

Enhancing Architectural Construction Waste Management Practices in Edo State's Building Industry: Towards Sustainable Material Use

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ABSTRACT

This research investigates construction waste management practices within Edo State's building industry, aiming to enhance sustainability and promote eco-friendly material use. The study covers a comprehensive analysis of current practices, challenges, and opportunities for improvement through a mixed-methods approach. Quantitative analysis, based on survey data collected from 110 participants, including architects, builders, and stakeholders, reveals insights into waste management practices, familiarity with sustainable strategies, and challenges encountered. Qualitative analysis of in-depth interviews provides deeper insights into key themes and issues surrounding construction waste management. Findings highlight significant challenges, including inadequate infrastructure, limited awareness, and regulatory constraints, while also identifying successful initiatives and best practices. Recommendations for improvement include investing in infrastructure, strengthening regulatory frameworks, raising awareness, promoting collaboration, incentivizing sustainable practices, fostering research and innovation, and monitoring progress. By implementing these recommendations, stakeholders can work together to create a more sustainable and environmentally responsible construction sector in Edo State, contributing to long-term environmental protection and economic prosperity.

Keywords: Construction Waste Management, Sustainable Materials, Edo State, Architectural Practices

I. INTRODUCTION

Construction activities are fundamental to economic development and infrastructure improvement globally. However, they are also significant contributors to environmental degradation, particularly through the generation of construction waste. Construction and demolition wastes (C&DW) are the materials that are generated when new buildings and civil engineering structures are built, and also when existing buildings and civil-engineering structures are renovated or demolished with deconstruction activities [1] - [3]. Construction waste encompasses various materials, including concrete, wood, metal, and plastics. The construction industry produces around 120 million tonnes of construction, demolition and excavation waste per year with only half of this currently being recycled or reclaimed [4].

In recent years, the focus on sustainable development has gained prominence across various sectors, including construction. There are numerous research works carried out on construction waste and the findings show several negative impacts to the environment, social and economy of a country [5] - [8]. Sustainable development aims at improving the standard of living without compromising the environmental qualities and future needs [9]. The construction industry is recognized as a significant contributor to environmental degradation due to its substantial resource consumption, energy usage, and waste generation. Despite various waste minimisation and sustainable disposal options that are available, construction material waste is still increasing in Nigeria, while disposal remains a major issue for firms and government [10]. Edo State, like many

other regions, faces the imperative to align its construction practices with the principles of sustainability, making efficient construction waste management a priority. The concept of construction waste management encompasses the entire lifecycle of a building project, from the extraction and processing of raw materials to construction, occupancy, and eventual demolition. The waste generated throughout this lifecycle encompasses materials, debris, and inefficiencies in resource utilization. These challenges are compounded by the absence of effective waste management practices, which can lead to environmental pollution, habitat destruction, and depletion of valuable resources.

Edo State's architectural sector, in particular, plays a pivotal role in shaping the region's built environment. As urbanization accelerates and new structures rise, the implications of construction waste become more pronounced. However, this challenge also presents an opportunity for innovation, as architects, builders, and stakeholders can adopt strategies that reduce waste, optimize resource utilization, and align with sustainable material choices. The transition towards sustainable construction practices necessitates a holistic approach that encompasses waste reduction, reuse of materials, and recycling. These principles, collectively known as the 3R principles (Reduction, Reuse, Recycling), form the cornerstone of responsible construction waste management. The integration of these principles not only aligns with global sustainability goals but also has the potential to transform Edo State's architectural landscape into a beacon of environmentally conscious development.

As Edo State seeks to achieve a balance between urban growth and environmental preservation, the research on enhancing architectural construction waste management practices gains significance. This research delved into the complexities of construction waste generation, identify challenges, and propose innovative strategies that will not only manage waste effectively but also usher in a new era of sustainable material use. By addressing this challenge, the research aimed to contribute to Edo State's vision of a sustainable future, where the architectural sector serves as a catalyst for responsible development, resource conservation, and environmental harmony.

II. REVIEW OF RELATED LITERATURE

The study done by [11] presents an innovative perspective on Construction Waste Management (CWM) through the lens of Integrated Construction Waste Management (ICWM). Spanning multiple academic dissertations at SUT's Civil Engineering Department, the study emphasizes a comprehensive approach to managing construction waste across the project life cycle. The authors begin by identifying waste sources within different project phases, highlighting the necessity of tailored solutions. Concurrently, they scrutinize the impact of contract types on waste generation, identifying the shortcomings of the prevalent cost-plus contract. The research employs field observations and surveys involving experienced industry experts, enriching its insights. Proposing practical ICWM solutions, the study recommends incentive-driven initiatives, stakeholder training, pre-project salvage planning and meticulous documentation for effective waste reduction. A noteworthy finding is the collaborative nature of ICWM, transcending a single stakeholder's responsibility. The research advances CWM practices by advocating for a holistic and cooperative approach.

In their work [10] investigated waste disposal challenges in the Nigerian construction sector. Despite waste's adverse effects on costs, time and the environment, effective waste management remains a pivotal concern. Examining various disposal methods such as incineration, recycling and landfilling, the authors emphasize the significance of the disposal phase. However, despite global literature offering sustainable options, Nigeria witnesses a rise in construction material waste, heightening disposal concerns. Employing a mixed-methods approach, the study involves surveys and interviews, revealing landfilling as the predominant method, trailed by reuse and recycling. Interestingly, company attributes like ownership, age and specialization show minimal correlation with disposal methods except for size. The research underscores the need for regulatory measures like waste management plans and landfill bans to minimize waste and promote sustainable approaches like recycling and reuse.

Also, [3] contributed to the discourse on sustainable construction waste management by addressing its significance in the Nigerian context. The study acknowledges the substantial challenge posed by construction debris, constituting a significant portion of municipal waste, particularly

in developing nations. Focusing on the Nigerian construction industry, the authors underscore the necessity of sustainable waste management practices amidst the inevitability of continued construction activity. The research evaluates existing waste disposal methods, assesses familiarity with sustainable practices and identifies impediments to their implementation. Reuse, recycling and landfilling emerge as familiar waste management methods, with reuse, burning and landfilling being the most practiced. Notably, insufficient government support for green technology and limited backing from professional organizations within the construction sector are recognized as key barriers. The study advocates for waste reduction strategies, positioning disposal as a last resort and highlights the pivotal role of governmental bodies and construction organizations in promoting sustainable waste management and construction practices.

In "A Review on Achieving Sustainable Construction Waste Management through Application of 3R (Reduction, Reuse, Recycling): A Lifecycle Approach" [12] addressed the lack of comprehensive research reviews within the ambient of sustainable construction waste management through the 3R approach. They emphasize the pressing need for effective strategies, policies and rating systems to enhance waste management efficiency. Focused on Malaysia, the study reviews sustainable waste management practices to amplify the 3R principles and curtail construction waste disposal. Acknowledging the environmental, economic and social ramifications of unsustainable waste practices, the authors stress the importance of revising current waste management systems and causal factors within the industry. The study envisions the potential for significant improvements in waste management through technological advancements, supporting the broader sustainability goals of Malaysia's construction projects.

The aim of this research is to improve architectural construction waste management practices within Edo State's building industry, with a focus on promoting sustainable material usage.

III. RESEARCH METHODS

A. Study Area

The study area for this research is Edo State, located in southern Nigeria. Edo State is characterized by a diverse architectural landscape, encompassing residential, commercial, and institutional building projects. The region experiences significant construction activity,

contributing to both economic growth and environmental challenges, particularly concerning construction waste management. With a population that includes architects, builders, and stakeholders involved in the construction industry, Edo State provides a rich context for investigating current waste management practices and exploring opportunities for enhancing sustainability through the integration of eco-friendly materials and improved waste management strategies.

B. Method of Data Collection

The data collection for this study employed a combination of site surveys and structured questionnaires. Site surveys were conducted at distinct locations within Edo State, encompassing various building typologies and construction stages, including residential, commercial, and institutional projects, both ongoing and completed. These surveys involved direct observation and documentation of waste management practices, infrastructure, and environmental conditions. Structured questionnaires were administered to architects, builders, and stakeholders involved in the construction industry to gather information on current practices, perceptions, and barriers related to waste management and sustainable material use. The questionnaire was designed to capture quantitative and qualitative data, allowing for a comprehensive analysis of the research objectives.

C. Sample Size and Sampling Technique

The sample size for this study comprises 120 participants, consisting of respondents who completed questionnaires and those who were interviewed. A total of 115 questionnaires were distributed, with 110 returned, yielding a response rate of approximately 96%. Additionally, 10 respondents were interviewed to gather in-depth qualitative insights into waste management practices and perceptions regarding sustainable material use in the construction industry. The sampling technique employed for both the questionnaire distribution and interviews was purposive sampling, aiming to include individuals directly involved in the architectural and construction sectors within Edo State, ensuring a representative sample that captures diverse perspectives and experiences.

D. Data Analysis

The data obtained from the survey questionnaires and in-depth interviews were subjected to a rigorous analytical process to extract

meaningful insights into construction waste management practices in Edo State's building industry. The analysis consisted of the following:

a. Quantitative Analysis

The quantitative data collected from the survey questionnaires were subjected to statistical analysis using Microsoft Excel statistical software. Descriptive statistics, including mean, mode, frequencies and percentage analysis were used to analyze the respondents' nature of involvement in the construction industry, type of construction project involved, level of familiarity with waste management strategies, adopted methods of sustainable waste disposal and challenges encountered with the current waste management practices in construction projects

b. Qualitative Analysis

Thematic analysis methods were employed to analyze the qualitative data gathered from in-depth interviews. The transcripts of these

interviews, along with relevant documents, underwent categorization to pinpoint the central themes, issues, and obstacles concerning construction waste management practices in Edo State's building industry. Subsequently, these thematic groupings underwent systematic scrutiny to uncover recurring patterns, disparities, and valuable insights inherent in the qualitative data.

IV. RESULTS AND DISCUSSION

4.1 Results

a. Quantitative Analysis

Table 1 presents the distribution of respondents based on their nature of involvement in the construction industry within Edo State. The data highlight the prevalence of different professional roles, including architects, builders, civil engineers, and project managers, providing insights into the composition of stakeholders involved in construction activities.

Table 1: Nature of involvement in the construction industry

S/N	Nature of involvement	Frequency	Percentage (%)
1	Architect	45	40.91
2	Builder	36	32.73
3	Civil Engineer	21	19.1
4	Project manager	8	7.3
	Total	110	100

Source: Field Data, 2024

Table 2 outlines the types of construction projects in which respondents are involved, categorizing them into residential, commercial, and

institutional projects. The data revealed the distribution of construction activities across different sectors.

Table 2: Type of construction project involved

S/N	Type of construction project	Frequency	Percentage (%)
1	Residential	58	52.73
2	Commercial	41	37.3
3	Institutional	11	10
	Total	110	100

Source: Field Data, 2024

Table 3 presents respondents' familiarity with various waste management strategies. The data provided an understanding of the extent to which respondents are knowledgeable about

different waste management practices, offering insights into areas that may require additional education or awareness campaigns.

Table 3: Respondents' level of familiarity with waste management strategies

S/N	Waste management strategies	Frequency	Mean	Rank
1	Re – Use	99	0.90	2
2	Recycling	94	0.855	5
3	Composting	85	0.773	6

4	Incineration	81	0.736	7
5	Landfilling	97	0.882	3
6	Burning	102	0.927	1
7	Open dumping	95	0.864	4
8	Pyrolysis	60	0.545	9
9	Shredding	65	0.591	8

Source: Researcher’s Computation

Table 4 illustrates the adoption of sustainable waste disposal methods by respondents. The data revealed the prevalence of each method

among respondents, highlighting the most commonly adopted practices.

Table 4: Respondents Adopted methods of sustainable waste disposal

S/N	Waste management strategies	Frequency	Mean	Rank
1	Re – Use	55	0.5	5
2	Recycling	64	0.58	3
3	Composting	31	0.28	7
4	Incineration	41	0.37	6
5	Landfilling	72	0.65	2
6	Burning	77	0.70	1
7	Open dumping	64	0.58	3
8	Pyrolysis	15	0.14	9
9	Shredding	22	0.2	8

Source: Researcher’s Computation

Table 5 identifies and ranks the challenges encountered with current waste management practices in construction projects within Edo State. The data provided insights into the key obstacles

hindering effective waste management, including inadequate infrastructure, regulatory constraints, high implementation costs, and lack of stakeholder coordination.

Table 5: Challenges encountered with the current waste management practices in construction projects

S/N	Challenges encountered with waste management practices in construction projects	Frequency	Mean	Rank
1	Inadequate infrastructure for waste management on construction sites	57	0.52	6
2	Inadequate government support to green technology	64	0.58	5
3	Compliance with existing waste management regulations and guidelines is challenging	37	0.34	11
4	High cost of implementation of sustainable practices	68	0.62	3
5	Lack of logistics and transportation in efficiently managing construction waste	52	0.47	7
6	Inefficient sorting and segregation of waste materials	23	0.21	13
7	Lack of stakeholders coordination	49	0.44	8
8	Limited space on construction sites	75	0.68	1
9	Seasonal variations and weather conditions	14	0.13	14
10	Resistance to change within the industry	42	0.38	9
11	Cultural and behavioral factors	12	0.11	15
12	Limited awareness and education regarding sustainable waste management practices and	68	0.62	3

	the benefits of using eco-friendly materials.			
13	Lack of tangible incentives or rewards for adopting sustainable waste management practices	42	0.38	9
14	Absence of standardized guidelines and best practices for construction waste management	72	0.65	2
15	Lack of credible research on the benefits of sustainable constructions	31	0.28	12

Source: Researcher's Computation

b. Qualitative Analysis

The qualitative analyses were analyzed as follows

Interview Questions and Responses

1. Research Question 1: What are the current waste management practices employed on construction sites in Edo State?

Summary of Responses

- Most sites practice basic waste segregation, but there's a need for improvement in recycling efforts
 - Waste management practices vary, with some sites having dedicated sorting areas while others lack proper disposal methods.
 - Limited infrastructure and awareness result in inconsistent waste management practices across construction sites.
2. Research Question 2: What challenges do you encounter with the current waste management practices in construction projects?

Summary of Responses

- Inadequate infrastructure and lack of recycling facilities hinder effective waste management efforts.
 - Limited awareness among workers about proper waste handling contributes to inefficient practices.
 - Cost constraints and regulatory barriers pose challenges to implementing sustainable waste management practices.
3. Research Question 3: How do you perceive the environmental impact of construction waste in Edo State?

Summary of Responses

- Construction waste significantly impacts the environment, contributing to pollution and resource depletion.
- The environmental footprint of construction waste is substantial, but proper management can mitigate its effects.
- Uncontrolled disposal of construction waste poses risks to ecosystems and public health, necessitating sustainable solutions.

4. Research Question 4: In your opinion, what are the benefits of integrating sustainable materials into construction projects?

Summary of Responses

- Using sustainable materials promotes resource efficiency, reduces environmental impact, and enhances building performance.
 - Integrating sustainable materials can lead to long-term cost savings and improved market competitiveness.
 - Sustainable materials contribute to healthier indoor environments and enhance the overall sustainability of construction projects.
5. Research Question 5: What role do you think government policies and regulations play in shaping waste management practices in the building industry?

Summary of Responses

- Government policies provide guidelines, incentives, and penalties to promote sustainable waste management practices.
- Regulations ensure compliance with environmental standards, encourage innovation, and create a level playing field for businesses.
- Effective policies can drive industry-wide adoption of sustainable practices and foster a culture of environmental responsibility.

6. Research Question 6: Can you share any successful initiatives or best practices in waste management that you have encountered in Edo State?

Summary of Responses

- Some firms have implemented on-site recycling programs, diverting a significant portion of waste from landfills and reducing environmental impact.
- Collaborations between construction companies and local communities to repurpose

construction waste for community projects have been successful.

- Educational campaigns and outreach programs have raised awareness about waste management, leading to improved practices on construction sites.
7. Research Question 7: What recommendations do you have for improving construction waste management practices in Edo State?

Summary of Responses

- Investing in infrastructure for waste sorting and recycling, providing training, and promoting awareness are crucial steps.
- Strengthening enforcement of waste regulations, incentivizing sustainable practices, and fostering partnerships can drive positive change.
- Government support through policy incentives, funding for research and development, and public-private collaborations can facilitate sustainable waste management practices.

4.2 Discussion

Table 1 illustrates the distribution of respondents based on their nature of involvement in the construction industry, with architects comprising 40.91%, followed by builders (32.73%), civil engineers (19.1%), and project managers (7.3%). This distribution highlights the prominent roles of architects and builders in waste management decision-making processes within the industry. Additionally, Table 2 highlights the predominance of residential construction projects (52.73%), compared to commercial (37.3%) and institutional projects (10%). This distribution underscores the importance of addressing waste management practices in residential settings to mitigate environmental impact.

Respondents demonstrated varying levels of familiarity with waste management strategies, as depicted in Table 3. Burning emerged as the most familiar method (mean rank = 1) followed by landfilling (mean rank = 2); while shredding (mean rank = 8) and pyrolysis (mean rank = 9) were the least familiar. However, despite high familiarity with certain methods, adoption rates varied, indicating potential discrepancies between knowledge and practice.

Challenges encountered with current waste management practices were identified and ranked based on frequency and mean scores, as presented in Table 5. Limited space on construction sites (mean rank = 1) and absence of standardized guidelines and best practices for construction waste

management (mean rank = 2) were among the top challenges reported by respondents; while seasonal variations and weather conditions (mean rank = 14) and cultural and behavioral factors (mean rank = 15) were among the least challenges reported by respondents. These findings underscore the systemic issues hindering effective waste management practices within the industry.

Qualitative analysis through thematic analysis of interview responses provided deeper insights into key themes, issues, and obstacles concerning construction waste management practices. Respondents highlighted the need for improvement in recycling efforts and identified challenges such as inadequate infrastructure, lack of awareness among workers, and regulatory constraints. Despite challenges, respondents identified successful initiatives and best practices, such as on-site recycling programs and collaborations with local communities. These initiatives demonstrate the potential for positive change and highlight opportunities for implementing sustainable waste management practices within the industry. Recommendations from respondents for improving construction waste management practices encompassed various strategies, including investing in infrastructure, strengthening enforcement of regulations, and fostering partnerships among stakeholders. Government support through policy incentives and funding for research and development emerged as critical enablers of sustainable waste management practices.

V. CONCLUSION

The research provides a comprehensive understanding of construction waste management practices in Edo State's building industry, revealing significant challenges alongside opportunities for improvement. Despite varying levels of familiarity with waste management strategies, there exists a gap between knowledge and practice, suggesting a need for targeted interventions to improve adoption rates of sustainable waste disposal methods. Challenges encountered with current waste management practices include inadequate infrastructure, limited space on construction sites, and regulatory barriers. These systemic issues underscore the urgency of implementing comprehensive solutions to address inefficiencies and promote sustainable practices within the industry. However, amidst challenges, respondents identified successful initiatives and best practices, such as on-site recycling programs and collaborations with local communities. These initiatives demonstrate the potential for positive

change and highlight opportunities for innovation and collaboration in waste management efforts.

VI. RECOMMENDATIONS

Based on the findings and conclusions of the study, the following recommendations are proposed to enhance architectural construction waste management practices in Edo State's building industry.

1. Invest in Infrastructure: Addressing the issue of inadequate waste management infrastructure should be a priority. This includes the establishment of recycling facilities, waste sorting centers, and designated disposal sites to streamline waste management processes and minimize environmental impact.
2. Strengthen Regulatory Frameworks: Government authorities should strengthen enforcement of existing waste management regulations and guidelines. This entails monitoring compliance, imposing penalties for non-compliance, and incentivizing the adoption of sustainable waste management practices through policy interventions.
3. Raise Awareness and Education: Initiatives to increase awareness and education about sustainable waste management practices should be implemented across the construction sector. Training programs, workshops, and awareness campaigns can help improve knowledge and understanding among stakeholders, encouraging the adoption of eco-friendly practices.
4. Promote Collaboration and Partnerships: Collaboration among stakeholders, including government agencies, industry associations, construction firms, and waste management authorities, is essential. Partnerships can facilitate knowledge sharing, resource pooling, and coordinated efforts to address common challenges and implement effective waste management strategies.
5. Incentivize Sustainable Practices: Government incentives, such as tax breaks or subsidies, can encourage construction firms to adopt sustainable practices. Financial incentives for implementing recycling programs, using eco-friendly materials, and reducing waste generation can stimulate industry-wide adoption of sustainable waste management practices.
6. Foster Research and Innovation: Continued research and innovation are crucial for developing new technologies, materials, and methods to improve waste management

efficiency and sustainability. Government funding and support for research initiatives in this area can drive innovation and accelerate the adoption of best practices.

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