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Item Type	Article
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Citation	Rezk, M. R. A., Piccinetti, L., Salem, N., Omoruyi, T. U., & Santoro, D. (2024). Nigeria's transition to a circular economy: challenges, opportunities and future perspectives. <i>Insights into Regional Development</i> , 6(2), 11-23. https://doi.org/10.9770/ird.2024.6.2(1)
DOI	10.9770/ird.2024.6.2(1)
Publisher	UAB Sustainability for Regions
Journal	Insights into Regional Development
Download date	2026-05-17 11:54:39
Item License	https://creativecommons.org/licenses/by/4.0/
Link to Item	http://hdl.handle.net/10034/629686



Publisher
Sustainability for Regions



NIGERIA'S TRANSITION TO A CIRCULAR ECONOMY: CHALLENGES, OPPORTUNITIES AND FUTURE PERSPECTIVES*

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Received 15 February 2024; accepted 2nd May 2024; published 30 June 2024

Abstract. The concept of a circular economy (CE) is a sustainable development strategy aimed at minimising waste and maximising resource efficiency. This paper explores the transition towards a circular economy in Nigeria, providing an overview of the challenges, opportunities, and future perspectives. Nigeria is rich in natural resources and has significant economic potential. However, the country faces severe environmental, economic, and social challenges that could be met with a circular economy. Although Nigeria has abundant natural resources and great economic potential, it faces many significant environmental, economic, and social challenges that must be addressed to move to a circular economy as a viable solution. The methods used in research are based on a mixed-methods research approach; the study synthesises findings from a comprehensive literature review, case studies of Nigerian businesses adopting CE practices, and insights from a SWOT analysis conducted in consultation with experts. The conclusions of the SWOT analysis, enriched by discussions with experts, form the basis for a set of targeted recommendations. These recommendations are aimed at policymakers, business leaders, and practitioners, outlining strategic actions to overcome the identified barriers and harness the opportunities inherent in a circular economy. This paper contributes to the scholarly discourse on sustainability and serves as a practical guide for other developing countries navigating the transition to a circular economy. It underscores the urgency and feasibility of adopting circular economy principles in Nigeria, highlighting the path towards a more sustainable, efficient, and economically robust future. In the study, prospects for Nigeria to benefit from include increased resource efficiency, job creation, economic diversification, and environmental sustainability if the circular economy approach were applied.

Keywords: Circular Economy (CE); Sustainable Development; Nigeria; SWOT Analysis

Reference to this paper should be made as follows: Rezk, M.R.A., Piccinetti, L., Salem, N., Omoruyi, T.U., Santoro, D. 2024. Nigeria's transition to a circular economy: challenges, opportunities and future perspectives. *Insights Into Regional Development*, 6(1), 11-23. [http://doi.org/10.9770/IRD.2024.6.2\(1\)](http://doi.org/10.9770/IRD.2024.6.2(1))

JEL Classifications: Q10, Q32, Q5, O1; O3

Additional disciplines: ecology and environment

* This research was supported and funded by Nigeria circular Hub project

1. Introduction

The conservation of natural resources has become a rising global concern in recent years, and the concept of Circular Economy (CE) has gained significant prominence due to its comprehensive nature, encompassing a wide range of related concepts. Circular economy is a framework that seeks to reduce waste and pollution and maximise the value of products and materials by sharing, leasing, reusing, repairing, refurbishing, and recycling them (Rezk et al., 2023; Kirchherr et al., 2023). Achieving a circular economy will require transformation throughout the supply chain and significant involvement of all the key actors, including government, business, researchers, and consumers, with the goal of achieving economic sustainability; the circular economy model works at three different levels: micro (products, businesses, and customers), macro (eco-industrial parks), and macro (cities, regions, countries, and beyond). This means fostering social advancement (the creation of jobs), environmental innovation (renewable energy, urban mining), and GDP growth to create economic prosperity (Xavier et al., 2021). Such models and new infrastructure and practices are based on new emerging principles that call for developing new models with flexibility in dealing with location-specific barriers (Giorgi et al., 2022; Feldman et al., 2024).

Globally, the circular economy is increasingly recognised as crucial for sustainable development. It offers an opportunity to address environmental issues and promote economic growth, job creation, and competitiveness. Countries and businesses worldwide are adopting circular economy practices to transform production and consumption patterns, leading to innovative business models and strategies prioritising sustainability (Grzymala, 2023; Zăpucioiu et al., 2023). The adoption of circular economy principles across Africa varies significantly by country and region, with many countries still in the early stages of integrating these concepts into their economies. (Desmond and Asamba, 2019). The traditional linear economic model predominates and is characterised by significant resource extraction, consumption, and waste generation. However, there is growing awareness of the benefits of a circular economy, including reduced environmental pressure, enhanced energy efficiency, job creation, and increased competitiveness on the global stage. The application of Circular Economy (CE) principles in Africa primarily targets alleviating poverty, mitigating environmental pollution, and diminishing inequality, aligning with several Sustainable Development Goals (SDGs). Current studies indicate a beneficial correlation between the implementation of CE strategies and the advancement towards achieving specific SDGs (Valverde & Avilés-Palacios, 2021; Andersen et al., 2021). In addition to a few studies from South Africa (Mativenga et al., 2017; Godfrey et al., 2021), Kenya (Koech & Munene, 2019), Nigeria (Ezeudu et al., 2021; Suleman et al., 2023) and Egypt (Rezk et al., 2023).

Nigeria is a developing West African country with enormous prospects, specifically regarding natural resources and human capital potential. It has a great endowment in crude oil and natural gas, solid minerals, and vast and suitable land for agriculture, water, and forest resources (Ezeudu & Ezeudu, 2019). Nigeria is the sixth most populous country in the world, with a population of more than 230 million. According to the United Nations Population Fund, this number is expected to reach 400 million by 2050. The demographics of Nigeria's population showed that 63 per cent is currently 24 years or younger. Nigeria's performance on the Environmental Performance Index 2022 underscores the country's pressing environmental challenges, including issues related to air and water quality, ecosystem degradation, and the urgent need for enhanced policies and actions to mitigate climate change impacts and improve overall environmental health and ecosystem vitality. It ranked 162 of 180 countries in terms of waste management performance; Nigeria's Environmental Performance Index 2022 data also indicates challenges in this area (Wolf et al., 2022). The country ranked 152 of 180 (scored 12.7 out of 100) in waste management (Figure 1), specifically under the controlled solid waste category. This score reflects the broader issues related to Nigeria's waste collection, recycling, and disposal practices. Nigeria's poor waste management score emphasises the necessity of a circular economic ecosystem.

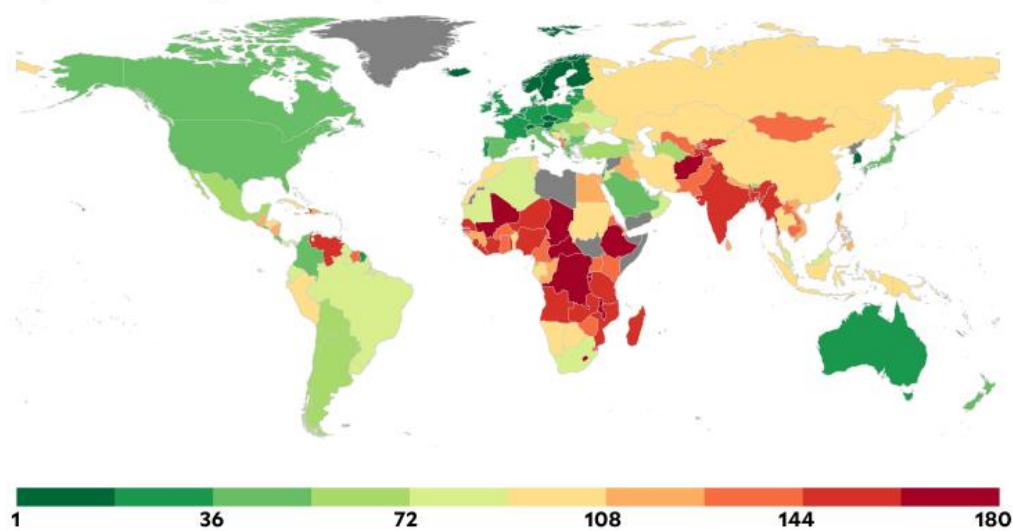


Fig. 1. Global Rankings on Waste Management in Environmental Performance Index 2022
Source: Wolf et al., 2022

Nigeria produces an estimated 32 million tons of solid waste annually, with only about 20-30 per cent of it being collected and managed correctly. At the same time, the rest ends up in landfills, sewers, beaches and bodies of water. Lagos, Nigeria's most populous city, with an estimated population of 24 million, generates more than 13,000 tons of waste daily (Table 1), according to the Lagos State Waste Management Agency (Lagos Waste Management Authority (LAWMA), 2024). According to World Bank (World Bank, 2023), Nigeria was found to be both the largest producer of plastic products and the biggest importer of plastic parts and products, accounting for 2.7 per cent of the global total, in addition to being the West African region's only producer of virgin plastic resin.

According to a survey by the United Nations Food and Agriculture Organisation (FAO), the global estimate of agricultural waste produced yearly is approximately 998 million tonnes, over 40 per cent of the two billion tonnes of global waste generated annually. Agriculture contributed to 22.35 per cent of the total gross domestic product, and over 70 per cent of Nigerians engaged in the agriculture sector mainly at a subsistence level. Nigeria has 70.8 million hectares of agricultural land area, with maize, cassava, guinea corn, yam beans, millet and rice being the major crops (FAO,2024). The average agrifood lost/wasted in Nigeria was an estimated 56.9 ± 3.3 MT per year, representing 32.3% of the average annual production (Afolabi et al., 2021).

Table 1. Solid waste generation rate for major cities in Nigeria

City	Geo-political region	Per capita waste generation (kg/capita/day)	Organic waste component (%)
Abuja	North-Central	0.634	63.6
Lagos	South-west	0.63	68
Port Harcourt	South-South	0.7	60
Kano	North-West	0.56	43
Bauchi	North-East	0.22 - 0.48	61
Enugu	South-East	0.31	58

Source: (Benjamin & Benjamin, 2023)

2. Literature review

The integration of circular economy (CE) concepts in Nigeria presents a promising approach to address the nation's waste management challenges, environmental pollution, and the goal of economic diversification. Research by Ezema et al. (2023) underscores the significance of resource optimisation and waste minimisation within the context of Nigeria's housing sector. The study advocates for adopting circular design principles to efficiently fulfil housing demands, hinting at the broader applicability of CE principles across different sectors. Further exploration into the potential of energy production from municipal solid waste in Abuja by Dickson et al. (2023) emphasises the necessity for ongoing policy and legislation reviews to foster a circular economy. Despite identifying this potential, the study points out a gap in the detailed understanding and application of CE concepts within the Nigerian context.

Despite the aspiration towards a circular economy, Thapa et al. (2022) note that Nigeria lacks specific national CE policies. While various circular platforms are present, challenges such as inadequate waste collection and the prevalence of open dumpsites hinder progress towards a fully realised circular economy. Meanwhile, Oyeboode (2022) and Ezeudu et al. (2021) both emphasise the critical need for effective waste management and stakeholder involvement to achieve a cleaner environment and advance towards a circular economy in Nigeria. These studies suggest a collaborative and inclusive approach involving government, businesses, and communities is essential for success.

Ezeudu et al. (2021) also highlight the potential of co-production efforts in solid waste management to promote the circular economy. They propose strategies such as implementing extended producer responsibility, establishing eco-industrial parks, and integrating informal waste recyclers as pathways to enhance circularity in waste management practices. The findings provided by Mokuolu & Timothy (2021) highlight the importance of Nigeria's shift from a linear to a circular economy. Their study illuminates the circular economy and waste management practices during the COVID-19 pandemic in Nigeria, stressing the critical need to adopt circular economy principles and practices amidst such global crises. This perspective underscores the resilience and sustainability benefits a circular economy can provide, particularly in unforeseen challenges.

Ezeudu & Ezeudu (2019) detail the complexities of implementing circular economy ideas in Nigeria's manufacturing sector. They present an analysis that balances the challenges against the opportunities, suggesting that while the transition poses significant hurdles, the long-term benefits include enhanced sustainability, reduced environmental impact, and potentially more excellent economic stability and growth. Their work posits that careful planning, policy support, and stakeholder collaboration are essential to navigate these challenges and capitalise on the opportunities for circular economy implementation. Dunmade et al. (2019) assess the influence of existing policies on resource utilisation and exploitation, along with engineering practices, in advancing Nigeria's move towards a circular economy. They underline the significant role governmental and policy frameworks play in enabling this shift. The study calls for enhancements in policies and engineering education to support the adoption of circular economy concepts within the country. By emphasising the need for policy reform and more comprehensive engineering training, Dunmade and colleagues suggest that such changes are essential for facilitating Nigeria's transition to a more sustainable economic model that prioritises resource efficiency and environmental sustainability.

Ogunsanwo & Ayo-Balogun (2020) examine the transformative potential of adopting a circular economy in Nigeria, highlighting its importance for achieving sustainable development. The study emphasises the shift from a linear to a circular economy model, prioritising the continuous use, recycling, and recovery of resources as crucial for environmental sustainability and economic growth. They identify the recycling sector as key to driving this economic shift and argue for government support in enhancing recycling initiatives. Ogunsanwo & Ayo-Balogun

propose that the government can play a significant role in adopting circular economy practices by recommending policy interventions, incentives, and education. This approach is essential for reducing environmental impact and bolstering economic stability against global sustainability challenges.

Abbas et al. (2022) delve into the impact of sustainability practices on supply chain resilience, highlighting how developing a circular economy in Nigeria can enhance this resilience. This research indicates the transformative potential of CE practices in strengthening supply chains against disruptions. Zuofa et al. (2022) focus on the construction sector, particularly small and medium-sized enterprises (SMEs), illustrating how circular economy principles such as reusing, repairing, and recycling can benefit the built environment. This approach addresses waste reduction and contributes to resource efficiency and sustainability in construction. The study examines numerous governmental efforts designed to stimulate investment in the circular economy alongside identifying both the opportunities and challenges that arise, as highlighted through a SWOT analysis.

3. Methodology

The paper uses a mixed-methods approach in its research, combining a survey of relevant literature with case studies of businesses in Nigeria that adopted the concept of the circular economy. The literature review includes data from academic journals, publications, and other relevant documents about the circular economy's concepts and how they are used in Nigeria. It also gathers and analyses the success stories of Nigerian companies that have successfully implemented the circular economy. Additionally, case studies of agricultural businesses in Nigeria that have adopted the circular economy approach are included in the research, providing specific examples of the challenges and opportunities associated with the adoption of circular economy concepts in the nation.

A SWOT analysis is carried out to pinpoint the strengths, weaknesses, opportunities, and threats related to implementing a circular economy in Nigeria, drawing upon literature reviews and discussions with experts. This analysis offers detailed insight into Nigeria's current expertise. The findings from the study are utilised to identify significant obstacles and prospects and to formulate recommendations for policy and practical actions to surmount these obstacles and leverage these opportunities. In addition, identify and discuss the success stories of companies which have applied the circular economy approach in Nigeria.

4. Results

4.1. Nigeria Initiatives and Programs for Circular Economy

Government efforts in Nigeria towards a circular economy have been directed towards creating a regulatory and policy environment that encourages waste reduction and recycling and promotes sustainable economic practices. The most critical initiatives monitored in supporting policies and procedures consistent with the principles of the circular economy in Nigeria are summarised in Table 2.

Table 2. The Main Nigeria Initiatives and Programs for Circular Economy

Initiatives and programs		References
The African Circular Economy Alliance (ACEA)	The African Circular Economy Alliance (ACEA) was established to spur Africa's transition to a circular economy at the country, regional, and continental levels. It is a collaborative platform to coordinate and link various initiatives across the continent. Nigeria, along with South Africa and Rwanda, is a founding member of the ACEA, highlighting its significant role in the alliance's formation and operations. The ACEA aims to deliver economic growth, jobs, and positive environmental outcomes by promoting a circular economy ecosystem in Africa.	(ACEA, 2024).

Initiatives and programs		References
African Circular Economy Network	Since its founding in 2018, the Nigeria Chapter of the African Circular Economy Network (ACEN) has expanded to include over 50 community members and over 3000 individuals from a founding group of 5 specialists. With the combined efforts of multiple stakeholders, the textile, water, agriculture, and energy sectors have changed the perception of circular principles. "Lagos to the world: Next steps" was the topic of a WCEF2023 Side Event organised by the ACEN Nigeria chapter. The circular economy and circularity in Nigeria's built environment were the main discussion topics at this side event.	(ACEN,2022).
Nigeria Circular Economy Working Group (NCEWG)	The Nigeria Circular Economy Working Group (NCEWG) is pivotal in promoting circular economy principles across Nigeria and is tasked with developing a national policy framework that encourages the adoption of these principles in various sectors. The NCEWG is currently coordinated by the Bank and the Government of Nigeria, which the Federal Ministry of Environment represents. Members are government, private sector, academia, and non-state actor experts.	(African Development Bank,2023).
Nigeria Circular Economy Programme (NCEP) and Road Map (NCERM)	The NCEP and NCERM are strategic frameworks designed to drive the adoption of circular economy practices in Nigeria. These documents outline the pathways for sustainable and inclusive green growth by 2030 and aim for long-term sustainability by 2050. They cover various sectors, including waste management, textiles, agriculture, and energy, with a focus on policy dialogues, project design, and implementation based on circular economy principles.	(Ajibesin, O, 2023).
Extended Producer Responsibility (EPR) Program	The Nigerian government, through the National Environmental Standards and Regulations Enforcement Agency (NESREA), has been promoting the Extended Producer Responsibility (EPR) Program. This program mandates producers to take back, recycle, or properly dispose of their end-of-life products to ensure environmental sustainability. The EPR Program represents a key strategy in transitioning towards a circular economy by reducing waste and encouraging the recycling and reuse of materials.	(NESREA,2023).
National Policy on Solid Waste Management	The Federal Ministry of Environment has developed a National Policy on Solid Waste Management, which provides a framework for managing waste in a manner aligned with circular economy principles. This policy emphasises waste reduction, reuse, recycling, and recovery as key strategies for sustainable environmental management	(FME,2022).
Green Bond Program	Nigeria launched its Green Bond Program in 2017, becoming the first African country to do so. The program aims to fund sustainable projects that address climate change and environmental degradation. Projects funded through green bonds contribute to the circular economy by focusing on sustainable agriculture, renewable energy, and waste management.	(Ministry of Environment, 2017).
Circular Economy Innovation Partnership (CEIP)	CEIP promotes Circular Economy business innovation and investment in Nigeria through research, advocacy, and program facilitation. CEIP works in close partnership with individuals and organisations who share the goal of building a cadre of local entrepreneurs with the capabilities and opportunities to develop successful circular economy ventures.	(CEIP, 2023).

4.2. SWOT analysis of CE in Nigeria

SWOT analysis was applied to identify internal factors (strengths and weaknesses) and external factors (opportunities and threats) that impact the current and future perspectives of applying a circular economy in Nigeria; for this purpose, in addition to the literature review, several experts on circular economy were consulted for the completion of the SWOT analysis.

Strengths

- Informal recycling activities and waste management policies are enablers of circular economy implementation (Ezema et al., 2023).
- Nigeria is rich in natural resources, which allows for a strong base for circular economy initiatives.
- Increasing awareness among businesses and consumers about sustainability and environmental protection in Nigeria.
- The emergence of some innovative startups that focus on recycling and sustainable practices encourages startups to invest in the circular economy.
- Government initiatives and policies supporting waste management and recycling.
- large young population capable of leading change and adopting new sustainable practices.
- Capacity for technological innovation to drive circular practices.
- Nigeria's abundant natural resources can be leveraged for recycling and repurposing, reducing the need for raw materials, and minimising environmental impact (Nzeadibe & Anyadike, 2010).
- Growing interest in promoting local manufacturing, which can be in line with circular economy principles.
- Increasing growth of the informal sector in waste recycling and management
- Circular economy practices can create new business opportunities and markets within Nigeria (Siagian et al., 2024)
- The growth of recycling industries in Nigeria, particularly for plastics and electronic waste, demonstrates a foundational strength in transitioning towards a circular economy.
- The strong entrepreneurial culture in Nigeria supports innovative startups focused on sustainable practices and circular economy business models.

Weaknesses

- Low adoption of circular strategies in public housing delivery in Nigeria (Ezema et al., 2023).
- Insufficient financial resources could impede the scaling up of circular initiatives.
- Inadequate infrastructure may hinder the effective implementation of circular economy practices.
- Lack of robust regulations and enforcement mechanisms may slow down progress in circular economy adoption.
- Limited expertise in circular economy principles and practices could be a barrier to implementation.
- Existing waste management challenges need to be addressed for a successful circular economy transition.
- There is a significant gap in public awareness and education regarding the benefits of the circular economy, which affects consumer behaviour and participation.
- The absence of robust policies and regulatory frameworks to support circular economy initiatives is a critical weakness.
- The unavailability of waste data.

Opportunities

- The Nigerian government's increasing interest in sustainable development and waste management presents opportunities for policy support and investment in circular economy practices.
- Advancements in recycling and waste processing technology offer opportunities to enhance efficiency and create new value chains within the circular economy framework.
- Circular economy initiatives have the potential to generate employment opportunities across various sectors.
- Adoption of circular practices can open new markets and increase competitiveness globally.
- Adoption of circular design in the construction sector to address energy crises, promote energy-efficient buildings, and reduce environmental impact (Suleman et al., 2023)
- Partnerships with international organisations and businesses can facilitate knowledge transfer and investment in a circular economy.
- Incentivising innovation in sustainable practices can drive economic growth and environmental benefits.
- Increasing global demand for sustainable products presents export opportunities for Nigerian businesses.

Threats

- Nigeria's economic volatility can impact the stability and growth of circular economy initiatives, affecting investment and sustainability.
- The country's heavy reliance on oil revenues may hinder the transition towards a more diversified and sustainable economic model, including circular economy practices.
- Resistance to change among businesses and consumers can slow down the adoption of circular economy principles.
- Environmental risks like climate change could exacerbate resource scarcity, affecting circular practices.
- Global competition in sustainable practices may pose challenges for Nigerian businesses entering the circular economy market.
- Rapid technological advancements require continuous adaptation, which could challenge some sectors in transitioning to a circular model.
- Barriers to the transition and implementation of a circular economy in municipal solid waste management including weak legislation, poor funding, and a lack of strategic planning (Onungwe et al., 2023)

4.3. Nigerian circular economy companies' success stories

Kaltani is one of the most successful companies in Nigeria. In the face of the escalating global plastic crisis, Kaltani emerges as a pioneering clean-tech entity dedicated to mitigating plastic pollution and municipal solid waste. Kaltani collaborates with a network of post-consumer waste collectors and post-production waste suppliers to gather a specific range of plastic materials. The collection focus includes PET plastics, such as water and soda bottles; PE plastics, encompassing cooking oil containers, shampoo and soap bottles, laundry detergents, and pure water sachets; and PP plastics, including bottle tops, margarine tubs, yoghurt cups, among others. This diversified collection strategy enables Kaltani to target a broad spectrum of plastic waste, contributing significantly to its reduction (Kaltani, 2024).

Kaltani has successfully secured a \$4 million investment earmarked to enhance its production capabilities. This financial injection is strategically aimed at expanding the company's annual production capacity to 15,000 tonnes. Such an increase is a testament to Kaltani's commitment to scaling its operations, reinforcing its position as a leader in the plastic recycling and waste management sector. Kaltani's approach showcases a comprehensive and scalable model for tackling plastic pollution. Through its collaboration with waste collectors and suppliers, coupled with a significant increase in production capacity, Kaltani is setting a precedent for sustainable practices in the clean-tech industry.

Another success story is RecyclePoints. It exemplifies an effective model for addressing waste management challenges while simultaneously generating social benefits. The process begins with the collection of recyclable materials from individuals, who, in return, receive "Points". These points serve as virtual currency, empowering participants to accumulate and redeem them for a variety of household items through RecyclePoints' iRecycle store. This mechanism not only encourages recycling but also provides tangible rewards, fostering a culture of environmental responsibility in the community. Once collected, the recyclable materials undergo a thorough processing phase at RecyclePoints' Collection and Sorting HUBs (CoSoHUB). These hubs play a crucial role in the venture's operations, ensuring the recyclables are efficiently sorted and prepared for the next stage. Subsequently, the sorted items are sold to manufacturing and recycling plants, where they are transformed into raw materials for producing an array of products. These include polyester fibre, carpets, hangers, pegs, aluminium ingots, and craft paper for cartons. This upcycling process not only diverts waste from landfills but also supports the manufacturing sector with sustainable raw materials (RecyclePoints,2024).

The narratives of Kaltani and RecyclePoints underscore the pivotal role of innovative approaches and strategic partnerships in driving Nigeria's circular economy forward. Both companies have harnessed the power of collaboration, technology, and community engagement to tackle the pressing issue of plastic pollution and waste management. Their success stories offer valuable insights into the potential of circular economy practices to create sustainable environmental impacts and foster socio-economic benefits.

5. Discussion

Through the SWOT analysis of the circular economy (CE) in Nigeria, as well as the success stories of some Nigerian companies and through a comprehensive overview of the current landscape and future potential for sustainable practices in Nigeria, some future opportunities are represented in the current informal recycling activities and increasing government support. International collaborations and increased community participation should be encouraged. Some weaknesses have also emerged, including insufficient financial resources, insufficient infrastructure, and the lack of strong regulatory frameworks. There are also major challenges due to limited public awareness and experience in the principles of the circular economy, which confirms the need for focused efforts in the field of education and capacity building.

Nigeria is one of the promising African countries that has recently been interested in supporting the circular economy, which will contribute to creating job opportunities and increasing the competitiveness of Nigerian companies. Through this study, it is recommended that comprehensive educational campaigns be implemented to increase public awareness of the benefits of circular economy practices. Education must target all levels of society, from schools to companies, to build a strong culture of sustainability. There is also a need to develop targeted government and private sector financing mechanisms to support emerging companies and circular economy initiatives. This can include grants, low-interest loans and incentives for sustainable practices. There is an urgent need to establish and enforce clear regulations and standards for waste management and recycling. This should include incentives for companies to adopt CE practices and penalties for non-compliance, creating a regulatory environment that supports sustainable development.

It is also recommended that cooperation between the government, the private sector, and international partners be encouraged to exchange knowledge, technology, and best practices. These partnerships can help overcome technological and financial barriers, drive innovation and, scale successful continuing education models, and increase investment in research and development to create and adopt new technologies for waste recycling and sustainable manufacturing. This includes supporting startups and companies developing innovative solutions to CE challenges. By addressing these recommendations, Nigeria can build on its existing strengths and opportunities to overcome the challenges facing its circular economy.

Conclusion

In conclusion, this paper comprehensively explored the circular economy (CE) concept as a transformative strategy for sustainable development in Nigeria. A multi-method research approach, including a literature review, case studies and detailed SWOT analysis in consultation with experts, paints an accurate picture of the current situation, challenges and opportunities for the transition towards CE in Nigeria. The necessity and feasibility of adopting circular economy principles in Nigeria has been emphasised, highlighting the way towards a more sustainable, efficient and economically vibrant future. The prospects for enhanced resource efficiency, job creation, economic diversification, and environmental sustainability are within reach, demonstrating the circular economy as a viable solution and a necessary development for Nigeria. This study underscores the critical importance of concerted efforts among all stakeholders to adopt and implement circular economy practices, paving the way for a sustainable development model that can inspire and guide similar initiatives globally.

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Funding: This research was supported and funded by Nigeria circular Hub project

Author Contributions: Conceptualisation: *All authors* methodology: *All authors*; data analysis: *All authors*, writing—original draft preparation: *All authors*, writing; review and editing: *All authors*; visualisation: *All authors*. All authors have read and agreed to the published version of the manuscript.

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