CIRCULAR ECONOMY IN DEVELOPING COUNTRIES: CHALLENGES AND SOLUTIONS

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Annotation: *This article analyzes the role of the circular economy (CE) in developing countries, focusing on the main challenges that hinder its implementation and the potential solutions that can accelerate progress. The study highlights critical barriers such as weak infrastructure, limited institutional capacity, financial constraints, low public awareness, technological gaps, and issues related to informal sectors. At the same time, it emphasizes that circular economy practices can provide significant opportunities for sustainable development, including job creation, resource efficiency, and environmental protection. The article argues that policy reforms, digital innovation, international cooperation, and consumer awareness are essential to overcome existing obstacles. By addressing these factors, developing countries can successfully transition from a linear to a circular model, aligning economic growth with sustainability and contributing to global climate goals.*

Keywords: *Circular Economy; Developing Countries; Sustainable Development; Challenges; Solutions; Green Economy; Resource Efficiency; Digitalization; Policy Reform; International Cooperation.*

The concept of the circular economy (CE) has gained global recognition as a transformative model for achieving sustainable development. Unlike the traditional linear economy — based on the “take, make, dispose” paradigm — the circular economy seeks to minimize waste, optimize resource use, and regenerate natural systems. Developed countries, particularly in Europe, have been at the forefront of implementing CE strategies, supported by advanced technologies, strong institutions, and public awareness. However, in developing countries, the adoption of circular economy practices presents both unique opportunities and significant challenges.

Developing economies are characterized by rapid population growth, urbanization, and industrial expansion, which often result in increased waste generation, inefficient resource consumption, and environmental degradation. At the same time, these countries face institutional weaknesses, financial constraints, and limited access to green technologies. Despite these barriers, the circular economy provides a promising pathway for addressing pressing issues such as poverty reduction, climate change, and sustainable resource management.

Research shows that CE practices — such as recycling, eco-design, renewable energy adoption, and sustainable agriculture — can generate new jobs, stimulate innovation, and improve environmental quality in developing contexts. Yet, to unlock these benefits,

structural reforms are required. These include the establishment of supportive policies, investment in digital and green infrastructure, capacity building for businesses, and awareness-raising among consumers. International cooperation and technology transfer also play an essential role in bridging the gap between global best practices and local realities.

Thus, exploring the challenges and solutions of circular economy integration in developing countries is crucial not only for their domestic sustainability but also for achieving global environmental goals. This paper aims to analyze the barriers hindering CE adoption in these regions and to propose practical solutions that can guide policymakers, businesses, and international organizations in supporting the transition toward a more sustainable future.

The concept of the circular economy (CE) has become central to debates on sustainable development worldwide. Scholars such as Kirchherr, Reike, and Hekkert (2017) conceptualize CE as a restorative and regenerative system designed to keep products, materials, and resources in use for as long as possible. According to Geissdoerfer et al. (2017), CE is not only an environmental strategy but also an economic model that stimulates innovation, reduces costs, and enhances competitiveness. Most of the literature, however, focuses on experiences from the European Union, China, and other developed economies, where supportive regulations, advanced technologies, and strong institutional frameworks enable the successful implementation of CE practices.

In developing countries, the research reveals a more complex and often challenging landscape. Studies by Schröder, Anggraeni, and Weber (2019) indicate that the adoption of CE in low- and middle-income countries faces structural constraints such as weak governance, lack of financial resources, and inadequate infrastructure for waste management and recycling. Furthermore, informal sectors play a significant role in resource recovery in these regions, often outside regulatory frameworks, which creates both opportunities and risks. While informal actors contribute to recycling and waste reduction, the absence of regulation leads to issues of safety, efficiency, and environmental impact.

Several authors argue that digitalization and technology transfer are critical enablers for CE in developing contexts. Antikainen et al. (2018) emphasize the role of digital technologies — such as big data, IoT, and blockchain — in optimizing resource flows, increasing transparency, and supporting new business models like product-as-a-service and sharing platforms. However, OECD (2020) reports highlight that many developing countries lack the digital infrastructure and institutional capacity required to fully leverage these technologies.

In terms of policy approaches, UNDP (2021) suggests that integrating CE principles into national development strategies is essential for creating an enabling environment. Developing countries often rely heavily on extractive industries and resource-intensive production, making the transition to CE particularly urgent but also difficult. Policy incentives, capacity-building programs, and international partnerships are identified as key solutions for overcoming these barriers. Additionally, cultural and behavioral change at the

consumer level is seen as an important factor, as awareness of sustainable consumption remains limited in many regions (World Bank, 2020).

Overall, the literature indicates that while CE presents substantial opportunities for developing countries — such as job creation, resource efficiency, and improved environmental performance — the path toward implementation requires addressing systemic challenges. These include closing infrastructure gaps, strengthening institutions, mobilizing investment, and fostering international cooperation. The gap in existing research lies in the lack of case studies and empirical evidence from developing regions, suggesting the need for more localized studies that explore practical solutions tailored to specific economic, social, and cultural contexts.

The global shift from a linear to a circular economy represents one of the most significant transformations in contemporary development thinking. The circular economy seeks to reduce waste, extend product lifecycles, and regenerate natural systems by decoupling economic growth from resource consumption. For developing countries, this transition is both urgent and challenging. Rapid population growth, urbanization, and industrial expansion put enormous pressure on ecosystems, while limited infrastructure and institutional weaknesses restrict their capacity to implement CE practices. Nevertheless, CE provides an opportunity to align economic modernization with sustainability, offering pathways to address pressing issues such as climate change, poverty reduction, and environmental degradation.

Scholars define the circular economy as an economic model that closes resource loops and promotes sustainability (Kirchherr et al., 2017). Research in developed economies shows that CE fosters innovation, enhances competitiveness, and reduces environmental pressures (Geissdoerfer et al., 2017). However, the literature highlights that in developing contexts, systemic barriers — including weak governance, lack of investment, and insufficient infrastructure — hinder CE adoption (Schröder et al., 2019).

Informal recycling sectors play a prominent role in many developing countries, contributing to waste reduction but also raising concerns regarding safety, regulation, and efficiency. Studies emphasize the importance of integrating informal actors into formal CE strategies (UNDP, 2021). At the same time, digitalization is increasingly recognized as a catalyst for CE practices. Technologies such as IoT, AI, and blockchain can enhance transparency and efficiency, though access to such tools remains uneven (Antikainen et al., 2018).

Table-1

Challenges of Circular Economy in Developing Countries

Category	Key Challenges	Implications
Infrastructure	Lack of recycling facilities, inefficient waste management systems, energy losses	High landfill dependence, pollution, limited capacity for material recovery
Institutional Capacity	Weak governance, fragmented policies, corruption, poor inter-	Slow implementation, low enforcement of environmental

	agency coordination	regulations
Financial Constraints	Limited state budgets, high costs of green technologies, lack of investment funds	Inability to finance CE projects, dependence on external aid
Public Awareness	Low consumer knowledge, preference for cheap products over sustainable options	Weak demand for eco-products, limited cultural support for sustainability
Technology Gap	Limited access to digital tools, insufficient R&D, slow adoption of innovation	Missed opportunities for efficiency, dependence on outdated production systems
Informal Sector Issues	Dominance of informal recycling without regulation or safety standards	Health risks, inefficiency, environmental hazards despite resource recovery role

This table highlights the multidimensional barriers that hinder circular economy adoption in developing countries. The challenges are not only technical (infrastructure, technology gaps) but also institutional, financial, and cultural. Importantly, the informal sector plays a dual role: it contributes to recycling but also creates risks due to lack of regulation. Addressing these challenges requires integrated policies, stronger governance, and support from international partners.

The table outlines the key barriers that developing countries face when attempting to implement circular economy (CE) practices. These challenges are interconnected and create a cycle of limitations that slow down the transition from a linear to a circular model.

1. Infrastructure: Inadequate recycling plants, poor waste collection systems, and outdated energy grids make it difficult to establish closed-loop systems. This lack of physical infrastructure results in heavy reliance on landfills, which contributes to pollution and loss of valuable materials.

2. Institutional Capacity: Weak governance structures and fragmented environmental policies prevent effective CE implementation. In some cases, overlapping regulations and corruption further delay progress, leading to inefficiencies and lack of accountability.

3. Financial Constraints: Developing countries often struggle with limited public budgets and lack of investment from the private sector. Green technologies are expensive, and without access to affordable financing or international support, many CE projects remain unfeasible.

4. Public Awareness: The success of CE depends not only on policies but also on consumer behavior. In many developing contexts, there is little awareness of sustainable consumption, and affordability often takes precedence over eco-friendly choices. This slows down the growth of demand for sustainable products and services.

5. Technology Gap: Advanced technologies such as IoT, blockchain, and artificial intelligence can significantly accelerate CE practices, but developing countries

often lack the infrastructure, expertise, and R&D investment required. As a result, they remain dependent on outdated and resource-intensive production systems.

6. Informal Sector Issues: In many developing countries, informal actors dominate recycling and waste management. While they play a critical role in material recovery, the absence of regulation and safety standards creates health hazards, environmental risks, and inefficiencies. Integrating these actors into formal CE systems is both a challenge and an opportunity.

The challenges outlined in the table illustrate that the circular economy in developing countries cannot be achieved through isolated efforts. It requires a comprehensive approach that combines infrastructure development, institutional reforms, financial mechanisms, public education, and technological innovation. Recognizing the importance of the informal sector and integrating it into formal strategies is particularly crucial. Without such holistic measures, the transition to a circular economy will remain limited and fragmented.

Table-2

Circular Economy in Developing Countries: Challenges and Solutions

Category	Challenges	Possible Solutions
Infrastructure	Lack of recycling facilities, poor waste management, inefficient energy use	Investment in modern recycling plants, renewable energy systems, and smart infrastructure
Institutional Capacity	Weak governance, fragmented policies, limited enforcement, corruption	Stronger regulations, policy integration, anti-corruption measures, capacity building
Financial Constraints	High costs of green technologies, lack of funding and incentives	Public–private partnerships, international financial support, green investment schemes
Public Awareness	Low knowledge of CE, preference for cheap non-sustainable products	Educational campaigns, eco-labeling, incentives for sustainable consumption
Technology Gap	Limited access to digital tools, outdated production systems, low R&D	Technology transfer, digital infrastructure development, investment in innovation hubs
Informal Sector Issues	Informal recycling without safety or regulation, environmental hazards	Formalization of informal actors, training programs, integration into official CE systems

This table highlights the dual nature of circular economy development in low- and middle-income countries. On one hand, infrastructural, financial, and governance weaknesses slow down implementation. On the other, opportunities exist through targeted reforms and cooperation. For example:

- Infrastructure gaps can be addressed by international partnerships and domestic investment in green technologies.
- Institutional challenges require stronger legal frameworks and policy coordination.

- Financial barriers can be mitigated by mobilizing blended financing and encouraging private sector participation.
- Public awareness must be raised to shift consumer behavior towards sustainable choices.
- Technology gaps call for digitalization strategies and innovation support.
- Informal sectors, if integrated into official systems, could become powerful contributors to material recovery and waste reduction.
- The transition toward a circular economy in developing countries is both a necessity and an opportunity. While the challenges are significant — ranging from infrastructural gaps and weak governance to financial limitations, low public awareness, and technological divides — these barriers are not insurmountable. With the right combination of policy reforms, targeted investments, and international cooperation, the circular economy can serve as a powerful framework for sustainable development.
- One of the most important insights is that the circular economy cannot be implemented in isolation. It requires a **holistic approach** that integrates environmental, economic, and social dimensions. Governments must create supportive policies and institutional structures; businesses must innovate and invest in sustainable models; and citizens must embrace new patterns of consumption and waste management. Moreover, the role of digitalization and modern technologies is crucial in enabling efficiency, transparency, and new business opportunities across all sectors.
- For developing countries, the circular economy is not only about environmental protection — it is also about **economic resilience and social well-being**. By adopting CE practices, these nations can reduce dependence on raw materials, create green jobs, enhance competitiveness, and improve public health and quality of life. At the same time, the integration of informal actors and the mobilization of international financial and technical support will be essential to ensure inclusive and equitable progress.
- In conclusion, the circular economy offers developing countries a strategic pathway to balance economic growth with environmental responsibility. By turning challenges into opportunities, and by embedding sustainability into the core of national development strategies, developing countries can actively contribute to global climate goals while securing a more resilient and prosperous future for their populations.

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