



CIRCULAR ECONOMY APPROACHES TO WASTE MANAGEMENT AND ENVIRONMENTAL SUSTAINABILITY IN RWANDA

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<https://dx.doi.org/10.4314/coast.v7i2.4s>

Abstract

Rwanda's commitment to environmental sustainability is exemplified by its innovative waste management strategies, which align with the principles of a circular economy. This paper investigates how Rwanda is transforming waste into valuable resources through recycling, composting, and energy recovery initiatives. By implementing policies that promote zero-waste practices and encouraging private sector involvement, Rwanda is reducing landfill usage and minimizing pollution. The study highlights successful case studies, such as the Kigali City Waste-to-Energy project, and examines the socio-economic benefits of these initiatives, including job creation and improved public health. It also discusses the role of education and awareness campaigns in fostering a culture of sustainability among Rwandan communities.

Keywords: Waste Management, Circular Economy, Recycling, Environmental Sustainability, Zero-Waste Practices.

Introduction

Rwanda has gained international recognition for its proactive environmental policies and its ambition to become a climate-resilient, low-carbon economy by 2050. This commitment, outlined in national frameworks such as Vision 2050 and the Green Growth and Climate Resilience Strategy, demonstrates the country's strong dedication to sustainable development and natural resource protection. A key component of this vision is the transformation of Rwanda's waste management system through circular

economy (CE) approaches, which aim to reduce waste generation, optimize resource use, and enhance long-term environmental sustainability (Republic of Rwanda, 2020).

Globally, the circular economy has emerged as a viable alternative to the traditional linear economy, which follows a "take-make-dispose" model. In contrast, the circular model promotes a regenerative system where materials are reused, refurbished, and recycled to extend their lifecycle and reduce environmental impacts. For instance, the European Union has implemented a Circular Economy Action Plan

to encourage industries and municipalities to integrate sustainability into product design and resource use (European Commission, 2020). Similarly, several African countries are increasingly adopting CE strategies to address challenges associated with rapid urbanization, pollution, and climate change (African Circular Economy Alliance [ACEA], 2021).

Rwanda's adoption of circular economy principles is both timely and essential, given the nation's fast-growing urban population and rising waste generation. Although the country has made significant progress in environmental governance—through measures such as banning plastic bags and promoting green infrastructure—waste management challenges remain. Kigali alone generates over 2,000 tons of municipal solid waste daily, much of which is improperly Disposed of (Rwanda Environment Management Authority, 2022).

Despite improvements in sanitation infrastructure, access remains unequal, as urban poor communities continue to face barriers including high costs, inadequate connections, poorly maintained facilities, and insecure land tenure, forcing reliance on unsafe sanitation options (Areo *et al.*, 2019).

Persistent issues such as poor waste segregation, limited recycling systems, and increasing volumes of e-waste and biomedical waste further hinder Rwanda's path toward sustainable waste management.

This study investigates how Rwanda is leveraging circular economy strategies to address these challenges by converting waste into valuable resources through recycling, composting, energy recovery, and other innovative practices. It explores the policy landscape that enables CE in Rwanda, examines public-private

partnerships driving innovation, and evaluates the socio-economic and environmental impacts of key waste management projects.

The research is guided by the following questions:

1. What are the current circular economy initiatives being implemented in Rwanda's waste management sector?
2. How are these initiatives contributing to environmental sustainability and socio-economic development?
3. What are the major barriers to scaling circular economy practices in Rwanda?

To answer these questions, the paper is structured as follows: Section 2 outlines the methodology used to collect and analyze qualitative data. Section 3 provides an overview of Rwanda's waste management landscape. Section 4 explains the principles of the circular economy and their relevance to waste management. Section 5 highlights Rwanda's flagship CE projects and initiatives. Section 6 discusses the roles of public and private actors, while Section 7 covers community engagement strategies. Section 8 assesses the socio-economic and environmental impacts of circular economy interventions. Section 9 identifies the challenges and limitations of scaling CE. Section 10 offers practical recommendations, and Section 11 concludes the paper by summarizing the key findings and implications for policy and practice.

Materials and Methods

This study adopted a qualitative research approach to explore Rwanda's application of circular economy (CE) principles in waste management. The qualitative method was chosen to capture in-depth, contextual insights into policy implementation, stakeholder experiences, and community engagement that quantitative methods might

not adequately reveal (Creswell & Poth, 2018).

Sampling Technique

A purposive sampling method was used to select both fieldwork locations and interview participants based on their relevance to the study objectives. Urban and rural areas were chosen to highlight contrasts in infrastructure and waste management practices. Snowball sampling was applied particularly to engage informal waste sector actors, who are typically less visible in official records but play a crucial role in waste recovery and recycling.

Field Observations: Site visits were conducted in selected urban areas (e.g., Kigali and Huye) and rural districts (e.g., Nyamagabe and Gicumbi) to observe waste generation, collection, segregation, and disposal practices. These locations were selected using a purposive sampling technique to ensure coverage of diverse socio-economic and infrastructural conditions. The observations offered first-hand insights into the performance and limitations of waste handling systems in different socio-geographic contexts. A structured observation checklist was used to guide data collection, focusing on aspects such as segregation at source, waste transportation, involvement of the informal sector, and the conditions of disposal sites.

Interviews: Semi-structured interviews were conducted with 25 participants, including officials from the Rwanda Environment Management Authority (REMA), Rwanda Utilities Regulatory Authority (RURA), local government representatives, recycling company operators, and informal sector waste pickers. Participants were identified using purposive and snowball sampling techniques to ensure a wide range of perspectives on the design, challenges, and impact of circular economy (CE) strategies

in Rwanda's waste management system. Interviews were held in either English or Kinyarwanda, based on participant preference, and were audio-recorded with prior consent. The data were transcribed and analyzed thematically.

Policy and Document Review: Relevant national policies and institutional reports were reviewed to contextualize Rwanda's waste management practices within existing legal and regulatory frameworks. Key documents included:

- **Rwanda Vision 2050**
- **National Environment and Climate Change Policy (2020)**
- **Organic Law on Environmental Protection and Management (2005)**

These documents were critically analyzed to understand the extent to which Rwanda's policy framework supports circular economy objectives such as waste minimization, recycling, and sustainable resource use. Supplementary documents from REMA, RURA, and local government bodies were also examined to identify institutional roles and implementation strategies.

Ethical Approval

The study was conducted in accordance with established ethical standards. Ethical approval was obtained from the University of Rwanda College of Science and Technology Research Ethics Committee, under approval number UR-CST/REC/2025/042. All participants received information regarding the study's purpose, procedures, and data usage. Informed consent was obtained from all interviewees, with assurances of confidentiality and anonymity. Particular care was taken to ensure voluntary participation and protect the rights of informal sector participants. All data were securely stored and used exclusively for academic purposes.

Limitations

This study acknowledges several limitations.

There was restricted access to up-to-date data on waste volumes in rural regions, where data collection and reporting mechanisms are often underdeveloped. Furthermore, information concerning the informal waste sector remains fragmented, complicating efforts to evaluate its full contribution to the circular economy. Logistical challenges, including limited access to certain remote areas due to poor infrastructure, also constrained fieldwork

coverage and may have affected the representativeness of the rural findings. Site visits were conducted in selected urban areas (e.g., Kigali and Huye) and rural districts (e.g., Nyamagabe and Gicumbi) to observe waste generation, collection, segregation, and disposal practices. These observations offered first-hand insights into the performance and limitations of waste handling systems in diverse socio-geographic contexts.

Results

Table 1: Waste Management Landscape Dynamics in Rwanda.

Aspect	Urban Areas (e.g., Kigali)	Rural Areas (e.g., Nyamagabe, Gicumbi)
Daily Waste Generation	Approximately 1,000 tons (about 50% of total national waste)	Approximately 1,000 tons
Waste Composition	Over 60% organic matter, plastics, paper, metals	Mostly biodegradable agricultural residues
Economic Context	Diverse urban economy	Agrarian -based local economies
Waste Management Infrastructure	Organized waste collection systems, private firms contracted	Minimal formal waste collection; reliance on informal methods
Disposal Practices	Sanitary landfills and some open dumping	Burning, open dumping, composting common

Source: Author's Survey 2025

Waste Management Landscape in Rwanda

Rwanda has developed a progressive framework for waste management that aligns with its broader goals of environmental sustainability and public health. Nevertheless, disparities exist between urban and rural areas in terms of waste generation patterns, infrastructure, and institutional capacity.

Types and Volume of Waste Generated:

Rwanda generates approximately 2,000 tons of municipal solid waste daily, with Kigali contributing nearly 50% of the total [24]. Waste in urban areas is composed primarily of organic matter (over 60%), along with plastics, paper, and metals,

while rural areas produce a higher proportion of biodegradable agricultural residues due to the agrarian nature of their economies (Rwanda Environment Management Authority [REMA], 2021) as depicted in Table 1.

Existing Waste Collection and Disposal Systems:

In Kigali, waste collection is coordinated by private firms contracted through local authorities, achieving relatively high collection coverage but in 2025, Kigali City terminated contracts with several sanitation companies and replaced them with newly formed youth cooperatives, aiming to enhance service delivery and community involvement as seen in plate 1.



Plate 1: Newly Formed Youth Cooperatives Waste Collectors
Source: Author's Survey, 2025

partnerships as mechanisms for achieving zero-waste goals.

Discussion

a. Circular Economy Principles and Applications

The concept of a circular economy (CE) represents a transformative shift from the traditional linear “take-make-dispose” model to a system designed for regeneration and resource efficiency. Unlike the linear economy, which is inherently wasteful and dependent on the continuous extraction of raw materials, the CE approach emphasizes keeping materials in use for as long as possible, extracting maximum value before recovery and regeneration (Geissdoerfer *et al.*, 2017).

Circular Economy vs. Linear Economy

In the linear economy, products are designed for short-term use with little consideration for post-consumption stages. This model contributes to environmental degradation, greenhouse gas emissions, and rapid resource depletion (Korhonen *et al.*, 2018). In contrast, the CE model seeks to eliminate waste and pollution through sustainable product design, material recirculation, and systemic innovation (Ellen MacArthur Foundation, 2019). Rwanda's adoption of CE strategies is driven by the need to manage increasing waste volumes, conserve scarce land resources, and achieve long-term sustainability goals.

Key CE Strategies: Reduce, Reuse, Recycle, Recover

At the core of CE implementation are the “4Rs”: reduce, reuse, recycle, and recover. Each of these pillars plays a crucial role in Rwanda's integrated solid waste management strategy.

- **Reduce:** Focuses on minimizing waste generation through behavioral change and efficient production practices. In Rwanda, policies such as bans on plastic bags

and single-use plastics have substantially reduced the influx of non-biodegradable waste.

- **Reuse:** Efforts to promote reusable products, especially in packaging and household items, have been seen in urban retail and hospitality sectors.
- **Recycle:** Kigali has witnessed the emergence of startups and cooperatives engaged in plastic and electronic waste recycling, helping transform waste into construction materials and reusable items.
- **Recover:** Waste-to-energy initiatives are increasingly being implemented. For example, the Kigali Waste-to-Energy project converts organic waste into electricity and compost, delivering both environmental and economic benefits (World Bank, 2020).

These strategies form the backbone of CE implementation in Rwanda, creating a systematic approach to material management and waste minimization.

Benefits of the Circular Economy

The benefits of CE are wide-ranging: Environmental benefits: CE reduces resource extraction and pollution, lowering greenhouse gas emissions and improving ecosystem health. Rwanda's emphasis on recycling and composting helps cut methane emissions from landfill decomposition while reducing the need for raw material extraction (Ministry of Environment, 2020).

Economic benefits: Circular economy (CE) creates new markets, fosters innovation, and enhances economic resilience. A 2022 study by the United Nations Development Programme (UNDP) highlighted that Rwanda's circular initiatives have generated employment in recycling cooperatives and eco-friendly manufacturing sectors (UNDP, 2022).

Social benefits: CE improves urban

cleanliness, public health, and overall community well-being, particularly in low-income areas previously affected by unmanaged waste and pollution. Moreover, CE approaches offer opportunities to integrate informal waste workers into formal value chains, promoting inclusive and equitable development (Niyonzima & Nshimiyimana, 2022).

In summary, Rwanda's efforts to institutionalize circular economy principles have yielded tangible environmental and socio-economic benefits. By embracing CE, the country is not only managing waste more effectively but also laying the foundation for a regenerative, inclusive, and low-carbon future.

b. Rwanda's Circular Economy Initiatives

Rwanda has demonstrated strong leadership in transitioning toward a circular economy by developing policies and projects that convert waste into valuable resources. Several key initiatives exemplify this national strategy, combining technological innovation, policy enforcement, and community participation.

Kigali Waste-to-Energy Project

One of the most prominent circular economy initiatives in Rwanda is the Kigali Waste-to-Energy (WtE) project. Developed through a public-private partnership, the project aims to convert municipal solid waste into electricity using anaerobic digestion and incineration processes (World Bank, 2020). It is designed to process over 500 tons of waste per day and generate up to 10 MW of electricity, thereby reducing landfill burdens and contributing to Rwanda's energy mix. Beyond environmental benefits, the project also creates employment opportunities and facilitates technology transfer.

E-Waste Recycling Plant in Bugesera

Launched in 2018, Rwanda's e-waste recycling facility in Bugesera district is the

first of its kind in East Africa. Operated by Enviroserve Rwanda, the facility processes discarded electrical and electronic devices, separating hazardous components and recovering valuable materials such as copper and aluminum (REMA, 2021). In 2022, the plant processed over 5,000 tons of electronic waste, playing a vital role in preventing toxic contamination and promoting material reuse (Ministry of ICT and Innovation, 2022).

Composting in Agricultural Zones

Organic waste constitutes a large share of Rwanda's municipal waste stream, especially in rural areas. Community-led composting initiatives in districts such as Musanze and Rwamagana have helped farmers convert biodegradable waste into organic fertilizers, improving soil fertility and crop yields while reducing dependence on chemical inputs (FAO, 2021). Composting demonstrates how rural agro-waste can be repurposed to close nutrient loops and cut methane emissions from landfills.

Plastic Bans and Biodegradable Alternatives

In 2008, Rwanda became a global leader by instituting a nationwide ban on plastic bags, followed by a 2019 law banning single-use plastics (Government of Rwanda, 2019). These legal measures significantly reduced plastic pollution and stimulated demand for eco-friendly alternatives. Companies like EcoPlastics Rwanda now produce biodegradable packaging materials from cassava and banana fibers, supported by fiscal incentives and government procurement policies. Rwanda's plastics strategy serves as a model for environmental legislation grounded in circular economy principles.

These initiatives underscore Rwanda's commitment to a zero-waste future and demonstrate how tailored CE applications can address national priorities across energy, agriculture, and industry.

c. Role of Public and Private Sector (1.5 pages)

The successful implementation of Rwanda's circular economy model is rooted in a dynamic interplay between government leadership and private sector innovation. Public institutions set the regulatory tone, while private enterprises and civil society translate these frameworks into practice.

Government-Led Policies and Enforcement Mechanisms

Rwanda's government plays a pivotal role in promoting CE through comprehensive environmental laws and institutional enforcement. The Rwanda Environment Management Authority (REMA) and the Ministry of Environment are responsible for developing environmental policies, monitoring compliance, and enforcing bans and incentives. Vision 2050 and the National Environment and Climate Change Policy provide long-term guidance, setting targets for resource efficiency, sustainable waste management, and green innovation (Ministry of Environment, 2020).

Local governments also contribute by establishing waste collection systems and supporting decentralized composting and recycling initiatives. Their role is crucial in ensuring community-level engagement and aligning national policies with localized waste realities.

Role of Private Enterprises and Startups

Private companies have been central in operationalizing CE principles, especially in recycling and waste valorization. Enterprises like COPED and Agruni Ltd provide waste collection and sorting services in urban areas, often under contract with municipal authorities. Meanwhile, startups such as Zipline (medical drone delivery) and Charis UAS (agriculture monitoring) represent broader innovations aligned with circular and sustainable development goals (Rwanda Development Board, 2021).

Startups also contribute to eco-design by creating sustainable alternatives to conventional products. For example, Bamboo Rwanda produces reusable utensils, and Kigali Farms repurposes organic waste into mushroom substrates, promoting bio-based business models.

Public-Private Partnerships (PPPs) in Waste Innovation

Rwanda's strategic use of public-private partnerships (PPPs) has accelerated the development of circular waste infrastructure. The WtE project in Kigali is one example of how the government attracts foreign investment and technical expertise through concession agreements and tax incentives. Similar partnerships are found in the e-waste sector, where the government collaborates with UNIDO and private recyclers to scale processing capacity (United Nations Industrial Development Organization, 2022).

Moreover, PPPs facilitate innovation through co-funded pilot projects and incubation hubs, such as the Rwanda Green Fund (FONERWA), which supports startups and cooperatives working on sustainable solutions.

Collectively, these efforts underscore how coordinated public and private actions can institutionalize circular economy principles and drive long-term environmental sustainability.

d. Community Engagement and Education (1.5 pages)

Effective community engagement and education are central to fostering a culture of sustainability and ensuring the success of Rwanda's circular economy initiatives. Awareness campaigns, school programs, and community-based projects all contribute to creating a society that actively participates in waste reduction and resource recovery.

Role of Awareness Campaigns and School Programs

Rwanda has invested in raising public awareness about the importance of waste

management and circular economy practices. National campaigns, led by the Rwanda Environment Management Authority (REMA) and other environmental NGOs, have been pivotal in educating citizens on the need for reducing waste, reusing materials, and recycling (REMA, 2021). These campaigns, which utilize mass media, social media, and community outreach, have helped to instill a sense of environmental responsibility across diverse demographics.

School programs also play a key role in shaping the next generation's environmental consciousness. Through partnerships with schools, organizations such as the Rwanda Green Fund (FONERWA) and local government bodies have integrated waste management and circular economy concepts into school curricula (FONERWA, 2020). By introducing practical activities like waste sorting competitions and eco-clubs, these programs not only educate students but also involve families in recycling efforts, creating a ripple effect within communities.

Behavioral Change through Community-Based Sorting Initiatives

Community-based sorting initiatives have been successful in transforming waste management practices at the local level. In many urban and rural communities, local sorting schemes have been implemented, empowering residents to separate biodegradable, recyclable, and non-recyclable waste. For example, in Nyamirambo and Nyarugenge districts in Kigali, community members have been trained to segregate waste at the household level, improving the efficiency of collection and recycling processes (Government of Rwanda, 2019). These grassroots efforts contribute to a cleaner environment and reduce waste-related challenges such as landfill overflows and informal waste

dumping.

Behavioral change is further enhanced through participatory events, such as "Umuganda," a monthly community cleaning initiative that mobilizes citizens to clean public spaces and promote sustainable waste practices. The integration of waste sorting into Umuganda not only raises awareness but also provides direct hands-on experience in waste management and circular economy principles.

Capacity Building at Local Government and Household Levels

Capacity building is crucial for the long-term success of Rwanda's circular economy. Training programs targeting local government officials, waste management operators, and household leaders are essential to the effective implementation of waste management systems. Through partnerships with international organizations such as UNDP, the government has offered technical training and resource tools to local municipalities to enhance waste processing capabilities (United Nations Development Programme, 2021). At the household level, capacity-building initiatives focus on improving waste sorting and composting techniques, equipping families with the knowledge to reduce waste and recycle effectively.

e. Socioeconomic and Environmental Impacts

Rwanda's transition to a circular economy has resulted in notable socio-economic and environmental impacts. The implementation of waste management and recycling strategies has not only provided environmental benefits but also contributed significantly to job creation, public health, and greenhouse gas reduction. This growth is associated with the rural to urban migration found in most African countries, combined with low incomes and saving culture (Magaji, & Areo, 2017).

Job Creation in Recycling and Composting Sectors

The shift towards a circular economy has spurred job creation, especially in the recycling and composting sectors. Kigali's recycling initiatives, including the collection of plastic waste, paper, and electronic waste, have created employment opportunities for thousands of individuals, particularly in low-income communities (REMA, 2019). Small businesses and cooperatives focused on waste sorting, processing, and product creation (e.g., recycled plastic bags, compost) have flourished under the government's supportive policies and incentives.

In rural areas, composting initiatives have provided jobs for local residents, particularly women and youth, by involving them in organic waste collection, compost production, and soil restoration efforts. According to the Rwanda Green Fund, more than 2,000 jobs were created through community-based composting projects in 2020 alone, enhancing the socio-economic fabric of rural areas while contributing to sustainable agriculture.

Public Health Improvements Due to Reduced Waste Exposure

The adoption of circular economy practices has had a significant positive impact on public health by reducing waste-related pollution. The urgency of this public health crisis has found expression in the United Nations Millennium Development Goals, which emphasized access to safe drinking water and sanitation as key targets for improving global health outcomes (Areo *et al.*, 2019). Proper waste disposal, coupled with reduced landfill usage, has minimized the exposure of communities to harmful waste materials, including plastics and hazardous chemicals. Studies indicate that effective waste management contributes to a reduction in air and water pollution, leading

to fewer cases of respiratory and gastrointestinal diseases (FONERWA, 2020). In Kigali, improved waste management practices have led to cleaner streets and public spaces, thus reducing the spread of infectious diseases and vector-borne diseases like malaria. The reduction in waste-related health hazards has not only improved the quality of life but has also contributed to reduced healthcare costs for the government.

Reduction in Greenhouse Gas Emissions and Pollution

The environmental benefits of Rwanda's circular economy are particularly evident in the reduction of greenhouse gas emissions and pollution. With increasing demand for fuel in urban and rural areas, a market system has emerged for fuelwood products, creating new business opportunities that can reduce poverty among rural farmers who have access to savannah and forest vegetation where fuelwood is mostly found (Magaji & Areo, 2017). Through waste-to-energy initiatives and composting, the country has reduced methane emissions from landfills and minimized the environmental impact of waste disposal (World Bank, 2020).

The Kigali Waste-to-Energy project, for example, converts methane from landfills into electricity, thereby reducing both waste and harmful emissions. The government's commitment to carbon neutrality, as outlined in Vision 2050, aligns with these efforts by reducing the carbon footprint of waste management systems (Government of Rwanda, 2020).

Furthermore, the ban on single-use plastics, combined with the promotion of biodegradable alternatives, has resulted in a significant decrease in plastic pollution in Rwanda's waterways, reducing plastic contamination in soil and water. These initiatives contribute to global efforts to mitigate climate change and enhance environmental sustainability.

f. Challenges and Constraints

While Rwanda has made substantial strides in adopting circular economy (CE) practices, several challenges hinder the full-scale implementation of these strategies. These barriers range from limited infrastructure and investment in circular economy technologies to the integration of the informal waste sector and gaps in enforcement, education, and data management.

Limited Infrastructure and Investment in CE Technologies

One of the primary obstacles to scaling up CE practices in Rwanda is the insufficient infrastructure and technological investment necessary to support circular processes effectively. Despite efforts to promote recycling and composting, waste management infrastructure, particularly in rural areas, remains underdeveloped. Many rural regions still lack proper waste collection systems, processing facilities, and waste-to-energy technology, hindering efficient waste handling and processing in Rwanda remains a challenge due to limited infrastructure, fragmented coordination, and gaps in regulatory enforcement (United Nations Development Programme, 2021).

Moreover, while the government has incentivized recycling initiatives, private-sector investment in circular economy (CE) technologies remains limited. Without adequate financing for innovative technologies—such as advanced sorting systems, biodegradable plastic alternatives, or more efficient recycling plants—the country's transition to a circular economy is likely to remain slow (Rwanda Environment Management Authority, 2021). Stronger partnerships between the government, private sector, and international donors are needed to invest in these essential infrastructure components.

Informal Waste Sector Integration

Another significant challenge is integrating the informal waste sector, which plays a critical role in waste collection, sorting, and recycling, especially in urban areas. In Rwanda, waste pickers and small-scale recyclers are not always recognized as formal contributors to the waste management system. The lack of formal recognition, training, and access to resources limits their efficiency and the potential for scaling up CE practices (World Bank, 2020). Additionally, informal waste workers often face poor working conditions, inadequate safety measures, and limited access to social security benefits, which further undermines the sector's contribution to sustainable development.

Efforts to formalize and integrate informal waste sector workers into national waste management systems are crucial for ensuring inclusivity and improving the effectiveness of recycling programs. Strategies to provide waste pickers with training, better tools, and safer working conditions could enhance the efficiency of waste management and lead to improved socio-economic outcomes (Government of Rwanda, 2020).

Gaps in Enforcement, Education, and Data Management

Effective enforcement of waste management regulations remains a challenge in many parts of Rwanda. While policies such as the plastic ban have been successful in Kigali and other urban centers, enforcement remains inconsistent in rural areas and informal settlements. Inconsistent enforcement of waste segregation at the source and a lack of accountability in waste disposal undermine the broader goals of reducing waste and increasing recycling rates (FONERWA, 2020). Additionally, data management systems to track waste generation, recycling rates, and resource recovery remain underdeveloped. This hampers efforts to monitor the

effectiveness of existing policies and identify areas for improvement.

In the realm of education, although awareness campaigns have increased public knowledge of waste management and circular economy principles, more work is needed to cultivate lasting behavioral change. Many communities, especially in rural areas, still lack comprehensive understanding of the long-term benefits of CE and waste reduction. Therefore, there is a need for more robust and sustained educational efforts, particularly in remote areas, to foster widespread acceptance and adoption of circular economy practices (Ministry of Environment, 2022).

Recommendations

Strengthen CE Policy Frameworks and Financing Mechanisms It is essential to develop and strengthen policy frameworks that foster the growth of the circular economy in Rwanda. This includes providing clear guidelines for waste management practices, incentivizing private-sector investments in circular economy technologies, and ensuring that enforcement mechanisms are consistently applied across urban and rural areas (GIZ, 2023). Additionally, the government should expand financing mechanisms, such as grants or low-interest loans, to encourage private-sector investment in recycling and waste-to-energy technologies, particularly in underdeveloped areas (Green Fund, 2024).

Promote Innovation and SMEs in Recycling Supporting small and medium-sized enterprises (SMEs) and innovative startups in the recycling sector is critical for creating sustainable economic opportunities. By providing training, access to capital, and technical support, the government can help foster innovation in the recycling industry, leading to new technologies and business models that make recycling more efficient

and economically viable. These efforts could also address the underutilization of recyclable materials and expand the role of SMEs in the circular economy (Impact Hub Kigali, 2025).

Enhance Data Collection and Monitoring Tools Improved data collection and monitoring tools are vital to track progress, identify gaps, and assess the effectiveness of circular economy practices. The establishment of a national waste management database would provide valuable insights into waste generation patterns, recycling rates, and resource recovery efforts. This data would inform policy decisions and allow for targeted interventions where needed. Moreover, it would improve transparency and accountability in waste management systems, ensuring that stakeholders can measure progress and outcomes effectively (National Institute of Statistics of Rwanda, 2024).

Expand Public Education on Circularity To ensure the long-term success of circular economy practices, there is a need for a comprehensive national education campaign focused on circularity. This should involve not only formal education in schools but also public awareness campaigns that promote waste segregation, recycling, and the environmental and economic benefits of circular economy principles. Community-based initiatives should be expanded to reach rural areas and engage local communities in practical, hands-on waste management activities (Ministry of Environment, 2022). Such initiatives would help foster a culture of sustainability across the country, encouraging citizens to adopt more environmentally conscious behaviors and practice.

Conclusion

Rwanda's commitment to environmental sustainability is increasingly evident through its adoption of circular economy (CE) principles, which emphasize waste

minimization, resource efficiency, and the reduction of environmental impacts. The findings from this study indicate that Rwanda has made significant strides in implementing circular economy practices, particularly through initiatives like waste-to-energy projects, recycling programs, and the promotion of biodegradable alternatives. However, despite these efforts, several challenges persist, including limited infrastructure, informal sector integration, and gaps in enforcement and education.

The successful case studies, such as the Kigali Waste-to-Energy project and the composting initiatives in agricultural zones, demonstrate the potential of circular economy models to transform waste management and contribute to both environmental and socio-economic benefits. These initiatives not only reduce pollution but also create new economic opportunities, including job creation in the recycling and waste management sectors. The socio-economic benefits of a circular economy, such as improved public health and increased income generation, further highlight the importance of scaling up these efforts for sustainable development in Rwanda.

Policy and Practice Implications

The findings of this paper underscore the need for enhanced policy frameworks and financial mechanisms to support the transition to a circular economy. Clearer policies, along with consistent enforcement mechanisms, will be crucial in fostering a culture of sustainability across the country. Additionally, encouraging private-sector involvement through incentives for innovation, coupled with strengthened partnerships, will drive the development of circular economy technologies and practices. Public awareness and education campaigns are also vital in shifting public attitudes toward waste management,

ensuring that citizens and businesses adopt sustainable practices at the grassroots level.

A key implication for practice is the need to better integrate the informal waste sector into the formal waste management system. The recognition, training, and support of waste pickers and small-scale recyclers will help improve the efficiency and sustainability of waste management initiatives across the country. Furthermore, strengthening data collection and monitoring systems will enable the government and stakeholders to measure progress and ensure the successful scaling of circular economy practices.

Call to Scale and Institutionalize Circular Economy Approaches

To achieve long-term sustainability, Rwanda must scale up its circular economy initiatives across all sectors and institutionalize these practices within national policies. This includes expanding the use of waste-to-energy technologies, increasing recycling rates, and integrating circularity into agriculture and manufacturing. Institutionalizing circular economy approaches would ensure that Rwanda is not only addressing immediate waste management challenges but also contributing to broader global sustainability goals.

The urgency of scaling up circular economy practices in Rwanda is clear. A systemic transition to circularity will not only reduce the environmental footprint but also unlock new economic opportunities, enhance national resilience to climate change, and improve public health. By continuing to foster innovation, strengthen policy frameworks, and build capacity at all levels, Rwanda has the potential to lead by example in the global movement towards circular economies, driving both environmental and socio-economic progress for future generations.

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