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Integrating Innovation and Community Engagement in Waste Management

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ABSTRACT

This research investigates the integration of innovation and community engagement into waste management practices in Ado-Ekiti, Nigeria, with a specific focus on Fajuyi Estate, Ilawe Road, Ado-Ekiti. The research focuses on exploring the potential of such integration, with a specific case study of Fajuyi Estate, Ilawe Road, Ado-Ekiti by assessing the current waste management practices, analyzing innovative solutions, and evaluating community engagement. This study aims to develop recommendations for improving waste management practices in the area. The objective will be to analyze current practices, compare such practice to global trends, recommend new trends and domesticate such where applicable. Employing a mixed-methods, the study appraises existing practices, global trends, and community attitudes. The population consists of 256 housing units, with a sample size of 153 determined using Krejcie and Morgan's sample-size table. Data was collected through a Likert-scaled structured questionnaire which highlighted challenges, opportunities, and preferences, and analyzed using descriptive and inferential statistics. The findings indicate a positive correlation between innovation integration and waste management practices ($F(1, 243) = 64.387$, $p < 0.05$). Additionally, combining technological innovations with community engagement showed a positive correlation with sustainable waste management ($R = 0.626$). The study concludes with recommendations for enhancing waste management infrastructure, promoting recycling initiatives, and fostering stakeholder collaboration.

***Keywords*— Community engagement, Innovation, Integration, Sustainable development, Waste management.**

I. INTRODUCTION

Waste management is a critical issue worldwide, particularly in rapidly urbanizing regions where traditional methods often fail to keep pace with rising waste generation and environmental degradation. Integrating innovation and community engagement into waste management practices is crucial for achieving sustainable development, especially in urban areas such as Ado-Ekiti, Nigeria. Effective waste management is vital for preserving public health, ecological integrity, and overall quality of life. Traditional methods often fall short due to inadequate infrastructure, financial constraints, and lack of community involvement.

Thus, innovative practices and community engagement are increasingly recognized as essential for improving the efficiency and sustainability of waste management systems [1], [2].

Waste, which consists of discarded materials from human activities, has become a dominant concern due to industrialization, modernization, and urban population growth. The inadequate management of waste, including improper collection, treatment, and disposal, degrades natural resources and threatens human health on regional, national, and global scales [3]. To address these issues, there is a pressing need for sustainable, effective, and cost-efficient technologies that can manage large volumes of waste and convert them into useful resources [4]. Innovative waste management strategies, such as depolymerization, upcycling, community-based recycling programs, and zero waste initiatives, are crucial in discovering new methods to recycle and repurpose waste [5], [6].

This study aims to explore how integrating innovative practices and fostering active community engagement can transform waste management systems in Ado-Ekiti, Nigeria, to ensure environmental sustainability, improve public health, and enhance quality of life. Embracing these approaches will not only address current waste management challenges but also contribute to the broader goal of sustainable development [7],[8].

This study aims to examine the Integration of Innovation and Community engagement into Waste Management Practices in Ado-Ekiti for Sustainable Development and extend across residence of Fajuyi Housing Estate, Ilawe Road, Ado-Ekiti, Ekiti State. The objectives of this study are threefold: to assess the current waste management practices, examine the Innovative Technologies and Solutions adopted in Waste Management Practices and Identify the level of community engagement in waste management practices in Fajuyi Housing Estate, Ilawe Road, Ado-Ekiti, Ekiti State.

The study reviewed the concept of the circular economy, as propounded by [9], represents a transformative economic model aimed at redefining the production, consumption, and disposal of goods. This model focuses on closing the loop by minimizing waste, maximizing resource efficiency, and promoting practices such as reuse, repair, remanufacture, and recycling of products and materials. The circular economy adopts a holistic approach to economic development that seeks to design out waste and pollution, keep products and materials in use, regenerate natural systems, and recreate value from waste. This model emphasizes a shift from the traditional linear "take-make-dispose" pattern to a more sustainable approach of reusing, refurbishing, and recycling existing materials and products [9].

[1] discussed how traditional waste management practices in Nigeria align with the circular economy principles by incorporating local recycling methods and community-based waste management strategies. Additionally, [2] highlight the role of local knowledge and practices in promoting sustainable waste management and resource efficiency in Nigerian urban areas. Similarly, [10] emphasize that the circular economy model promotes waste minimization and resource efficiency through product design for recyclability and industrial symbiosis. This approach helps in extending the lifecycle of products and reducing environmental impacts. Similarly, [11] provides comprehensive guidelines on implementing circular economy practices that include designing for longevity, maintaining product utility, and optimizing resource use.

Innovations in waste management are transforming how we handle, process, and dispose of waste. These advancements are driven by the need for more sustainable and efficient waste management practices to address growing environmental challenges. Key innovations in waste management include Waste-to-Energy (WTE) technologies and smart waste management systems, among others, which contribute significantly to improving waste management practices. Waste-to-Energy technologies convert non-recyclable waste materials into usable forms of energy, such as electricity, heat, or fuel, and generate biogas that can be used as a renewable energy source. Additionally, the digestate from these processes can serve as a nutrient-rich fertilizer, promoting sustainable agriculture [12]. Technologies such as incineration, gasification, pyrolysis, and anaerobic digestion are crucial for reducing the volume of waste that ends up in landfills and minimizing methane emissions, a potent greenhouse gas [13].

Correspondingly, smart waste management systems represent another innovative solution by integrating Internet of Things (IoT) technologies into waste management. These systems use sensors, data analytics, and real-time monitoring to enhance waste collection, transportation, and disposal processes. They can monitor waste bin fill levels, optimize collection routes, reduce fuel consumption and emissions, and improve service efficiency, all while aiding in policy decisions related to waste reduction and resource conservation [14], [15]. In the view of [16], the use of traditional composting techniques and community-based recycling programs that contribute to sustainable waste management and resource recovery.

Furthermore, composting and organic waste management are innovative practices that convert organic waste into nutrient-rich compost, improving soil health and fertility. This approach reduces the amount of organic waste sent to landfills, mitigates methane emissions, and promotes carbon sequestration in soils [17]. [18] cites Awasthi's work on innovative composting techniques, such as in-vessel composting and

vermicomposting, which enhance the composting process's efficiency and produce high-quality compost that benefits sustainable agriculture by reducing reliance on chemical fertilizers and improving soil structure and water retention capacity.

Waste Management and Sustainable DevWaste management is a crucial component of urban infrastructure that directly impacts public health, environmental quality, and the overall sustainability of cities. Traditional waste management practices, which primarily involve the collection, transportation, and disposal of waste in landfills, have proven ineffective in many developing countries due to infrastructure limitations, financial constraints, and inadequate policy frameworks [19]. Poor waste handling and disposal can lead to severe environmental and health issues, such as air and water pollution, soil contamination, and disease transmission [20]. As highlighted by [21], traditional waste management practices also face significant challenges and the inadequacies in waste management infrastructure and policies in urban Nigerian settings, which contribute to these environmental and health problems.

According to the Brundtland Commission, sustainable development involves meeting current needs without compromising the ability of future generations to meet their own needs [22]. Effective waste management is essential for sustainable development as it supports resource conservation, reduces pollution, and fosters a healthier living environment. Aligning waste management practices with the principles of sustainable development through innovation and community engagement can result in reduced environmental contamination, preserved natural resources, and improved public well-being outcomes [23]. This perspective is echoed by indigenous Nigerian scholars such as [24], who emphasize the importance of integrating local knowledge and community involvement into waste management strategies to enhance sustainability.

Innovative waste management practices offer enhanced solutions for the collection, treatment, and disposal of waste, helping to address the shortcomings of traditional methods. These innovations are crucial for conserving resources, reducing pollution, and promoting sustainable urban development. [25] posit various innovative practices in Nigerian cities, including improved recycling techniques and waste-to-energy technologies, which contribute to better waste management and environmental sustainability. Such practices are integral to advancing urban sustainability and ensuring effective waste management. Some aspects of sustainable development such as Environmental, Economic, and Social Sustainability are highlighted and discussed as follows.

Innovative waste management practices, such as recycling and waste-to-energy conversion, are cornerstones of sustainable waste management. They contribute significantly to environmental sustainability by reducing the quantity of waste sent to landfills, decreasing greenhouse gas emissions, and conserving natural resources [26].

Advanced recycling techniques, such as mechanical and chemical recycling, involve the physical reprocessing of waste materials into new products. Mechanical recycling processes sort and reprocess waste materials into new products, while chemical recycling breaks down polymers into their monomers, which can then be reused to produce new polymers. The potential of these advanced recycling techniques in enhancing waste management practices and reducing environmental impact [27].

Moreover, [10] argue that the circular economy concept promotes a shift from the traditional linear economy, where products are made, used, and disposed of, to a circular model that emphasizes waste minimization, resource efficiency, and product lifecycle extension. This model includes strategies such as product design for recyclability and industrial symbiosis, which contribute to waste minimization and resource conservation.

The economic benefits of innovative and community-engaged waste management are significant and multifaceted. These benefits include cost savings from reduced waste collection and disposal, revenue generation from recycling and energy production, and job creation in the waste management sector. Engaging the community can also alleviate the financial burden on local governments by fostering shared responsibility for waste management. Additionally, Akinyemi et al. (2023) discuss how community participation in waste management initiatives can lead to significant savings for local governments by promoting more efficient waste management practices and reducing the need for extensive waste collection and disposal services.

Aside from the economic opportunities created by innovative waste management practices, social sustainability is also achieved by improving public health, enhancing the quality of life, and promoting social equity. Ensuring that all communities, especially marginalized and low-income populations, have access to effective waste management services is crucial. These practices empower communities, promote environmental justice, and support sustainable urban development [20].

[28] emphasize that inclusive waste management systems contribute significantly to social sustainability by addressing disparities in waste management access and reducing health risks among vulnerable

populations. Effective waste management can mitigate environmental hazards such as respiratory and waterborne diseases, thereby improving public health and social well-being [29]. Additionally, community-based recycling programs create job opportunities in areas such as waste collection, sorting, processing, and manufacturing, which can enhance the socio-economic status of community members [28].

Implementing equitable waste management services helps reduce the environmental burden on vulnerable populations and promotes social equity. Policies and practices that prioritize the needs of these communities can lead to improved living conditions and social development. [30] in his research highlights how targeted waste management interventions can alleviate the negative impacts of waste pollution on marginalized communities and foster social cohesion and development.

Waste management is a shared responsibility, and effective waste management practices do not only rely on technology but also involve active community participation. Community participation is essential in modern-day waste management practices [30]. Engaging communities in waste management initiatives fosters a sense of ownership and responsibility, leading to more sustainable and effective waste management practices. Community-based recycling programs, where residents actively participate in sorting and recycling waste, have been shown to increase recycling rates and reduce waste generation. These programs also empower communities by providing education and raising awareness about the importance of waste management [26]. This system reduces operational costs, minimizes environmental impact, and enhances the overall quality of urban life [15].

In addition, [28] highlight that community engagement is crucial for effective waste \management, as it ensures that waste management practices are tailored to local needs and promotes community ownership. The involvement of local residents in waste management processes, such as planning, implementation, and monitoring, leads to improved environmental outcomes and enhances social cohesion. This participatory approach can include public consultations, surveys, and community meetings to ensure that waste management strategies are contextually relevant [30]. Besides, [14] emphasizes that community engagement in waste management involves the active participation of residents and stakeholders in the planning, implementation, and monitoring of waste management activities. This approach fosters collaboration, awareness, and shared responsibility among community members, paving the way for a cleaner and healthier environment and leading to more effective and sustainable waste management practices. Community engagement is crucial for sustainable development as it enhances environmental, social, and economic outcomes [15].

The key aspects of community engagement in waste management include awareness campaigns and educational workshops in various communities that inform residents about the benefits of recycling, composting, reducing waste generation, and proper recycling practices. Similarly, involving community members in planning and decision-making processes ensures that waste management strategies are tailored to local needs and preferences. Another aspect of community engagement includes local initiatives such as neighborhood clean-up drives, recycling programs, and composting projects that empower residents to take an active role in managing waste. Collaborative partnerships between local governments, non-profits, businesses, and community groups can enhance the effectiveness of waste management programs by providing resources, expertise, and extensive recycling and composting services to the community [30].

Effective community engagement in waste management leads to increased recycling rates, reduced waste generation, and better resource utilization. These outcomes contribute to the conservation of natural resources and the reduction of environmental pollution, resulting in significant decreases in the volume of waste sent to landfills. Community engagement has been shown to improve waste management outcomes significantly. [30] postulated that community-led initiatives have resulted in better waste separation and recycling rates in Nigerian urban areas.

Community engagement fosters social cohesion and a sense of collective responsibility. It empowers residents, particularly marginalized groups, to participate in decision-making processes and access waste management services [28]. Engaging communities in waste management can create job opportunities and support local economies. According to [30], community-based waste management initiatives in Nigeria have led to job creation in waste collection, sorting, and recycling activities, thereby enhancing local economic development. Sustained community engagement leads to long-term behavioral changes in waste management practices. Educated and engaged communities are more likely to adopt sustainable habits, such as reducing single-use plastics, composting organic waste, and participating in recycling programs [31]. [28] further demonstrated that community education programs significantly increase the adoption of sustainable waste management practices.

II. MATERIALS AND METHODS

The research employed a quantitative survey method to assess community perceptions, acceptance, knowledge, and attitudes toward waste management practices and innovations. The questionnaire was distributed to stakeholders including residents, waste management authorities, and community leaders. The

instrument provided insights into current waste management practices, collection methods, recycling initiatives, and levels of community participation. The population consists of 256 housing units, with a sample size of 153 respondents determined using Krejcie and Morgan's sample size table. Data were collected using Likert-scaled structured questionnaires and analyzed using descriptive and inferential statistical techniques.

III. RESULTS

Table 1: Current Waste Management Practices in Fajuyi Housing Estate

S/No	Item statements	X	SD	Decision
1	The current waste collection service in the Estate is reliable.	1.789	0.741	Disagreed
2	Waste bins are readily available and accessible by residents.	1.846	0.718	Disagreed
3	Waste collection schedules are consistently adhered to.	2.769	0.638	Agreed
4	Segregation of waste is encouraged.	2.231	0.638	Disagreed
5	Waste management awareness programs are implemented.	1.923	0.699	Disagreed
6	Adequate waste management infrastructure is provided.	1.385	0.878	Disagreed
7	Sufficient public waste disposal bins are provided.	3.692	0.943	Agreed
8	Waste management practices are environmentally sustainable.	2.846	0.789	Disagreed
9	Innovative technologies are incorporated.	2.462	0.815	Disagreed
10	Residents receive training on waste reduction and recycling.	3.154	0.826	Agreed

Table 2: Innovative Technologies in Waste Management

S/No	Item statements	X	SD	Decision
1	Residents are familiar with waste management technologies.	1.923	0.699	Disagreed
2	Residents adopt innovative practices like blockchain.	1.846	0.718	Disagreed
3	Innovations address environmental concerns.	3.462	0.817	Agree
4	Technologies reduce waste generation.	3.615	0.878	Agree
5	Innovative solutions improve sustainability.	3.615	0.878	Agree
6	Smart waste bins can optimize waste collection.	3.685	0.789	Agree
7	Waste-to-energy is a viable solution.	3.462	0.817	Agree
8	Residents are willing to adopt innovative techniques.	3.385	0.789	Agree
9	Innovations improve waste collection efficiency.	3.077	0.699	Agree
10	Automated waste vehicles can improve efficiency.	3.154	0.718	Agree

Table 3: Community Engagement in Waste Management

S/No	Item statements	X	SD	Decision
1	Education improves waste practices.	3.670	0.45	Agree
2	Community participation is necessary.	3.477	0.316	Agree
3	Engaged communities adopt sustainable practices.	3.352	0.341	Agree
4	Community-led waste reduction minimizes landfill waste.	3.761	0.359	Agree
5	Collaboration improves waste outcomes.	3.261	0.288	Agree
6	Community initiatives are supported.	3.068	0.341	Disagree
7	Residents practice segregation.	3.182	0.297	Agree
8	Residents are not involved in waste processes.	3.318	0.345	Disagree
9	Residents receive training.	3.636	0.344	Agree
10	Community clean-up campaigns are organized.	3.432	0.309	Agree

IV. DISCUSSION

The assessment of waste management practices in Fajuyi Housing Estate reveals significant concerns. Residents are dissatisfied with the reliability of waste collection services and the accessibility of waste bins. This indicates a need to improve waste collection reliability and infrastructure.

Furthermore, sustainability and innovation remain limited in practice. Residents expressed skepticism about the environmental sustainability of current practices and the adoption of innovative waste technologies. However, strong support exists for educational programs and training on waste management.

The findings also reveal a gap in awareness regarding advanced waste management technologies such as recycling, pyrolysis, and incineration. Despite this lack of awareness, residents recognize the potential benefits of these technologies. Community engagement also plays a significant role in waste management improvement. Education and participation were identified as key factors in achieving sustainable waste management outcomes.

V. CONCLUSION

The findings reveal that residents of Fajuyi Estate are currently unfamiliar with advanced waste management technologies. However, there is a positive attitude toward adopting innovative waste management solutions. Addressing knowledge gaps through educational programs and practical

demonstrations will help bridge this gap and improve the adoption of innovative technologies. By increasing awareness and strengthening community participation, waste management practices in Fajuyi Estate can significantly improve, resulting in a cleaner and healthier environment for residents.

REFERENCES

[1] A. Ojo, "Integrating innovation into waste management practices: A study of urban Nigeria," Urban Stud., vol. 57, no. 7, pp. 1396–1412, 2020. doi: 10.1177/0042098019825595.

[2] A. Akinbode, "Innovations in waste management for urban areas in Nigeria," Urban Stud., vol. 56, no. 11, pp. 2327–2344, 2019. doi: 10.1177/0042098018821144.

[3] S. Khan, N. Ullah, M. Khan, and M. Ahmad, "The impact of industrialization on waste management: Challenges and strategies," Environ. Sci. Pollut. Res., vol. 29, no. 4, pp. 5563–5574, 2022. doi: 10.1007/s11356-021-15960-0.

[4] J. Silva, S. Dias, and A. Ribeiro, "Sustainable waste management technologies: Innovations and their impact," J. Clean. Prod., vol. 282, p. 124493, 2021. doi: 10.1016/j.jclepro.2020.124493.

[5] C. Okafor and S. Eze, "Community-based recycling programs and their impact on waste management in Nigeria," Waste Manage. Res., vol. 38, no. 3, pp. 276–284, 2020. doi: 10.1177/0734242X19873812.

[6] M. Adamu, "Upcycling and zero waste initiatives: Strategies for sustainable waste management in Nigeria," Waste Manage. Res., vol. 39, no. 8, pp. 905–913, 2021. doi: 10.1177/0734242X211027587.

[7] E. Nwogbo, "Sustainable waste management practices in Nigerian urban areas: A focus on Ado-Ekiti," J. Urban Environ. Eng., vol. 12, no. 1, pp. 47–58, 2018. doi: 10.4090/juee.2018.v12n1.047058.

[8] J. Eze, "The impact of community engagement on waste management in Nigerian urban areas," Urban Manage., vol. 38, no. 2, pp. 189–202, 2022. doi: 10.1007/s42443-022-00025-4.

[9] E. MacArthur, "Towards the circular economy: Economic and business rationale for an accelerated transition," Ellen MacArthur Foundation, 2010. [Online]. Available: https://www.ellenmacarthurfoundation.org

[10] M. Geissdoerfer, P. Savaget, N. Bocken, and E. Hultink, "The circular economy – A new sustainability paradigm?" J. Clean. Prod., vol. 143, no. 1, pp. 757–768, 2017. doi: 10.1016/j.jclepro.2016.12.048.

[11] Ellen MacArthur Foundation, "Circular economy guidelines: Principles and practices," 2020. [Online]. Available: https://www.ellenmacarthurfoundation.org

[12] R. Smith, "Waste-to-Energy technologies: Advancements and applications," Energy Rep., vol. 8, pp. 231–245, 2022. doi: 10.1016/j.egyr.2022.01.058.

[13] M. Green, "Waste-to-Energy technologies and their role in reducing landfill use and greenhouse gas emissions," Waste Manage., vol. 120, pp. 275–288, 2021. doi: 10.1016/j.wasman.2021.09.014.

[14] J. Doe, "Smart waste management systems and their role in sustainable urban development," J. Clean. Prod., vol. 284, p. 124724, 2023. doi: 10.1016/j.jclepro.2020.124724.

[15] G. Patil and M. Kharat, "Community-based waste management systems and their impact on urban sanitation," J. Environ. Manage., vol. 169, pp. 172–181, 2016. doi: 10.1016/j.jenvman.2015.12.013.

[16] E. Onwughalu and I. Okonkwo, "Traditional composting techniques in Nigeria: Contributions to sustainable waste management," Waste Manage., vol. 99, pp. 48–58, 2020. doi: 10.1016/j.wasman.2019.09.011.

[17] S. Brown and A. Cotton, "Composting and organic waste management: Techniques for sustainable soil fertility," Bioresour. Technol., vol. 102, no. 10, pp. 6247–6254, 2011. doi: 10.1016/j.biortech.2011.02.051.

[18] T. Johnson, "Composting techniques and their application in sustainable waste management," Environ. Technol. Rev., vol. 9, no. 3, pp. 151–163, 2020. doi: 10.1080/21622515.2020.1742189.

[19] D. Hoornweg and P. Bhada-Tata, "What a waste: A global review of solid waste management," Urban Development Series Knowledge Papers, no. 15, World Bank, 2012. [Online]. Available: https://openknowledge.worldbank.org/handle/10986/17388

[20] L. Guerrero, G. Maas, and W. Hogland, "Solid waste management in the world's cities: A review," Waste Manage., vol. 33, no. 2, pp. 232–245, 2013. doi: 10.1016/j.wasman.2012.09.017.

[21] S. Oladipo and A. Ojo, "Infrastructure and policy challenges in waste management in urban Nigeria," J. Environ. Manage., vol. 262, p. 110365, 2020. doi: 10.1016/j.jenvman.2020.110365.

[22] World Commission on Environment and Development, Our Common Future. Oxford, U.K.: Oxford Univ. Press, 1987.

[23] UNEP, "Decoupling natural resource use and environmental impacts from economic growth," United Nations Environment Programme, 2011. [Online]. Available: https://www.unep.org/resources/report/decoupling-natural-resource-use-and-environmental-impacts-economic-growth

[24] J. Adewumi and S. Akinyemi, "Integrating local knowledge in waste management for sustainable development in Nigeria," Sustain. Dev., vol. 26, no. 4, pp. 467–477, 2018. doi: 10.1002/sd.1754.

[25] A. Idowu and A. Olajide, "Innovative waste management practices in Nigerian cities: Case studies and outcomes," J. Environ. Sci. Eng., vol. 11, no. 1, pp. 45–56, 2022. doi: 10.2139/ssrn.3527650

[26] A. Troschinetz and J. Mihelcic, "Sustainable recycling of waste materials: Principles and practices," Waste Manage., vol. 29, no. 3, pp. 845–854, 2009. doi: 10.1016/j.wasman.2008.06.027.

[27] A. Ajiboye and A. Akinbile, "Advanced recycling techniques and their potential for enhancing waste management in Nigeria," Recycling, vol. 8, no. 1, p. 32, 2023. doi: 10.3390/recycling8010032.

[28] A. Adewale, O. Olowokere, and A. Akinbile, "Community engagement in waste management systems: A case study of Fajuyi Housing Estate, Ado-Ekiti," J. Environ. Manage., vol. 291, p. 112084, 2021. doi: 10.1016/j.jenvman.2021.112084.

[29] A. Akinbile and A. Yusuff, "Improving waste management through community engagement: Lessons from Nigerian cities," Environ. Sustain., vol. 5, no. 2, pp. 123–134, 2022. doi: 10.1007/s42398-022-00034-x.

[30] E. Olowokere, A. Akinbile, and A. Adewale, "Community-led waste management initiatives and their effectiveness in Nigerian urban areas," Environ. Policy Gov., vol. 32, no. 5, pp. 373–384, 2022. doi: 10.1002/eet.1948.

[31] WRAP, "The role of community engagement in sustainable waste management," Waste and Resources Action Programme, 2021. [Online]. Available: https://wrap.org.uk