germany)
3	A Review of Circular Economy Development Models in China, Germany and Japan	(Campoli, Jessica Suárez, *et al.*,2025)	Compares the evolution of circular economy frameworks across advanced economies and sectors, including waste management systems.	Developed & Emerging
4	Advancing to a Circular Economy: Three Essential Ingredients for a Comprehensive Policy Mix	(Wasserbaur, R., Sakao, T., & Milios, L., 2022).	Analyzes EU circular economy policy mix and identifies areas where material efficiency is lacking for more sustainable waste handling.	Developed (EU)
5	Conceptualizing the Circular Economy: An Analysis of 114 Definitions	Kirchherr, Julian, *et al.*, 2023	Examines a wide range of definitions and interpretations of the circular economy, revealing its integration into sustainability and waste management frameworks.	Global

Search Criteria

The definition of specific inclusion and exclusion criteria for the selection of studies related to the research questions was a crucial first step of this systematic review. Given the fact that this study could be characterized as a comparative study, it empowers the comparison between what it means for the circular economy to enter both developed and developing countries from the standpoint of sustainable waste management. It led to the use of a transparent and varnished search strategy to warrant the credibility and relevance of the selected data sources. The present study is limited to the scientific literature published in reputable databases (Scopus, ScienceDirect, Google Scholar, and Web of Science). Textbooks and other non-journal or non-academic material were not part of this review. Non-academic sources (e.g., books, non-peer-reviewed reports, conference presentations, and unpublished theses) were not considered to ensure academic quality. The following criteria guided the selection of studies:

Type of Access and Type of Documents

Only open-access peer-reviewed journal articles were included in order to keep the data open and academically transparent. The searches were restricted to published articles and reviews indexed in Scopus and Web of Science.

Year of Publication
As the knowledge of the concept of circular economy is still developing, we only considered articles published from 2010 to 2020. This period is when the circular economy discourse increased, and there appeared innovation in sustainable waste management.

Author Competence
The included studies were held by researchers with a reputation in the development of circular economy studies, some of them even having published more than one article in high-impact environmental and sustainability sciences journals.

Subject Area
Only papers with the subject area environmental science/ sustainability were included in order to maintain theme relevance with waste management and circular economy activities.

Country/Territory Designation
The study concentrated on a comparison between developed and developing countries. Country categorization was based on the classification of the World Bank [34] and the classification of the International Monetary Fund (IMF).

Developed countries
Australia, USA, UK, Germany, Netherlands, Sweden, France, Japan, Finland, Italy, Norway, Austria, New Zealand and other high-income economies.

Low- and Middle-Income Countries
South Asia, South East Asia, Sub-Saharan Africa and Latin America.

Special Sase China
Although the country is not identified as a developed state, having made significant progress in circular economy practices, China was added to the list.

Language
Only English language publications were included to maintain uniformity and clarity in data interpretation.
The full range of criteria factored into the selection process, and these ensured that the selected studies became ones which were methodologically sound, thematically relevant, regionally diverse, and, in effect, allowing a critical comparative analysis of circular economy uptake sustainable waste management.

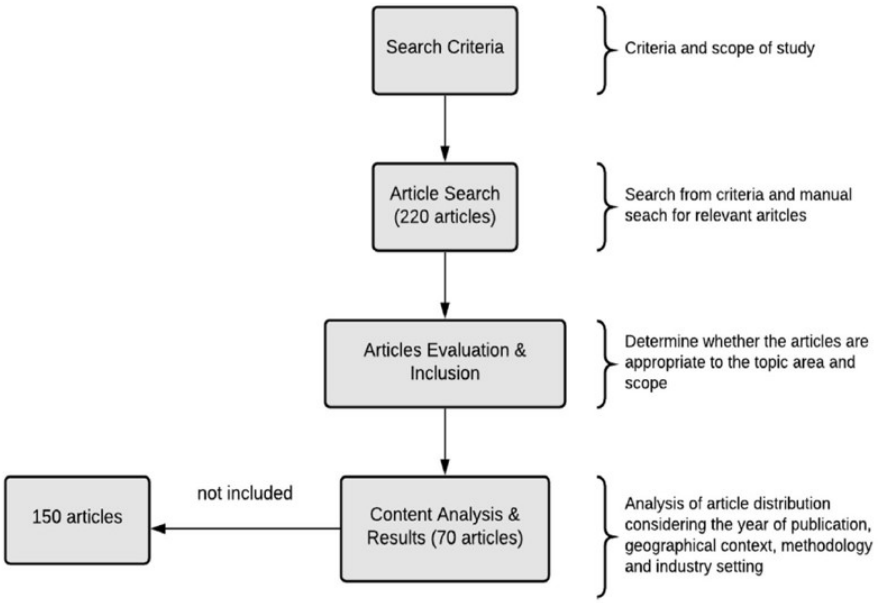

Figure 3: Research methodology overview

Article Search
The second step of this systematic review type study was a comprehensive search and collection of the academic papers related to the main topic of the circular economy adoption between developed and developing countries from which soft waste management (so-called waste management system), in particular, deserved special interest. We performed a search primarily in two established academic databases: SCOPUS and Web of Science (WOS). A sum of 182 articles were obtained from these databases: A total of 106 articles were found from SCOPUS, which includes 70 published research papers, 11 review papers, and 25 conference papers. Of these, 103 were published in full and added to the collection, and three articles were in press.76 articles were found in the Web of Science, including 66 research articles and 10 reviews. A manual search was also conducted to cover comprehensively this study design and avoid abstract bias. It was necessary to do so to prevent search restrictions and keyword-related omissions, particularly in automated database systems. The manual review aimed at confirming the relevance of

each article according to the study and at filtering articles used in the dataset to keep only the most relevant ones. Consistent with the scope of the study introducing circularity in developed and developing economies, the database search was narrowed down through delimitation with regional keywords. For instance, the terms "circular economy in developing countries" and "circular economy in South Asia" were employed to identify contextually relevant literature. On the other hand, the key term circular economy in Australia" was adopted as a case concentration for advanced countries and resulted in 23 SCOPUS articles and 28 articles from the Web of Science. Examination of articles the articles generated from the search in each database were screened. This methodical and systematic article search established the basis of an exhaustive comparative examination of the extent to which CE principles are being researched, applied and evaluated in both high-income and low-to-middle-income countries in the scope of sustainable waste management. Another thirty-eight papers were secondarily recruited from previous search results. A disproportionately high number of them had already been searched; their initial searches revealed that they were not being included because of not initially meeting the criteria for inclusion.

Screening of Articles and Inclusion Criteria

After a thorough search process, 220 research papers were initially obtained from the selected databases. Each paper was meticulously read and assessed to ensure that they were in line with the requirement scope of this study, contributing to either implemented or adopted circular economy principles in both developed and developing countries, focusing mainly on sustainable waste management. Papers which did not relate to circular economy, sustainability, or waste strategies, in particular those that did not involve comparative frameworks or did not focus on the implementation side, were the ones discarded from the final data set. Nevertheless, if the circular economy was found to be a relevant sub-theme, we used an independent, more profound assessment of the texts of such publications, as they were likely to offer supplementary views on relevant knowledge. In the process of systematic review, 150 articles were eliminated from the review, leaving 70 articles that were considered powerfully relevant to the research questions.

Content Analysis of Articles and Results

The results of this final stage of the systematic review consisted of a thorough review of the 70 articles retained, which provided an exploration into the main dimensions relevant to the comparison between developed and developing countries' uptake of the circular economy. Year of publication to track change and development in how discourse on the circular economy is framed. Methods used to determine whether studies used qualitative, quantitative or mixed methods. Industry or sectoral focus urban waste, industrial waste, plastic recycling, construction waste, etc. The patterns of keywords of these last 70 articles reveal the themes that shape the circular economy in this field of waste management and illustrate both emerging trends and geographic differences. The list of keywords found across the final sample is provided in Table 2.

RESULTS AND DISCUSSION

This section analyses the final sample of 70 articles that were chosen, including aspects such as the methodology used, the geographical scope, and the industry settings of the covered papers. The results are presented in Table 3, which shows the number of documents classified under each dimension and their respective percentage. We will elaborate on these percentile distributions in the following subsections. This surge demonstrates an increasing concern in both developed and developing countries on circular economy approaches in dealing with sustainable waste management issues. Recent growth in publications evidences the widening research interest in how circular economy principles can be put into practice to drive resource efficiency and recirculation and, hence, reduce waste in different economic settings.

Table 2: Keyword Search for final draft

No.	Search Keywords	Scopus (Final Selected)	Web of Science (Final Selected)
1	"Circular economy" AND "developed countries" AND "developing countries"	106 (22)	76 (13)
2	"Circular economy" AND "sustainable waste management"	23 (10)	28 (5)
3	"circularity" AND "recycling" AND "end-of-life" AND "closed-loop" AND "developed countries" AND "developing countries"	26 (15)	20 (5)
Total		**155 (47)**	**124 (23)**

• Numbers outside parentheses represent the total articles found in the databases.

• Numbers inside parentheses indicate the final selected articles included in the review after screening.

Table 3: Analysis of Research Methodology and number of relevant papers

Category	Subcategory/Methodology/Region/ Industry	Number of Papers	Percentage (%)
Research Methodology			
	Literature Review	13	19
	Case Study	20	29
	Model	10	14
	Survey	9	13
	Theoretical and Conceptual Papers	13	19
	Analysis (MDA, CWA, Empirical)	6	9
Geographical Context			
	Oceania (Australia)	15	21
	Europe	30	43
	North America	4	6
	Asia	15	21
	Worldwide	6	9
Industry Setting			
	Technology and Innovation	10	14
	Urban and Municipal	9	13
	Metal and Steel	6	9
	Food and Agriculture	6	9
	Plastics	5	7
	Construction	4	6
	Mining	3	4
	Glass	1	1
	Electronics (Household Appliances and Mobile Phones)	3	4
	Tourism	2	3
	Energy (Oil and Gas, Bio-hydrogen)	6	9
	Textile	2	3
	SMEs (Small and Medium Enterprises)	3	4
	Transportation and Logistics	3	4
	Others (Material Flow, etc.)	2	3
	Unspecified	5	7

Table 4: Analysis of Research Methodology and percentage of relevant paper

Research Methodology	Description	Percentage (%)	Geographic Focus (Examples)
Case Study	Most common method; applied in Australia, Europe (Poland, Italy, Netherlands, Finland, Spain, Germany, Sweden, Latvia), Asia (mainly China)	29	Australia, Europe, China
Literature Review	Reviews of previous studies on circular economy across various regions	19	Multiple regions
Theoretical and Conceptual Papers	Explanation of circular economy theories and concepts in different regions	19	Multiple regions
Model	Use of models to study circular economy concepts	14	Various
Survey	Questionnaires and interviews to collect primary data	13	Various
Analysis	Includes multidirectional analysis (MDA), common weight analysis (CWA), empirical studies	9	Various

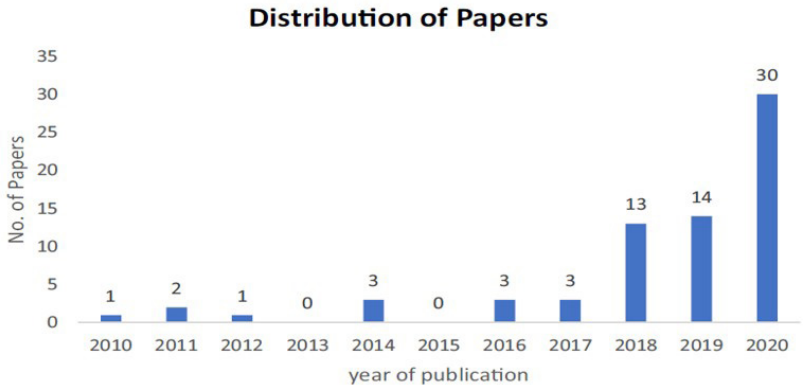

Figure 4: Distribution of papers

Geographical Context

The geographical setting of this exploration indicates the countries /regions in which circular economy and sustainable waste management have been considered. We consider a developed-developing country comparison in this analysis. The places of primary focus are Oceania (predominantly Australia), Europe, North America, and Asia, and some interest in international studies that consist of two or more countries. For Europe, several studies consider the "European Union" as a pool rather than specific countries. Yet, individual nation-states such as the Netherlands, Sweden, Poland, Germany, the United Kingdom and Finland are also captured, given their essential positions about the adoption of the circular economy. Australia is central to Oceania, where waste management, including a circular economy, is of growing interest. For North America, the United States is most prominently reported, and for Asia, China is at the forefront with its excellent developments and mass-scale initiatives of the circular economy. Publications in Asia, especially China, began already in 2011, coinciding with the nation's early and strong national embrace of circular economy. China's role shows that developing countries, too, can be instrumental in promoting circular economy concepts for sustainable waste management. This spatial comparison emphasizes the different stages and centers of attention between developed and developing countries in the uptake of the circular economy, stressing global patterns and region-specific patterns.

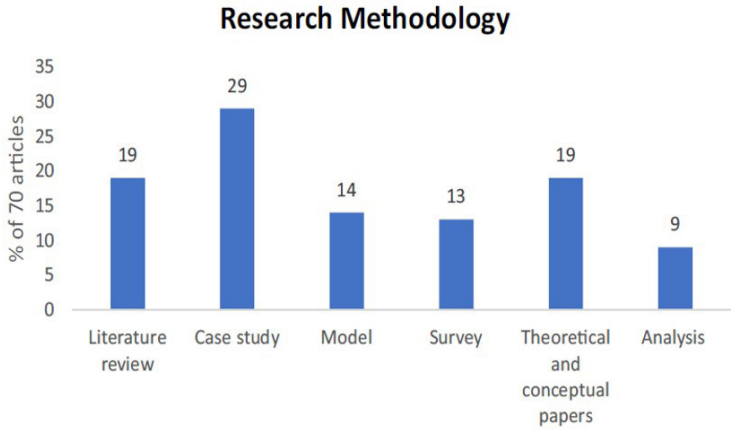

Figure 5: Research methodology used

Industry Setting

The 20 selected papers demonstrate a variety of cases from industry sectors adopting the circular economy for the sustainable management of waste, with differences between those considered in developed and developing countries. The technology and innovation sectors are disproportionately referenced-a clear indication of the technology-led change required to push forward the circular economy. Urban, municipal and metropolitan spaces are also key focus areas, particularly in developed economies like those of Europe, where much attention is devoted to circular economy transitions in cities and urban infrastructure. The representations of the three sectors in metal and steel, energy, food and agriculture industries are about 9% respectively. The metal and steel industry are one of the most significant contributors to the world economy, especially in developing countries, including China, with economic growth and urbanization leading to rising needs for sustainable resource utilization in Industry 4.0. Metal recycling and reuse through circular economy practices have been investigated in developed countries like the USA, Australia, the European Union,

etc. The food and agriculture industry are a critical component of the global economy but also a significant driver of environmental pressures associated with resource inefficiencies and GHG emissions. Both developed and developing nations are experimenting with circular economy approaches to ease the impacts of these pressures, and scholars have detailed examples from Australia and Europe.

There are a number of papers focused on the energy areas that reflect the world's interest in the management of waste and emissions in the world in a sustainable way. Plastics, and more specifically packaging and single-use plastics, play a crucial role as well in light of the enormous societal and financial cost of plastic waste that affects us all over the world. SMEs represent about 4% of the studies; in most cases, the units of analysis are European SMEs, which shift from a linear to a circular business model. Other sectors described include textiles & wearing apparel, mining, construction, transportation & logistics, tourism, and electronics (consumer goods, computers and phones). Some articles cover the principles of the circular economy without a specific industry, although they offer reasonable content for sustainable waste management.

Table 5: Industry Setting Distribution in Circular Economy Publications (N=70)

Industry Sector	Number of Papers	Percentage (%)
Technology and Innovation	10	14
Urban, Municipal & Metropolitan	9	13
Metal and Steel	6	9
Food and Agriculture	6	9
Energy (Biofuels, Oil, Gas)	6	9
Plastics	5	7
Construction	4	6
SMEs (Small and Medium Enterprises)	3	4
Electronics (Appliances, Mobile)	3	4
Transportation and Logistics	3	4
Mining	3	4
Textile and Clothing	2	3
Tourism	2	3
Others (Material Flow, etc.)	2	3
Glass	1	1
Unspecified	5	7

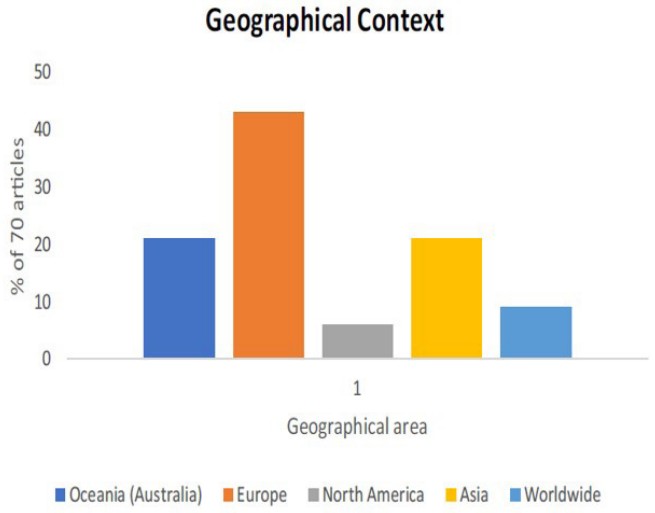

Figure 6: Geographical context

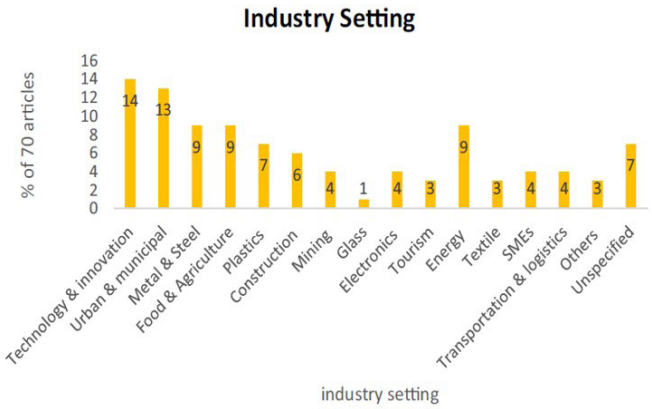

Figure 7: Industry Setting

Discussion

In this analysis, we critically examine the application of circular economy (CE) principles for sustainable waste management and compare the practices of the developed world, including (but not limited to) Australia and other high-income nations, with the developing world. The conversation is structured in terms of the environmental, economic, and social impacts of CE and the existing situation of waste management systems in different degrees of development (Mallik & Rahman, 2024). More developed economies such as Australia have become more aware of the way the behavior of individuals and industry have contributed to the widespread loss of natural resources. Such consciousness has led some to seek CE as a model for sustainable development. One example is in Australia, where, through the power of technology and engineering, industrial design has been repositioned in the realms of human-centered and environmentally sustainable grounds (Islam *et al.*, 2025). On the other hand, in many developing countries, there are serious problems of waste mismanagement, such as disposal by open dumping, open burning, and infrastructure facilities. Environmental pollution, health hazards and economic losses are some of the consequences of these practices. Cases in Asia and Africa, such as Cambodia, Thailand, Nigeria, and Mozambique, illustrate the extent of the problem (cities producing hundreds of thousands of tons of unmanaged waste a year). Environmental pollution of heavy metals, particularly in urban agglomerations like Chennai city (India), is another supporting reason for addressing the given problem at the earliest time. Although many alternatives have been suggested, including waste-to-energy and recycling programs, little has been done to deal with the issue at the source. This is where CE provides a fundamental way forward through its reuse, redesign, refurbishment and remanufacturing principles (Mallik *et al.*, 2025). Recently, Developmental Organizations and Academia have also started to examine some CE models in emerging countries. Examples from India, Brazil, Kenya, and Ghana indicate that CE carries the potential to realize triple-bottom-line effects: economic development, job creation, and environmental sustainability (Mallik, 2024).

Bio-Economy Sector

Places such as the Congo Basin, Amazon rainforest , and Southeast Asian tropical forests are home to a wealth of biodiversity and forest products. Circular approaches in the bio-economy may also contribute to counteracting deforestation by supporting efficient biomass utilization and the manufacture of products from biological resources, which is consistent with CE principles, e.g. cascading use of resources.

Mineral Extraction and Mining

Resource-rich developing countries (for example, Nigeria, Brazil, Chile and India) tend to depend heavily on extractive-based industries. But they can also be environmentally depleting. CE practices impose a sustainable solution based on recycling, reuse and much less virgin resources so as to enhance the protection of the environment (Li, 2019) and encourage indirect support to the economy.

Urban Waste Disposal and Recycling

Municipal waste generation in the cities of developing countries is increasing while most cities of the world are disposing of their waste in one way or another in open dumps and landfills. CE is also characterized by practical end-of-life disposal solutions (including comprehensive recycling models, wastewater reuse, and digital techniques, such as innovative sorting systems) facilitating efficient and sustainable urban waste management.

Table 6: Comparative Analysis: Developed vs. Developing Countries

Aspect	Developed Countries (e.g., Australia, EU Nations)	Developing Countries (e.g., India, Nigeria, Cambodia)
Public Awareness and Behavior	High level of awareness; citizens recognize their microeconomic impact on resource decline	Limited awareness; behaviors shaped more by poverty and lack of education than by sustainability concerns
Technology & Innovation	Strong emphasis on R&D; human-centered design; advanced technologies in waste processing (computerized sorting)	Limited access to technology; reliance on basic, often informal waste management practices
Economic Impact of Circular Economy	Proven positive economic effects; e.g., EU can save €600 billion annually and gain €1.8 trillion net benefit	Circular economy potential recognized but underutilized; promising economic benefits still largely theoretical
Environmental Benefits	Significant potential for emissions reduction (7.5 billion tones CO_2 globally); aligned with climate goals	Severe pollution from open dumping and burning; circular economy could alleviate major environmental health issues
Employment Impact	Estimated creation of hundreds of thousands of jobs (EU: up to 747,829 new jobs)	High potential for job creation in recycling and circular sectors, but hampered by skill gaps and lack of training
Waste Management Practices	Well-developed infrastructure; widespread recycling and controlled disposal systems	Predominantly open dumping, poor collection systems, and landfill overuse
Key Circular Sectors	Technology, manufacturing, construction, and packaging industries	Bio-economy (forests/agriculture), mineral extraction & mining, municipal waste management
Challenges	Skill gaps in specific circular roles; need for more integrated policy frameworks	Poor infrastructure, lack of circular economy education, informal waste sectors, and limited funding
Adoption Drivers	Strong policy support, innovation ecosystems, environmental urgency	International aid, emerging academic interest, local entrepreneurial initiatives
Circular Bio-Economy	Efficient use of biomass resources, focus on cascading use and sustainable packaging	Rich in forest resources (e.g., Amazon, Congo Basin) but threatened by deforestation; circular bio-economy can reverse trends
Extractive Industries	Focus on reducing raw material extraction through recycling and product redesign	Economies heavily dependent on mining (e.g., Nigeria, Brazil, India); circular economy can reduce socio-economic and environmental risks
Municipal Waste Management	Smart city solutions, Industry 4.0 integration, formal recycling infrastructure	Rapid urbanization with informal systems, often unmanaged waste; circular economy offers cooperative, scalable models
Government Role	Policy-making, innovation funding, regulation of circular practices	Must play central role in regulation, public education, and enabling community-level initiatives
Business Involvement	Leading investments in circular innovations and sustainable products	Emerging interest; opportunities for SMEs and social enterprises in local circular business models
Role of General Public	Increasing participation in recycling, reuse, and sustainable consumption	Limited engagement due to lack of infrastructure and access; potential to scale through education and policy incentives

The successful adoption of CE requires coordinated efforts from multiple stakeholders:

Businesses and Industries
Can drive innovation through sustainable product design, materials substitution, and investment in clean technologies.

Governments (National and Local)
Must provide leadership through policy frameworks, funding, and educational initiatives to foster CE.

General Public
Plays a key role by adopting sustainable consumption practices, proper waste sorting, and preferring reusable products.

CONCLUSION

The transition to a circular economy holds transformative potential for sustainable waste management. While

developed countries have made significant progress in adopting CE principles, developing nations are still at the early stages, hindered by infrastructural, educational, and governance challenges. A comparative understanding of these contexts provides valuable insights for tailoring CE strategies that align with local capacities, resources, and socio-economic conditions. Bridging these gaps through policy support, investment in innovation, and inclusive stakeholder participation will be crucial for global progress toward sustainability.

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