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Assessing The Relevance Of Waste Management System In The Construction Industry In Warri

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Abstract

This study assesses the relevance and implementation of waste management systems in the construction industry, using Warri, Delta State, as a case study. Employing a mixed-methods approach, the study draws data from 41 survey respondents and in-depth interviews with 7 industry professionals to analyze the types, sources, and impacts of construction waste, as well as current waste management practices. The research reveals that construction sites in Warri commonly generate waste from cement packaging, timber formwork, demolition, and poor material handling. While over 63% of respondents claimed to have waste management plans, the actual implementation varied significantly, with only 39.5% consistently sorting waste on-site. Qualitative insights further indicated that labour inefficiencies, lack of training, poor supervision, and inadequate regulation remain core barriers to effective waste reduction. The study also found that unmanaged waste contributes to site congestion, project delays, safety hazards, and increased costs, despite many professionals underestimating its impact. Policy enforcement by regulatory bodies was seen as inconsistent, with participants advocating for stricter monitoring, better training, and improved access to recycling infrastructure. The findings underscore the need for an integrated strategy combining government regulation, contractor compliance, professional oversight, and worker education to improve waste management outcomes in Warri.

Keywords: Construction Waste, Waste Management, Sustainability, Recycling

Introduction

Construction waste materials include like metal scraps, wood shavings, plastic fragments, concrete, bricks, and other materials that are generated as a result of demolition, construction or renovation. In Nigeria, and particularly in Warri, the construction sector continues to expand to meet growing demands for housing, infrastructure, and commercial buildings. Despite this growth, waste management practices remain inadequate, often leading to economic losses and environmental issues. managed (Ajayi and Oyedele, 2023). Waste materials generated from construction practices incur several economic implications when they aren't properly controlled and managed. This could lead to potential penalties for non-compliance with environmental regulations, incurring additional project costs as a result of the additional materials which end up being wasted and also waste disposal fees. On the other hand, proper waters management creates jobs in recycling sectors, improves the construction project performance, and also saves cost. By analyzing the current

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state of waste management in Warri's construction industry, this study aims to highlight its economic benefits and encourage better practices managed (Ajayi and Oyedele, 2023).

The construction industry plays a vital role in the socio-economic development of any nation, particularly in urbanizing regions such as Warri, a major commercial hub in Delta State, Nigeria. However, alongside its economic benefits, the industry is one of the largest generators of waste globally. Construction and demolition (C&D) waste such as concrete, wood, metal, packaging materials, and excavated soil poses significant environmental and public health challenges if not effectively managed (Ajayi and Oyedele, 2023).

2.0 Review of Literature

This study focused on the growing problem of poor waste disposal in Nigerian cities, caused by rapid urban growth and the government's struggle to manage solid waste properly. The aim was to examine how the private sector contributes to managing and recycling solid waste, and whether this helps create cleaner, healthier cities. Using Actor-Network Theory (ANT) as a guide, the researchers studied how different groups like government agencies, private companies, informal waste pickers, community groups, and residents interact in the waste management system (Igiekhume *et al.,* 2021). They used interviews and case studies from cities like Lagos, Abuja, and Ibadan, analyzing the data with software (NVivo) to identify key challenges and relationships. The findings showed that although private companies (known as Private Sector Participants or PSPs) were brought in to improve waste collection, their efforts were often blocked by local youth groups or ignored by residents who preferred informal waste collectors (Opoko and Oluwatayo, 2016). Many people trust informal waste pickers more because they are familiar and more active in hard-to-reach areas. However, these informal workers are often not recognized or supported by the government, even though they play an important role in recycling (Nzeadibe and Iwuoha, 2008). The study also found that some PSPs focused only on wealthy neighborhoods, leaving poor areas without proper services, which caused more illegal dumping and made people unwilling to cooperate. Overall, the study concluded that involving the private sector alone is not enough to solve Nigeria's waste problems. A better approach would be to include all actors—both formal and informalin waste policies and programs. The researchers recommend that the government should officially recognize informal waste workers, improve roads and facilities, involve community leaders in decision-making, and educate people on the importance of proper waste disposal (Igiekhume *et al.,* 2021). These changes would create a more balanced and effective waste management system, where all actors work together. This inclusive method follows global best practices and supports the goal of building clean and sustainable cities, as outlined in the United Nations Sustainable Development Goals.

Studied showed how to make solid waste management more sustainable in developing countries by reviewing different assessment methods that help improve decision-making. The aim was to find out which tools are most useful in low- and middle-income areas where resources and data are limited. They used a systematic review of 48 studies found through Scopus and grouped the tools into categories like technical, environmental, economic, social, and organizational. The researchers analyzed how often and how effectively each tool was used. They found that although many helpful tools exist—such as Life Cycle Assessment (LCA), Material Flow Analysis (MFA), and cost–benefit analysis (CBA) these are not often used in developing countries because they are too complex or require too much data. Social and institutional tools were also rarely used, often limited to specific cases. The study recommends making these tools simpler, easier to use, and more suited to places with limited information. It also encourages better training for local workers and improved

data collection systems. These changes would help cities and communities in developing countries plan and manage waste in a more sustainable and effective way.

Deus et al., (2019) studied how to improve solid waste management in small Brazilian towns by using clear, measurable indicators. Their goal was to find out which types of performance indicators help local governments make better decisions for sustainable waste practices. They analyzed municipal sanitation plans using a mix of content analysis and tools like Life Cycle Assessment (LCA) and Material Flow Analysis (MFA) to develop ten useful indicators. These included how much waste was produced, how much was recycled, how far waste was transported, energy used, and emissions produced. The results showed that towns using these indicators regularly had better waste management results, especially in reducing environmental impact. For example, tracking transport distances and energy use helped lower carbon emissions. However, they also found that many towns lacked good data on social and policy factors. The study recommends that local governments collect data more consistently, train workers, and use performance dashboards to track progress. This method can help improve not only day-to-day operations but also long-term sustainability goals in waste management.

Fakunle (2024) conducted a systematic review of household waste practices in Nigeria, identifying cultural influences on disposal behaviors. The study highlighted recurring recommendations such as zero-waste methods and policy interventions, yet found these are scarcely implemented at scale .

Maiha and Yusuf (2025) analyzed 2023 waste generation trends across Nigeria's 36 states using public datasets. They calculated per-capita waste and recommended tailored state-level management plans, recycling initiatives, and fostering public–private partnership.

Udemeobong et al. (2024) performed direct sorting of MSW at the Uyo landfill and calculated a per-capita generation rate of 1.34 kg/day. Their findings showed a high recyclable share (>50%) and projected a 40% increase over ten years, suggesting need for supporting recycling infrastructure.

Akinbode and Okoye (2024) implemented a survey-based study of informal waste collectors in Abuja's Gwagwalada and Kuje councils. Using stratified interviews and inferential analysis, they found that informal collection significantly reduced poverty dependency and recommended formalizing roles in municipal systems.

Alencar et al. (2024) introduced and applied a Municipal Solid Waste Governance Index (MSWGI) in Brazil, proposing a framework adaptable to Global South contexts including Nigeria to monitor governance effectiveness along policy, data, and management dimensions.

Recycling in Lagos Slums: A study by Ogunwumi and Lawal (2024) in Lagos showed that community-led recycling programs helped increase recycling rates from 22% to 48% in just six months. The success came from using local leaders and education.

Smart Bins in Abuja: Ibrahim et al. (2024) tested smart waste bins with sensors in Abuja. These bins sent real-time data on how full they were. This helped improve waste collection routes, cut costs by 16%, and reduced fuel use by 12%.

Waste Sorting in Kaduna: Suleiman and Musa (2025) ran a waste education campaign in schools and communities in Kaduna. After one year, properly sorted waste rose from 15% to 57%. The study shows education and better infrastructure really help.

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Comparing Waste in Nigeria and Ghana: Boateng and Nwosu (2023) studied waste in two border cities. They found most of it (54%) was organic, 33% was recyclable, and 13% was not reusable. They suggest building shared recycling centers in the region.

Plastic Recycling Jobs in Port Harcourt: Emeka et al. (2024) found that informal plastic recyclers in Port Harcourt earn more than the national minimum wage. They recommend that the government support and formalize this sector to create more jobs and reduce waste.

3.0 Methodology

The study adopts descriptive survey design, the study was conducted in Warri, located in the southern part of Delta State, Nigeria. Warri is a major urban center with vibrant economic activity, including construction and infrastructural development. The city is home to numerous building and road construction projects, making it an ideal location for investigating construction waste issues. The data for the study was collected from two sources: primary and secondary source. primary data from the field were collected using online questionnaires in the study area. 41 questionnaires were responded via the online survey.

Quantitative data were coded and analyzed using descriptive statistics such as mean, frequency tables, percentages, and charts. Qualitative responses from interviews were subjected to thematic analysis to identify recurring themes and insights. For instance, cost implications of poor waste management were quantified by comparing reported cases of material waste against project cost overruns (Adenaiya et al., 2023).

4.0 Findings

The findings of this study affirm that construction sites in Warri generate a diverse array of waste materials ranging from packaging (cement bags, plastic wrappers) to timber, ceramics, metals, and block waste. Both quantitative and qualitative data reveal a predominant presence of wood waste, corroborated by over 70% of survey respondents and echoed in interviews. This aligns with previous literature highlighting that packaging waste and timber form a significant proportion of construction waste due to on-site cutting, formwork discard, and inefficient inventory systems (Ajayi & Oyedele, 2017; Amoah & Pretorius, 2021). The causes identified poor planning, inaccurate material estimates, inadequate supervision, and substandard materials are consistent with the views of Kheni et al. (2020), who emphasize that improper material handling and the absence of qualified professionals contribute to excessive waste generation. Notably, 25% of waste was attributed to poor storage and handling, with demolition activities accounting for 30%, emphasizing the need for proactive planning and reuse strategies, such as pre-demolition audits and salvage protocols (Hasan et al., 2023).

The study further indicates that while over 60% of construction sites report having a waste management plan, practices such as waste sorting and reuse are inconsistently applied. Only 39.5% of respondents stated that they always sort waste, with nearly half doing so only sometimes. This inconsistency echoes findings from Yakubu and Olanrewaju (2022), who note that although policy awareness exists, its implementation is often hindered by informal practices and lack of skilled labor. Qualitative data confirm this pattern; while some contractors engage professional waste firms, others rely on informal dumping or reuse practices. Participant accounts highlight that worker awareness is uneven—some teams receive training, while others lack basic understanding of waste segregation or environmental impact. These findings align with Idirisu et al. (2021), who argue that awareness and routine site supervision are essential to ensure that site-level sustainability protocols are maintained. Additionally, key challenges reported such as lack of space (35.1%), high disposal costs (24.3%), and limited recycling infrastructure mirror global barriers identified by Ghosh et al. (2020),

indicating that systemic constraints and infrastructural deficits remain persistent obstacles to efficient waste management in developing contexts.

Despite a majority (52%) of respondents claiming that waste has no impact on construction performance, site congestion, delays, and safety issues were widely reported. Over 51% of respondents identified congestion as a key issue, with 23% noting project delays and 15% citing safety risks. These contradictions suggest a potential gap in awareness or a normalization of inefficiencies caused by poor waste handling. Literature supports the assertion that unmanaged waste leads to schedule slippages, cost overruns, and increased accident rates due to obstructed pathways and cluttered workspaces (Tiri et al., 2023). Participants stressed that improper waste management inflates costs, slows construction progress, and degrades site safety a conclusion reinforced by empirical studies such as Akinade et al. (2022), who found that Nigerian construction sites with robust waste protocols reported improved project outcomes. Finally, while existing environmental regulations exist, enforcement was perceived as weak. Respondents called for stricter monitoring, streamlined permitting, and stronger collaboration between government agencies and private sector actors, reflecting the policy enforcement gaps described by Oyedeji and Iroye (2024). Without institutional enforcement and contractor commitment, site-level practices are likely to remain inconsistent, undermining broader sustainability objectives.

5.0 Conclusion

This study set out to examine the relevance of waste management systems in the construction industry in Warri, Delta State, employing both quantitative (41 responses) and qualitative (interviews with 7 participants) approaches. The findings reveal a multifaceted and systemic issue rooted in poor planning, low awareness, infrastructural constraints, and weak policy enforcement. The majority of the construction waste in Warri originates from packaging materials, timber waste, and demolition debris, emphasizing inefficiencies in material utilization, logistics, and design processes. The prominence of offcuts, substandard materials, and design errors underscores the urgent need for improved project planning and monitoring by skilled professionals such as quantity surveyors and site engineers.

The study identifies poor storage practices, weak supervision, and unskilled labour as critical contributors to waste generation. These issues not only lead to resource wastage but also compromise sustainability efforts and increase project costs. Although most construction professionals in the study claimed to have waste management plans, the practical implementation of these plans remains inconsistent. Waste segregation and reuse occur sporadically, often depending on the commitment of individual contractors or supervisors. This is further compounded by a general lack of worker awareness and insufficient training on proper waste handling. Interviews revealed that most artisans do not understand the long-term implications of poor waste management unless closely supervised or trained. This implies that educational initiatives and site-level enforcement are essential components of a successful waste reduction strategy.

The impact of construction waste on project outcomes is significant yet underappreciated by many in the field. While over half of the respondents claimed waste had no serious effect on project delivery, a closer analysis reveals clear evidence of congestion, delays, and safety hazards resulting from unmanaged waste. Poorly managed sites experience delays due to restricted movement, increased material replacement costs, and hazards that compromise worker safety. These outcomes demonstrate the hidden but pervasive influence of waste on construction performance. Furthermore, the role of government in promoting and enforcing sustainable waste practices remains inadequate. Although regulatory frameworks exist, participants expressed

scepticism about their implementation, especially on non-government projects. There is a strong call for policy reform, including stricter enforcement of existing laws, capacity-building among regulators, and penalties for violators. The study concludes that for Warri's construction industry to become sustainable, both private and public sectors must adopt a more proactive stance on waste management—through training, infrastructure investment, and institutional collaboration.

6.0 Recommendation

Based on the findings of this study, the following recommendations are proposed:

1.Enhance Training and Awareness: Construction workers, especially labourers and artisans, should undergo regular training on waste segregation, safe disposal, and the environmental implications of poor waste practices. Orientation should be part of every project on boarding process.

2.Implement Strict Site-Level Waste Policies: Contractors and supervisors must adopt standardized waste management protocols including on-site sorting, storage, reuse, and material tracking. Waste audits should be performed at every phase of the project.

3.Strengthen Government Regulation and Monitoring: Regulatory bodies such as NESREA and local planning authorities must enforce waste policies more stringently, including site inspections, penalties for non-compliance, and incentives for sustainable practices.

4.Encourage Material Innovation and Circular Economy Practices: Use of reusable, recyclable, and biodegradable materials should be promoted. Builders should adopt procurement strategies that reduce excess and improve storage practices.

5.Facilitate Public-Private Collaboration: Government and construction stakeholders should partner on awareness campaigns, infrastructure for recycling, and creating an enabling environment for sustainable building practices in Warri.

Compliance with Ethical Standards

Conflicts of Interest: The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Ethical Approval: Ethical approval is not required

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