
AWARENESS, BARRIERS, AND ENABLERS OF CIRCULAR ECONOMY ADOPTION IN ABUJA'S CONSTRUCTION SECTOR

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DOI: <https://doi.org/10.67203/sp.ICESID.2026>

ABSTRACT

Construction & Demolition (C&D) waste has been identified as one of the major problems facing rapidly growing cities in Nigeria and has both environmental and economic consequences. The methods through which waste is managed in this industry continue to be largely linear: dispose by default. Circular economy (CE) principles provide a pathway towards sustainable construction; however, their implementation in Nigeria's construction sector remains poorly researched. This study examines CE awareness, practices, attitudes, and barriers using a cross-sectional survey of 110 construction professionals. A seven-item CE-attitude scale was tested for internal consistency (Cronbach's $\alpha = 0.803$). Professional role, years of experience, and educational attainment were examined in relation to CE attitudes and practices using chi-square tests and Spearman correlation. There were no statistically significant differences between professionals' awareness of CE in terms of their professional roles ($p = 0.71$) or levels of education ($p = 0.81$). Yet, professionals' roles turned out to be significantly correlated with the frequency of waste separation ($\chi^2 = 10.86, p = 0.028$) and readiness to engage in CE practices if incentivized ($\chi^2 = 11.19, p = 0.025$). While contractors and builders were more behaviorally responsive to CE than engineers, there were no statistically significant differences between their levels of awareness of the concept. The quality of recycled materials was found to be the most influential factor when respondents decided to pay for them ($p = 0.61$). The main barriers included the lack of awareness (59.1%), the lack of proper recycling infrastructure (48.2%), and the lack of regulation enforcement (40.0%). Guaranteed markets (49.1%) and technical training (47.3%) appeared to be the most important enablers of CE.

Keywords: circular economy; construction and demolition waste; barriers; enablers; and sustainable construction

1. INTRODUCTION

The construction industry is among the biggest users of natural resources across the world, accounting for 35% of all material consumption and 40% of the annual waste (Dsilva et al., 2023). The C&D waste types comprise concrete, masonry, wood, metal, glass, plastics, and asphalt. The sources of such wastes are construction, remodelling, and demolition of structures, whereby the occurrence of C&D wastes is common in fast and poorly regulated urban cities. Nigeria offers a useful example, where the construction industry contributes about 3–5% to the nation's GDP (National Bureau of Statistics, 2023). However, the inefficiency in materials utilization, inadequacy of regulation regarding demolition works, and lack of recycling opportunities negatively impact the competitiveness of the industry and overall sustainability goals of the country.

The Federal Capital Territory of Nigeria, Abuja, is an illustrative example in this field. Being an urban center, which has been expanding continuously for the last few decades in terms of residential areas, commerce, and infrastructure, Abuja produces significant amounts of construction and demolition (C&D) waste. A considerable amount of C&D waste in the city ends up in either unused lands, water bodies, or roads instead of being recovered (Lanrewaju, 2012; Ogunseye et al., 2023; Unegbu et al., 2024). However, such state of affairs contradicts the goals of SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). On the other hand, it is an untapped resource due to the fact that there is easily recoverable C&D waste in Abuja.

A circular economy (CE) approach that replaces the traditional "take-make-dispose" model through initiatives that help to reduce, reuse, recycle, and regenerate materials via closed loops

(Kirchherr et al., 2017, 2023) is one such model that has gained traction across the globe to address this problem. Countries like Germany, Sweden, and the Netherlands have shown that CE-related initiatives can help recover 80–90% of C&D wastes (Bonifazi et al., 2025; Shajidha & Mortula, 2025). The construction sector in Nigeria, on the other hand, is still rooted in linear processes with inefficient use of resources, poor regulation enforcement, and lack of awareness among stakeholders about CE (Bello & Idris, 2023; Unegbu et al., 2024).

The consistent finding across the Nigerian studies on CE among construction professionals is that there is a knowledge-to-action gap whereby most construction professionals claim to have knowledge about CE principles, but very few actually practice them (Unegbu et al., 2024). The current study aims to establish the reasons for the failure of knowledge translation into action and identify professional attributes that determine the size of the gap. The specific objectives are to (i) assess CE awareness and current C&D waste management practices among Abuja construction professionals; (ii) identify and rank key barriers and enablers of CE adoption; and (iii) test whether professional role, experience, and education are statistically associated with CE attitudes and behaviors. The remainder of the paper covers literature (Section 2), methodology (Section 3), results (Section 4), discussion (Section 5), and conclusions (Section 6).

2. LITERATURE REVIEW

2.1 The Circular Economy: Principles and Models

The circular economy (CE) has emerged as a widely recognized tool to harmonize economic growth with sustainable development. Unlike the linear economy model where the flow of materials follows a straight-line trajectory of "take-make-use-waste," the CE model entails a cyclic approach in which products, parts, and materials retain their value through processes of reusing, repairing, remanufacturing, and recycling (Kirchherr et al., 2017). This concept has been defined as a policy framework since the 1990s through initiatives of the Ellen MacArthur Foundation and the European Union (Kirchherr et al., 2023; Velenturf & Purnell, 2021). The circular economy is no longer seen as a solution to minimizing waste but as a revolutionary paradigm that considers economic, environmental, and social goals simultaneously.

The CE approach within the built environment is implemented through an integrated set of approaches that include elimination of waste at the source, sustaining the flow of materials through reuse and recycling, regeneration of natural systems, and systems thinking within the value chain (Velenturf & Purnell, 2021). In the built environment, material use constitutes around 40% of the overall material demand on Earth along with waste production, making the built environment one of the sectors where the CE can be most impactful.

2.2 Barriers and Enablers: A Four-Domain Framework

The literature clearly outlines the barriers and motivating factors behind the C&D waste recycling process through four related areas (Table 1). This typology, which was synthesized from international and local sources, serves as the foundation behind the barriers and motivators in the questionnaire for this study.

Table 1: Barriers and enablers of CE adoption in C&D waste management, by domain.

Domain	Key Barriers	Key Enablers
Technical	Heterogeneous, contaminated waste streams; absence of advanced sorting/recycling equipment; and designs that do not support disassembly.	On-site segregation; lean construction practices; optimized mechanical recycling
Economic/Market	Recycling is perceived as costlier than disposal; weak market demand; low trust in recycled material quality; unpredictable supply chains	Landfill taxes, subsidies for recyclers; cost savings from waste minimization
Institutional/Policy	Weak enforcement of regulations; absence of quality standards for recycled materials; few staff assigned to waste management	Mandatory waste management plans; green building certification; government procurement mandates
Social/Cultural	Low awareness; poor workmanship; prevailing use-and-discard culture; community nuisance from poor practice	Targeted training, incentive, and accountability systems; stakeholder engagement

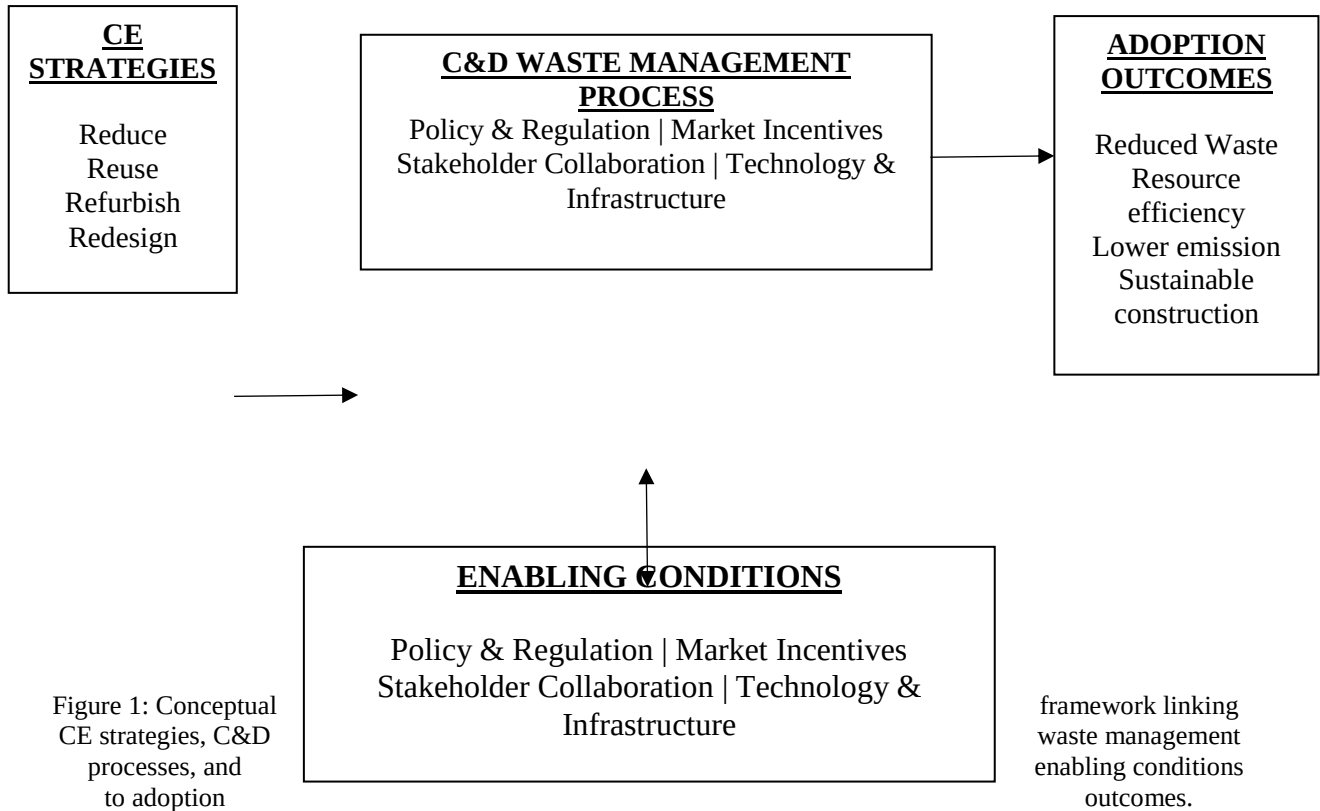
2.3 Prior Survey-Based CE Studies in Nigeria and Comparable Contexts

Survey-based studies investigating the CE awareness in the construction industry of Nigeria are increasing in number. According to Unegbu et al. (2024), there is a significant gap in CE implementation where 58% of respondents had knowledge about CE principles, but only 15% implemented them, whereas 68% of companies were still using unsustainable practices in disposal. The major challenges included financial constraints (about 70%), lack of enforcement of regulations (65%), and poor infrastructure (63%). Similarly, Bello and Idris (2023) highlight that the adoption of CE in Nigeria is in a "know without doing" phase. In similar environments, a study conducted in Addis Ababa found that more than three-quarters of companies did not have staff designated for handling waste management issues (Shajidha & Mortula, 2025).

From a methodological perspective, the literature is highly descriptive in nature, recording frequency and average Likert scale ratings but rarely testing for scale validity or evaluating whether there is an association between respondents' demographics and their outcomes. One of the major policy-oriented questions that remain open is the following: Is the awareness-performance gap general in the construction sector, or is it limited to certain professions?

2.4 Conceptual Framework

The research has been conducted in the context of circular economy theory, which assumes that material value should be kept by repeating use, recovery, and regeneration continuously (Velenturf & Purnell, 2021). Figure 1 illustrates the theoretical framework where the link between CE approaches and the processes of construction and demolition waste management, along with enabling conditions that condition adoption outcomes, has been considered. The research framework is the basis for the analysis in this research: first, there will be the evaluation of CE knowledge and application; second, barriers and enabling factors will be analyzed; and, third, the moderation effect will be tested.



3. METHODOLOGY

3.1 Research Design

In order to examine awareness, behaviors, and perception about CE barriers/enablers among construction professionals in Abuja, Nigeria, the study uses a descriptive-correlational questionnaire survey research design. In addition to presenting descriptive statistics about the data, it tests whether there exists a statistical relationship between the demographic variables of the respondents and CE-related behaviors/attitudes/perceptions. This paper reports only the perceptual and survey component of the broader research project. The associated waste-quantification component is outside the scope of the present paper and will be reported separately.

3.2 Study Area

This study was conducted in the Federal Capital Territory (FCT), Abuja, Nigeria. It is selected as the study area because it is among the fastest-growing construction markets in the country, with sustained residential, commercial, and infrastructural development generating substantial C&D waste volumes that are largely managed through informal or unregulated channels (Abah et al., 2023).

3.3 Population and Sampling

The sample for the study involved construction practitioners in Abuja; this included engineers, architects, quantity surveyors, contractors, builders, site supervisors, waste managers, and policymakers. Purposive sampling with participation in construction activities was employed to select the respondents, and a total of 111 questionnaire forms were issued, resulting in 110 valid responses since one participant withdrew his consent.

For inferential testing, professional roles were grouped into three categories to maintain adequate cell sizes: engineers/design professionals, including architects (n=76); contractors/builders (n=24); and managerial/policy professionals (n=7). This classification was chosen to facilitate the application of the requirements of the chi-square test. The fourth classification ('Others', n=3) was not included in any of the role-related chi-square tests, since the small size of its cells might lead to

insufficient expected values. Therefore, role-related tests were carried out based on $n=107$, while education/experience-related tests were on $n=110$.

3.4 Research Instrument

The data were collected using a standardized questionnaire that had five sections:

- Section A: Demographic and professional characteristics of the respondents
- Section B: Existing practices of C&D waste management
- Section C: Knowledge about the circular economy (CE)
- Section: D: Challenges/barriers and enablers for recycling C&D waste
- Section E: Instruments of policy and incentives

Most questions were answered on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Content validity of the questionnaire was ensured by its verification by experts and practitioners.

3.5 Scale Reliability

A composite measure of CE-attitudes comprising seven Likert items based on Sections C and D was created and assessed for internal consistency using Cronbach's alpha prior to performing any further analysis. Seven Likert items were kept since there was acceptable correlation between all of them and a consistent alpha value (Section 4.1).

3.6 Data Analysis

The analysis was conducted in three steps. Firstly, the descriptive analysis involved calculating frequencies, percentages, means, standard deviation, and skewness. Secondly, the chi-square test of independence was used to establish the relationship between categorical respondent variables and categorical outcome variables. The Likert response was reduced into three categories (disagree 1-2, neutral 3, and agree 4-5), while the effect size was calculated using Cramér's V. Thirdly, the Spearman rank correlation (ρ) analysis was conducted on the relationship between the seven CE-attitude variables as well as the relationship between experience and each of the attitude variables. Spearman's rank correlation was used because the CE-attitude variables were measured using five-point Likert-scale responses, which are ordinal in nature. The non-parametric Spearman procedure was therefore considered appropriate for assessing monotonic associations without requiring the assumptions associated with Pearson correlation.

3.7 Ethical Considerations

Participation was entirely voluntary, and informed consent was obtained from all respondents. No personally identifying information was collected, ensuring respondent anonymity throughout.

4. RESULTS

4.1 Respondent Profile and Scale Reliability

Out of 111 surveys that were distributed, 110 responses were valid. Out of the total number of respondents, most were male (57, 91.8%), held a bachelor's degree (68.2%), and had fewer than five years of experience (58.2%). Engineering was the largest profession group (69.1%), while contractor/builders came second (21.8%), and management/policymaking third (6.4%).

Table 2: Respondent profile (n=110).

Characteristic	Category	n	%
Gender	Male	101	91.8
	Female	8	7.3
	Prefer not to say / Missing	1	0.9
Professional Role	Engineer (incl. Architect)	76	69.1
	Contractor / Builder	24	21.8
	Management / Policy	7	6.4
	Other (excl. from role tests)	3	2.7
Years of Experience	≤5 Years	64	58.2
	6–10 Years	35	31.8
	>10 Years	11	10.0
Educational Qualification	Bachelor's Degree	75	68.2
	Master's Degree	22	20.0
	Diploma / NCE	7	6.4
	PhD and above	3	2.7
	Secondary School (SSCE)	3	2.7

The internal consistency of the CE attitude scale consisting of seven items was satisfactory (Cronbach's $\alpha = 0.803$, $n = 110$), exceeding the generally acceptable standard of 0.70. The correlations between each item and total scores ranged between 0.39 (adequacy of regulation and enforcement) and 0.62 (quality beliefs). The elimination of any one of the items could increase the alpha value by at most 0.81; hence, all the items were kept.

Table 3: Descriptive statistics and reliability indices for the CE-attitude scale (n=110).

Item (Likert 1–5)	Mean	SD	Median	Skewness	Item-total r	n
Awareness of CE concept	3.67	1.12	4	−0.68	0.51	110
Knowledge of recycling techniques	3.56	1.11	4	−0.44	0.61	110
Organization has C&D waste policy	3.29	1.22	3	−0.36	0.54	110
Regulation/enforcement adequacy	3.04	1.31	3	0.03	0.39	110
Recycled materials meet quality needs	3.61	1.01	4	−0.25	0.62	110
Willingness to pay more	3.58	1.00	4	−0.75	0.58	110
Will adopt CE if incentives are introduced	3.86	1.00	4	−0.78	0.57	110
Cronbach's $\alpha = 0.803$ (n=110)						

Note: Likert scale: 1=Strongly Disagree, 5=Strongly Agree. Item-total r = corrected item-total correlation.

4.2 Current C&D Waste Management Practices

Dumping of waste in dumping sites and landfills has been identified as the major method of waste disposal practice adopted by 80.2% of the respondents ($n=89$). Informal on-site reuse of waste ranked second at 42.3%, followed by selling waste to informal recyclers at 34.2%, and formal recycling at 17.1%. Waste separation too showed a degree of inconsistency in practice, with 39.6% not separating waste at all, 41.4% doing so occasionally, and only 19.0% doing so regularly.

4.3 CE Awareness and Applicability

The mean scores (Table 3) show that there is moderate to high CE awareness ($M = 3.67$) and moderate knowledge about the methods of recycling ($M = 3.56$). There is also a moderate belief in the quality of recycled products ($M = 3.61$) and moderate willingness to pay extra ($M = 3.58$). The highest mean score is obtained for conditional adoption ($M = 3.86$, $SD = 1.00$), while perceived adequacy of regulations scores the lowest and the most uniformly ($M = 3.04$, skewness ≈ 0.03).

4.4 Association Between Professional Characteristics and CE Attitudes/Practices

Chi-square tests for independence were used to investigate the relationships between respondent characteristics and circular economy (CE) results (Table 4). Professional role has been shown to be significantly related to waste segregation frequency ($\chi^2 = 10.86$, $df = 4$, $p = 0.028$, $V = 0.225$) and intention to practice CE when offered certain incentives ($\chi^2 = 11.19$, $df = 4$, $p = 0.025$, $V = 0.229$). There is no significant relationship between professional role and awareness of circular economy ($p = 0.709$). Education is not related to awareness of CE ($p = 0.810$). Years of experience are not significantly related to willingness to pay ($p = 0.867$) and regulatory effectiveness ($p = 0.652$).

Table 4: Chi-square tests of association between respondent characteristics and CE outcomes.

Test	χ^2	df	n	p	Cramér's V	Result
Role $\times$ Waste separation frequency	10.86	4	107	0.028	0.225	Significant*
Role $\times$ Adoption-if-incentives	11.19	4	107	0.025	0.229	Significant*
Role $\times$ CE awareness	2.14	4	107	0.709	0.100	Not significant
Education $\times$ CE awareness	4.49	8	107	0.810	0.143	Not significant
Experience $\times$ Willingness to pay	1.27	4	107	0.867	0.076	Not significant
Experience $\times$ Regulation adequacy	2.46	4	107	0.652	0.106	Not significant

Note: * $p < 0.05$. Cramér's V: <0.10 = negligible; $0.10-0.29$ = small; $0.30-0.49$ = moderate effect. Role-based tests exclude the 'Other' category ($n=3$) and therefore use $n=107$; all other tests use the full sample ($n=110$).

The cross-tabulation table for the professional roles and waste separation is illustrated in Figure 2 below. Of the 24 contractors/builders, 9 often/always separated their waste, while 1 never/rarely did, and in contrast, of the 76 engineers, 37 often/always separated their waste, and 18 never/rarely did. The variation in behavior but not in awareness is the main finding of this research.

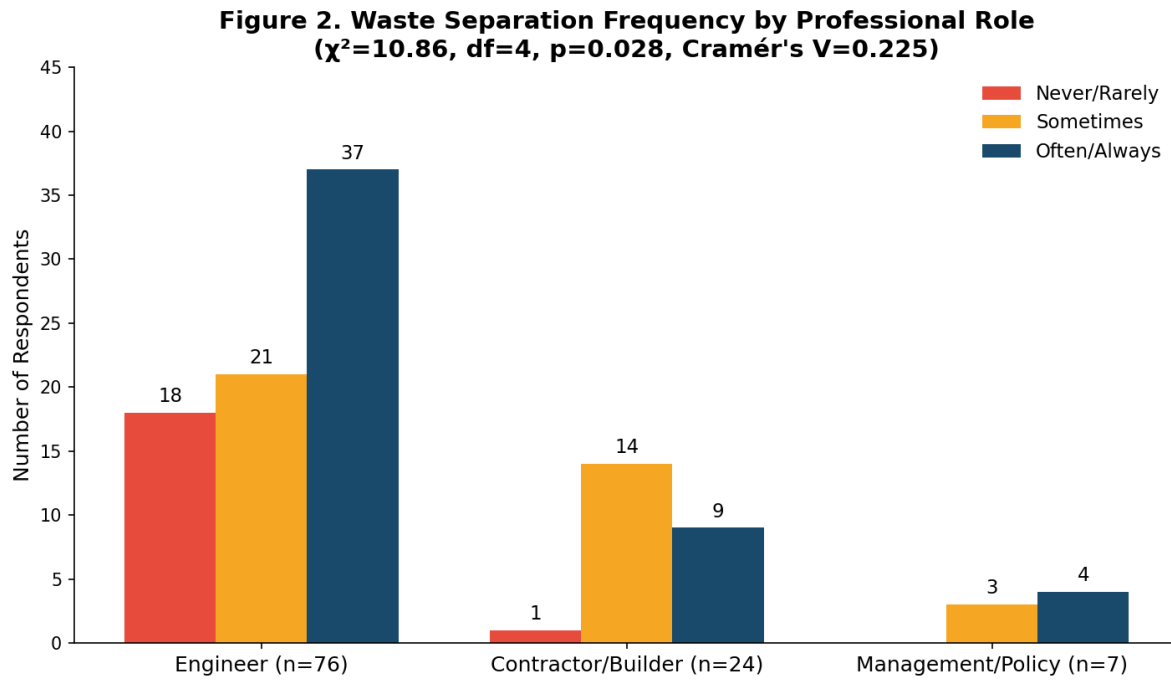


Figure 2: Waste separation frequency by professional role ($\chi^2=10.86$, $df=4$, $p=0.028$, Cramér's $V=0.225$).

Supplementary ordinal correlation analysis found that years of experience were positively correlated with knowledge of recycling techniques ($p=0.22$, $p=0.022$) and adoption of incentives ($p=0.26$, $p=0.006$), though effect sizes were modest. All other experience correlations were non-significant ($p > 0.06$).

4.5 Barriers to C&D Waste Recycling

Barriers mentioned by the respondents have been presented in Table 5 on the basis of their frequency of mention. Lack of awareness was found to be the highest barrier, mentioned by 59.1% of respondents, followed by lack of recycling facilities (48.2%) and weak regulation/enforcement (40.0%).

Table 5: Ranked barriers to C&D waste recycling in Abuja (n=110; multiple selection, up to 3).

Barrier	n	% of respondents	Rank
Lack of awareness	65	59.1	1
Lack of recycling facilities	53	48.2	2
Weak regulation or enforcement.	44	40.0	3
High cost of processing.	42	38.2	4
Logistical challenges (transport/storage)	31	28.2	5
Preference for new materials	31	28.2	5
Low market demand for recycled materials	28	25.5	7

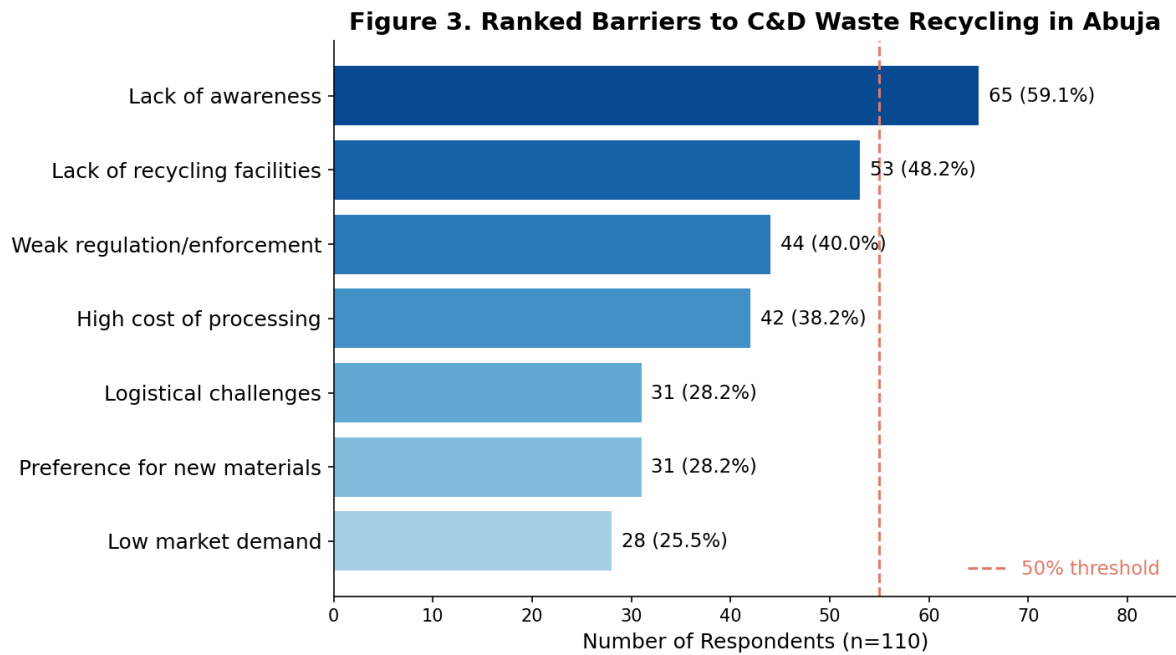


Figure 3: Ranked barriers to C&D waste recycling in Abuja (n=110). A dashed line indicates a 50% threshold.

4.6 Enablers and Preferred Incentives

The incentives that were seen to be more effective in fostering the use of CE have been highlighted in Table 6 below. The incentive that was the most widely selected was the assurance of markets for recycled products (49.1%), followed by technical training and development (47.3%), grant provision of recycling equipment (42.7%), and recycling legislation (40.9%). Respondents could select up to two incentives; therefore, the percentages represent the proportion selecting each option and are not expected to sum to 100%.

Table 6: Incentives most likely to encourage greater CE adoption (n=110; multiple selection, up to 2).

Incentive	n	% of respondents
Guaranteed markets for recycled materials	54	49.1
Technical training & capacity building	52	47.3
Grants for recycling equipment:	47	42.7
Mandatory recycling regulation	45	40.9
Tax rebates or subsidies	39	35.5

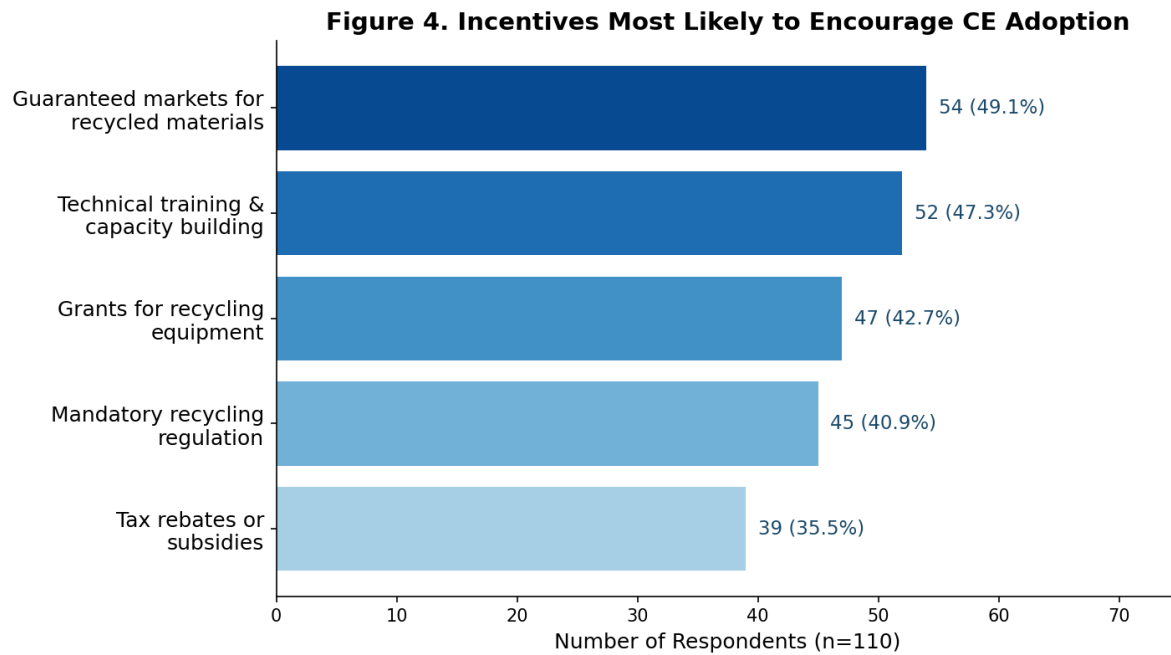


Figure 4: Preferred incentives for encouraging greater CE adoption (n=110).

4.7 Correlation Structure Among CE-Attitude Items

Positive Spearman rank correlations were found for all 21 pairings of the seven CE-attitude variables, thus demonstrating the internal consistency of the measure (see Table 7 and Figure 5). Strong correlations were observed between quality belief and willingness to pay ($\rho = 0.61$) as well as between knowledge and organizational policy ($\rho = 0.62$). There was a strong correlation between quality belief and adoption-if-incentives ($\rho = 0.52$), while there was an equally strong correlation between willingness to pay and adoption-if-incentives ($\rho = 0.50$). The variable that exhibited the weakest correlations was regulation adequacy ($\rho = 0.22$ – 0.41), owing to its institutional focus.

Table 7: Spearman correlation matrix of CE-attitude scale items (n=107–110).

	Awareness	Knowledge	Org. Policy	Reg. Adequacy	Quality Belief	Willing to Pay
Knowledge	0.46					
Org. Policy	0.40	0.62				
Reg. Adequacy	0.25*	0.22*	0.31**			
Quality Belief	0.38***	0.43***	0.44***	0.41***		
Willing to Pay	0.37***	0.48***	0.39***	0.35***	0.61***	
Adopt-if-Incentives	0.46***	0.37***	0.30**	0.29**	0.52***	0.50***
Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; all non-starred values significant at $p < 0.0001$						

Figure 5. Spearman Correlation Matrix of CE-Attitude Scale Items (n=107-110)
All values significant at $p < 0.05$

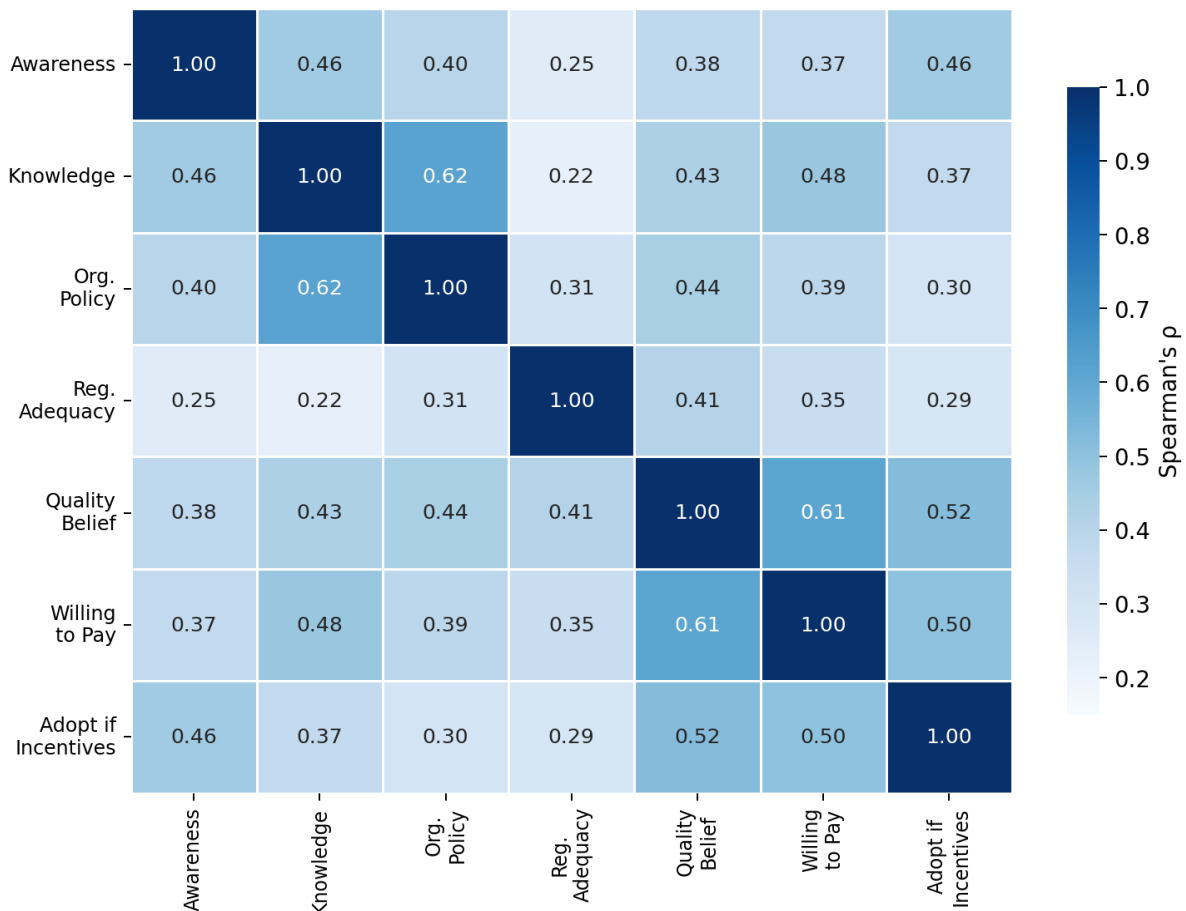


Figure 5: Spearman correlation heatmap of CE-attitude items. All values are significant at $p < 0.05$.

5. DISCUSSION

5.1 The Awareness-Practice-Incentive Decoupling

The main implication of the current study is that the gap in awareness and practice that is prevalent in Nigeria's construction CE literature (Unegbu et al., 2024) does not emerge due to differences in awareness amongst professionals. However, this interpretation should be considered in light of the measurement approach. Awareness was assessed through self-reported Likert-scale responses, which may capture perceived familiarity with CE concepts rather than the depth or quality of respondents' underlying knowledge. Consequently, professionals may report similar levels of awareness while still differing in their technical understanding or ability to apply CE principles in practice. There were no statistically significant differences in awareness levels with regard to role ($p = 0.709$) or education ($p = 0.810$). In turn, behavior related to waste separation and incentives showed statistically significant differences depending on role ($p = 0.028$ and $p = 0.025$, correspondingly). This separation of variables carries much significance in terms of intervention design, which should recognize that the variable on which it operates, "greater awareness leads to greater practice," is evenly distributed among professionals.

5.2 Quality Assurance as a Market-Side Lever

The most significant correlation found in attitude data was between perceptions regarding the quality of the recycled material and willingness to pay premium prices ($p = 0.61$). Such an observation adds empirically to the claim that has often been made in the academic literature but rarely tested, namely, that consumer acceptance of recycled construction and demolition (C&D) material is based more on perception of performance than on environmental attitudes (Ranasinghe et al., 2024). From

this, tools like certifications, material passports, and testing are demand-side tools, not auxiliary technical solutions. If there is a correlation between perception of quality and willingness to pay a higher price, it would mean that measures that enhance quality would be much more effective than measures focused on raising awareness in motivating recycling.

The findings provide evidence of particular engineering solutions that could transform the awareness of the circular economy into tangible construction techniques. It is clear that the strong correlation between the perception of the quality of recycled materials and willingness to pay should make engineering solutions to guarantee quality the key component of implementing the concept of a circular economy. This can be done through material testing, quality certification, and digital material passports for recycled construction materials. Similarly, the reported lack of recycling facilities indicates a need for accessible sorting and processing technologies, including on-site or decentralized systems for the separation, crushing, and recovery of recyclable construction materials. Such intervention techniques could be helpful in reducing the risk of contamination and increasing the reliability of recovered material. The implications of the research findings do not stop at awareness and policy but also help identify areas where the role of engineering and information technology is significant in transitioning from traditional waste management practices to material recovery and recycling techniques.

5.3 Why Contractors and Builders Behave Differently from Engineers

The most practically useful findings of this research can be obtained from the chi-square analysis carried out for every specific role separately. The contractors and the construction workers proved to separate waste more efficiently and be prepared to apply the principles of circular economy under the influence of motivation. The probable reason behind it, although not tested in the course of this research, is the fact that the contractors and builders may be more engaged in construction-related activity and, thus, more familiar with the waste generation process. It has to be considered a hypothesis that requires further research, as a cause-and-effect relationship has yet to be proven.

5.4 Institutional Constraints and the Limits of Voluntary Adoption

Lack of awareness was the most frequently reported barrier, cited by 59.1% of respondents, followed by lack of recycling infrastructure (48.2%) and weak regulation/enforcement (40.0%). However, this finding should be distinguished from the study's statistical assessment of individual CE awareness. The barrier question captures respondents' perceptions of constraints affecting CE adoption across the sector, whereas the awareness analysis measures respondents' own reported level of CE awareness. Thus, the fact that lack of awareness was frequently perceived as a sectoral barrier does not necessarily contradict the finding that reported awareness did not differ significantly by professional role or educational attainment. Respondents may, for example, perceive inadequate awareness among clients, workers, suppliers, policymakers, or other stakeholders even when their own reported awareness is relatively similar. It should be noted that infrastructure-/market-facilitating enablers such as guaranteed markets (49.1%) and equipment grants (42.7%) are preferred over regulation (40.9%) and tax incentives (35.5%), reflecting the view that the development of infrastructure and markets is more actionable for respondents compared to legislation. Internationally, a combination of regulatory, infrastructure investment, and market development was recognized as the most efficient approach to achieve high recovery rates of C&D in Sweden and Germany (Bonifazi et al., 2025). The attitude among the surveyed professionals is seen to be quite positive, with the respondents having moderately to highly aware levels and high conditional willingness to use CE ($M = 3.86$). When taking into consideration the other constraints such as infrastructure, markets, and enforcement, it is clear that there are many more constraints other than awareness.

The results from the analysis can be used to indicate that overcoming the implementation gap would require much more than just institutional reforms and awareness programs. The infrastructure and market gaps discussed above can be solved with a combination of C&D waste recovery systems, including source separation, mechanical sorting, processing, testing, and tracking of materials. For instance, proper sorting and crushing systems could enhance the process of recovering concrete, masonry, and other recoverable construction materials, whereas material testing and certification could

help generate the performance data required to improve market acceptance of recycled construction materials. The combination of the two approaches could create an efficient system of separation, processing, testing, and reutilization of recycled materials.

5.5 Limitations

There are various limitations to consider in relation to these results. Firstly, the use of cross-sectional methodology makes it impossible to determine causation. Secondly, purposive sampling prevents the results from being statistically generalized beyond the Abuja construction labor force. Thirdly, all practices under study are based on self-reporting and therefore prone to social desirability bias. Fourthly, the research is only done in one city. Fifthly, the limited size of the management/policy group ($n = 7$) limits the statistical comparison power. In addition, engineers and architects were combined into a single professional category for role-based analysis because of sample-size and cell-frequency considerations. Although this grouping supported the statistical analysis, the two professions may differ in training, responsibilities, and degree of site involvement, and their combination may therefore mask within-group differences.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

The current research seeks to assess the awareness level, practice, and determinants of construction waste management (CE) among 110 construction professionals in Abuja. For this purpose, a seven-question attitude scale (Cronbach's $\alpha = 0.803$) and inferential statistical techniques not typically applied to similar surveys of construction professionals in Nigeria have been used. Findings have confirmed the existence of the awareness-practice paradox previously reported in the literature as well as shed light on its nature: the awareness level is statistically consistent in terms of the professionals' positions and education levels; however, separation behaviors and reactions to incentives differ greatly depending on the position held. The belief in the high quality of the recycled materials proves to be the main determinant of willingness to pay, thus demonstrating that quality control is the key market-side determinant of CE. The findings also highlight the need to translate these behavioral and institutional insights into engineering practice through improved waste-separation systems, sorting and material-recovery technologies, standardized quality testing, and digital material traceability. Such interventions can help bridge the gap between willingness to adopt CE and actual recovery and reuse of construction materials."

6.2 Recommendations

For Policymakers and Regulators

Strengthen enforcement of existing C&D waste management regulations rather than relying on voluntary compliance; introduce mandatory waste management plans for projects above a defined size threshold; and develop standards and certification mechanisms for recycled C&D materials to directly address the quality-belief constraint identified as the strongest correlate of market willingness to pay.

For Training and Capacity-Building Programs

Target site-level contracting roles (contractors/builders) specifically, given this group's demonstrated stronger behavioral and incentive responsiveness; prioritize incentive-linked training formats, consistent with the high mean agreement ($M=3.86$) for incentive-conditional adoption; and invest in quality-assurance training as a mechanism for shifting quality perceptions that are holding back market demand.

For Industry and Market Actors

Make investments in engineering-based quality assurance measures such as standardized material testing, certification, and material passports to improve confidence in recycled construction materials. Construction firms and recyclers should also think about waste separation techniques at the job site, along with the proper technology for sorting, crushing, and recycling of the construction waste

materials. If there is no facility for centralized recycling available, then it will be better to use the decentralized technique. Digital material passports can further support traceability by recording material composition, quality characteristics, reuse potential, and recovery history. These methods can assist in turning willingness to embrace CE into actual processes of recovery and reuse, which is a problem for 48.2 percent of those surveyed, as lack of recycling facilities was mentioned as one of the key barriers. Public-private partnerships may be considered as a way to increase access to such facilities.

6.3 Suggestions for Future Research

Future research should:

- i. Use probability-based sampling across a wider Abuja construction workforce to strengthen generalizability of role-based findings.
- ii. Adopt a longitudinal design tracking the same cohort before and after specific regulatory or incentive interventions to test incentive responsiveness causally.
- iii. Replicate this survey design in other rapidly urbanizing Nigerian cities to determine whether the awareness-practice decoupling observed in Abuja reflects a broader national pattern or FCT-specific conditions.

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