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# OPTIMIZING CIRCULAR ECONOMY PRACTICES IN NIGERIAN CONSTRUCTION: EFFECTIVE STRATEGIES FOR WASTE REDUCTION AND RESOURCE EFFICIENCY

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**Abstract** This study explores the current state of circular economy (CE) practices in the Nigerian construction industry, identifying key challenges and opportunities for their implementation. Utilizing a mixed-methods approach, data were collected from 200 survey participants and 20 key informants through structured surveys and semi-structured interviews. The quantitative data were analyzed using descriptive and inferential statistics, including regression and factor analysis, to uncover the relationships between variables and the underlying dimensions of barriers to CE adoption. The findings reveal that while there is a moderate level of awareness and implementation of CE practices, such as waste segregation and the use of recycled materials, these practices are not yet widespread. Major barriers identified include lack of awareness, high implementation costs, and insufficient regulatory support. Specifically, 75% of respondents cited lack of awareness as a significant barrier, and 80% identified high costs as a deterrent. Regression analysis indicated that awareness level, regulatory support, and company size positively influence CE practice adoption, while perceived cost has a negative impact. The study also highlights positive perceptions towards CE practices among industry professionals, with 85% of respondents recognizing their importance for the future of the construction industry. Factor analysis revealed three main dimensions of barriers: financial, awareness and education, and regulatory and policy barriers. Based on these findings, the study recommends targeted educational programs to increase awareness, financial incentives to mitigate cost barriers, and stronger regulatory frameworks to enforce sustainable practices.

**Keywords**: Circular Economy, Recycled Materials, Regulatory Support, Sustainable Practices, Waste Management.

## 1. Introduction

The circular economy (CE) emphasizes reducing waste, keeping products and materials in use, and regenerating natural systems, contrasting the linear 'take-make-dispose' model [1]. It addresses critical issues like resource depletion, environmental degradation, and climate change [2], [3], advocating strategies such as recycling and refurbishing [4]. Economically, the CE could increase the EU's GDP by 0.5% by 2030 and create 700,000 jobs [5], gaining global recognition as essential for sustainable development [6].

The construction industry, consuming 40% of global resources and generating 30% of waste [7], can significantly benefit from CE practices, such as using recycled materials and modular construction [8]. These practices not only reduce costs and environmental impact but also improve industry sustainability [9], [10]. In Nigeria, the construction sector is rapidly growing, yet it faces challenges like increased waste and resource inefficiency [13]. Traditional practices lead to significant material wastage and economic losses [15].

Adopting CE in Nigerian construction can improve resource efficiency, reduce environmental impacts, and foster economic development [16]. However, this requires systemic changes in policies and industry practices [17]. Current waste management in Nigeria is inadequate, with significant waste not properly managed [14], [18]. Sustainable practices can mitigate these issues, enhancing industry competitiveness [13].

This research aims to identify effective waste reduction strategies in Nigerian construction, addressing environmental and economic challenges [19]. It reviews strategies like on-site waste segregation and digital tools such as BIM [15], exploring advanced technologies like 3D

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printing [12]. The study uses qualitative and quantitative methods to gather data from industry stakeholders, providing actionable recommendations [20]. Another objective is to enhance resource efficiency through CE practices, such as using sustainable materials and designing for disassembly [2], [8]. These practices reduce the demand for new resources and minimize waste [19]. The study also explores the role of material recovery facilities in creating a circular supply chain [21].

CE adoption in Nigerian construction offers environmental and economic benefits, including waste reduction and resource efficiency [8], [19]. It supports the United Nations Sustainable Development Goals, particularly SDG 11 and SDG 12 [22], by promoting sustainable construction practices and enhancing urban sustainability [21]. This research provides a roadmap for implementing CE strategies in the construction industry, contributing to sustainable development goals [2].

## 2. Method

### 2.1 Literature Review

The circular economy (CE) is an economic model focused on eliminating waste and continuously using resources, based on three main principles: designing out waste, keeping products and materials in use, and regenerating natural systems [1]. Unlike the traditional linear economy's 'take-make-dispose' model, CE aims for sustainability by re-circulating resources [2]. Key frameworks include the butterfly diagram, illustrating the flow of biological and technical materials in two cycles, and the ReSOLVE framework—Regenerate, Share, Optimize, Loop, Virtualize, Exchange—which guides businesses in implementing CE principles [1], [23]. The 3R principles—Reduce, Reuse, Recycle—are central to CE, aiming to minimize waste and enhance resource efficiency [8]. CE also supports economic growth by decoupling resource use from economic activities, fostering sustainable business innovations, and overcoming barriers such as regulatory and financial constraints [6], [24]-[25].

### 2.2 Circular Economy in Construction

The construction industry is a significant consumer of resources and producer of waste. CE practices, including recycling, reuse, and sustainable materials, can mitigate these issues [2]. The European Union has adopted policies promoting CE, leading to reduced waste and improved resource efficiency in construction [9]. Successful implementations include the Netherlands' use of modular construction and Finland's design for disassembly, which facilitate material recycling and reuse [8], [10]. China's focus on green building standards and eco-industrial parks has significantly increased recycling rates and the use of secondary materials in construction [19], [26]. Technologies like Building Information Modeling (BIM) and prefabrication help reduce waste and improve construction efficiency by enhancing material management and planning [16], [20]. The use of sustainable materials such as low-carbon concrete and recycled aggregates also reduces the environmental impact of construction activities [21].

### 2.3 Current Practices in Nigeria

In Nigeria, the construction industry faces challenges such as waste generation and resource inefficiency, often due to traditional practices and inadequate waste management systems [14], [27]. The sector's reliance on a linear economy model exacerbates environmental degradation and inefficient resource use. Current waste management practices involve limited recycling and reuse, with much waste ending up in landfills or illegal dumpsites, leading to significant environmental pollution [14]. Despite the global emphasis on CE, its adoption in Nigeria is limited by financial, infrastructural, and technical barriers [27], [28]. Implementing on-site waste segregation and establishing material recovery facilities could enhance recycling efforts and reduce landfill waste [19], [16]. Incorporating recycled materials into new construction projects could improve resource efficiency and environmental outcomes, yet these practices are not widely adopted [16], [20]. There is a need for increased awareness, investment in infrastructure, and the development of supportive policies to promote CE in Nigeria's construction sector [14], [28].

### 2.4 Gaps in Literature

The literature on CE in Nigeria's construction industry is limited, often focusing

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on general barriers such as inadequate infrastructure and financial constraints, without providing detailed, context-specific strategies [14], [16]. More in-depth research is needed to explore the feasibility, effectiveness, and scalability of specific CE practices in Nigeria, considering local material availability, construction methods, and economic conditions [2]. There is also a critical need to study the integration of advanced technologies like BIM, 3D printing, and modular construction, which have proven effective in other regions [20]. Understanding local cultural attitudes towards waste and recycling, regulatory frameworks, and economic incentives is essential for designing successful CE strategies [29]. Engaging stakeholders—including government, industry, and communities—is crucial for promoting sustainable practices [3]. Addressing these gaps can provide valuable insights and actionable recommendations for policymakers and industry stakeholders, enhancing sustainable construction and economic resilience in Nigeria [8], [6].

## 3. Method

This study used a mixed-methods approach, combining qualitative and quantitative methods to explore circular economy (CE) practices in the Nigerian construction industry [30]. The approach captured the complexity of real-world phenomena through surveys, interviews, and case studies [31], [32]. Quantitative data were gathered via surveys from construction professionals, assessing trends in waste management, CE awareness, and implementation barriers [15], [20] as shown in Table 1. Semi-structured interviews provided qualitative insights into the challenges and solutions for CE adoption [8], [34]. Case studies involved site visits to document real-world CE applications, highlighting successes and challenges [9], [29]. This mixed-methods approach ensured a comprehensive analysis and enhanced the validity of the findings [35].

Structured surveys targeted construction professionals to gather data on waste management practices, CE awareness, and barriers [15]. These surveys were based on existing studies to ensure relevance [20]. Semi-structured interviews with key stakeholders explored themes such as regulatory frameworks and economic incentives [8], [13], [40]. Case studies provided practical examples and empirical evidence of CE practices [9], [29], [42], [43]. A purposive sampling technique was used to select knowledgeable participants, ensuring a comprehensive view of CE adoption [37]. The survey included 200 respondents, and 20 key informants were interviewed [15], [38]. Quantitative data were analyzed using SPSS, with descriptive and inferential statistics to explore relationships [36]. Qualitative data were analyzed through thematic analysis, identifying key themes [39]. Triangulation was used to integrate data, enhancing study reliability [30].

Ethical considerations included obtaining informed consent from all participants, ensuring their awareness of the study's purpose and their right to withdraw at any time [35]. Confidentiality and anonymization of participant data were maintained to build trust and protect participant identities, ensuring the integrity of the data collected [35].

**Table 1.** Research Questionnaire

| SN | Category | Question | Citation |
|---|---|---|---|
| 1 | General Information | What is your role in the construction industry? | Adapted from [15] |
| 2 | | How many years of experience do you have in the construction industry? | Adapted from [20] |
| 3 | | What is the size of your company? | Adapted from [27] |
| 4 | | What type of construction projects does your company primarily engage in? | Adapted from [13] |
| 5 | | What is your highest level of education? | Adapted from [36] |

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**Table 1.** Research Questionnaire (Cont')

| SN | Category | Question | Citation |
|---|---|---|---|
| 6 | Current Practices | Have you received any training on circular economy practices? | Adapted from [8] |
| 7 | | How familiar are you with circular economy principles? | Adapted from [29] |
| 8 | | Does your company practice waste segregation on-site? | Adapted from [15] |
| 9 | | Do you use recycled materials in your construction projects? | Adapted from [9] |
| 10 | | Do you implement Building Information Modeling (BIM) in your projects? | Adapted from [20] |
| 11 | | How often do you conduct environmental impact assessments? | Adapted from [8] |
| 12 | | Do you incorporate modular construction methods in your projects? | Adapted from [29] |
| 13 | | How frequently do you engage in design for disassembly (DfD)? | Adapted from [13] |
| 14 | Barriers to Implementation | Are there policies in your company promoting circular economy practices? | Adapted from [9] |
| 15 | | What are the main barriers to implementing circular economy practices in your projects? | Adapted from [15] |
| 16 | | How significant is the lack of awareness as a barrier to CE implementation? | Adapted from [8] |
| 17 | | How significant is the cost of implementation as a barrier to CE practices? | Adapted from [29] |
| 18 | | How significant are regulatory challenges as a barrier to CE practices? | Adapted from [20] |
| 19 | | How significant is the lack of technical expertise as a barrier to CE implementation? | Adapted from [37] |
| 20 | | How significant is the resistance to change as a barrier to CE practices? | Adapted from [38] |
| 21 | | How significant are supply chain issues as a barrier to CE practices? | Adapted from [36] |
| 22 | Perceptions and Attitudes | How important do you think circular economy practices are for the future of the construction industry? | Adapted from [30] |
| 23 | | How willing are you to adopt circular economy practices in your future projects? | Adapted from [39] |
| 24 | | How effective do you think circular economy practices are in reducing construction waste? | Adapted from [8] |
| 25 | | How effective do you think CE practices are in improving resource efficiency? | Adapted from [36] |
| 26 | | How supportive are you of government policies promoting circular economy practices? | Adapted from [20] |
| 27 | | How likely are you to recommend circular economy practices to other professionals? | Adapted from [37] |
| 28 | | How confident are you in the feasibility of implementing CE practices in Nigeria? | Adapted from [38] |

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## 4. Results

### 4.1 Response Rate

The response rate is a key metric in survey research, indicating the proportion of respondents who completed the survey. In this study, 300 construction industry professionals were approached, with 200 completing the survey, resulting in a response rate of 66.7%. Additionally, 20 out of 30 invited industry experts participated in in-depth interviews, also yielding a 66.7% response rate. This rate is robust, particularly given the demanding nature of the construction industry, where professionals often have limited time for such activities [44]. According to Nulty [45], a response rate above 50% is generally acceptable and suggests a reliable dataset for drawing meaningful conclusions. The high response rate indicates strong interest in the issues surrounding circular economy (CE) practices in the construction industry, highlighting their relevance and importance to professionals.

The effective strategies employed to encourage participation, including personalized emails, follow-up reminders, and assurances of confidentiality, likely contributed to this strong response rate. The use of online survey platforms and flexible scheduling for interviews further facilitated participation.

### 4.2 Quantitative Data Analysis

The quantitative data were analyzed using descriptive and inferential statistics, including regression analysis and factor analysis, to explore relationships between variables. Table 2 shows that a majority of respondents have significant experience in the construction industry, with 65% having more than 5 years of experience. This experienced sample base enhances the reliability of the findings, reflecting well-informed perspectives on CE practices. Understanding the demographics, such as the level of expertise among respondents, is crucial for validating the data collected [36].

**Table 2.** Experience in the Construction Industry

| SN | Experience (Years) | Frequency | Percentage |
|---|---|---|---|
| 1. | <1 | 10 | 5% |
| 2. | 01-May | 60 | 30% |
| 3. | 06-Oct | 70 | 35% |
| 4. | Nov-15 | 40 | 20% |
| 5. | >15 | 20 | 10% |

### 4.3 Current Practices

Table 3 illustrates that 50% of respondents reported practicing waste segregation on-site either always or often, indicating a moderate awareness and implementation of these practices within the industry. However, 10% of respondents indicated they never practice waste segregation, highlighting a significant area for improvement. This finding aligns with previous studies, such as Ajayi et al. (2017), which noted gaps in the implementation of waste management practices in the construction sector [15]. Enhancing training programs and enforcing stricter waste management policies could help improve compliance and promote more sustainable practices within the industry.

**Table 3.** Waste Segregation on-site

| SN | Response | Frequency | Percentage |
|---|---|---|---|
| 1 | Always | 40 | 20% |
| 2 | Often | 60 | 30% |
| 3 | Sometimes | 50 | 25% |
| 4 | Rarely | 30 | 15% |
| 5 | Never | 20 | 10% |

The usage of recycled materials as shown in Table 4 is relatively low, with only 25% of respondents reporting that they often or always use recycled materials. This finding aligns with Adams et al. (2017), who noted that the adoption of recycled materials in construction is still in its early stages globally and more so in developing countries like Nigeria. The high percentage of those rarely or never using recycled materials (50%) indicates significant barriers, such as a lack of availability of recycled materials and insufficient incentives to encourage their use.

**Table 4.** Use of Recycled Materials in Projects

| SN | Response | Frequency | Percentage |
|---|---|---|---|
| 1 | Always | 20 | 10% |
| 2 | Often | 30 | 15% |
| 3 | Sometimes | 50 | 25% |
| 4 | Rarely | 70 | 35% |
| 5 | Never | 30 | 15% |

### 4.4 Barriers to Implementation

The data in Table 5 indicates that 75% of respondents view the lack of awareness as a moderately to very significant barrier to the implementation of CE practices. This aligns with

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[8] who highlighted awareness as crucial for the successful adoption of CE practices. The high percentage underscores the need for educational and awareness initiatives to promote the benefits and methodologies of the circular economy. Implementing comprehensive educational programs and campaigns can bridge this knowledge gap and cultivate a culture of sustainability within the construction industry.

**Table 5.** Lack of Awareness as a Barrier

| SN | Response | Frequency | Percentage |
|---|---|---|---|
| 1. | Not significant | 20 | 10% |
| 2. | Slightly significant | 30 | 15% |
| 3. | Moderately significant | 60 | 30% |
| 4. | Very significant | 90 | 45% |

The cost of implementation, as shown in Table 6, is perceived as a major barrier, with 80% of respondents rating it as moderately to very significant. This finding is consistent with [29], who identified financial constraints as a significant obstacle to adopting sustainable practices in the construction sector. The data suggests a need for financial incentives and government support to mitigate these cost barriers. Implementing subsidies, tax breaks, and grants could significantly reduce financial obstacles, making it more feasible for construction companies to adopt CE practices. Additionally, developing cost-effective technologies and materials that align with CE principles can further lower implementation costs and encourage broader adoption.

**Table 6**. Cost of Implementation as a Barrier

| SN | Response | Frequency | Percentage |
|---|---|---|---|
| 1. | Not significant | 15 | 7.50% |
| 2. | Slightly significant | 25 | 12.50% |
| 3. | Moderately significant | 60 | 30% |
| 4. | Very significant | 100 | 50% |

Table 7 reveals that 85% of respondents consider CE practices to be moderately to very important for the future of the construction industry. This positive perception indicates a growing recognition of the critical role of sustainability in construction, consistent with the findings of [13]), who noted increasing awareness and positive attitudes towards sustainability among industry professionals. This widespread acknowledgment reflects an industry poised to embrace sustainable practices, provided that sufficient support and resources, such as education, training, and financial incentives, are available to facilitate this transition.

**Table 7.** Importance of CE Practices for the Future

| SN | Response | Frequency | Percentage |
|---|---|---|---|
| 1. | Not important | 10 | 5% |
| 2. | Slightly important | 20 | 10% |
| 3. | Moderately important | 70 | 35% |
| 4. | Very important | 100 | 50% |

The descriptive analysis of the collected data provides a comprehensive overview of the current state of CE practices, the barriers to their implementation, and the perceptions and attitudes towards these practices in the Nigerian construction industry. Addressing the identified barriers through targeted educational programs, financial incentives, and robust regulatory frameworks is essential for promoting the widespread adoption of CE practices. This approach will not only enhance the industry's environmental performance but also contribute to the broader goals of sustainable development.

### 4.5 Regression Analysis

A multiple regression analysis was performed to identify the key predictors of circular economy (CE) practice adoption in the Nigerian construction industry. The dependent variable was the level of CE practice adoption, quantified through a composite index aggregating responses on various CE practices. The independent variables included awareness level, perceived cost, regulatory support, and company size. These variables were chosen based on their relevance to CE adoption, as emphasized in previous studies [8], [20]. The analysis aimed to determine the extent to which

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each of these factors influenced the adoption of CE practices within the industry.

**Table 8.** Regression Analysis

| SN | Variable | Coefficient (β) | Standard Error | t-Value | p-Value |
|---|---|---|---|---|---|
| 1. | Awareness Level | 0.45 | 0.1 | 4.5 | <0.001 |
| 2. | Perceived Cost | -0.3 | 0.12 | -2.5 | 0.014 |
| 3. | Regulatory Support | 0.35 | 0.11 | 3.18 | 0.002 |
| 4. | Company Size | 0.2 | 0.09 | 2.22 | 0.028 |

The multiple regression analysis results in Table 8 show that awareness level is a significant positive predictor of CE practice adoption ($\beta = 0.45$, $p < 0.001$), indicating that greater awareness about CE principles correlates with increased adoption of these practices in the construction industry [8]. Regulatory support also positively impacts CE adoption ($\beta = 0.35$, $p = 0.002$), highlighting the role of effective regulations in providing necessary guidelines and incentives [20]. Company size is another positive predictor ($\beta = 0.20$, $p = 0.028$), with larger companies more likely to implement CE practices, possibly due to their greater resources and capabilities [36]. Conversely, perceived cost negatively affects CE adoption ($\beta = -0.30$, $p = 0.014$), with higher costs being a significant barrier, consistent with studies identifying financial constraints as a major challenge in the industry [29].

### 4.6 Factor Analysis

A factor analysis was conducted to uncover the underlying dimensions of barriers to implementing circular economy (CE) practices in the Nigerian construction industry. This technique identifies clusters of related variables, known as factors, helping to understand the structure of the observed variables. The analysis identified three main factors: financial barriers, awareness and education barriers, and regulatory and policy barriers. The eigenvalues and the variance explained by each factor were calculated to assess their relative importance, providing insights into the primary challenges facing CE implementation.

**Table 9**. Factor Analysis

| SN | Factor | Eigenvalue | Variance Explained (%) |
|---|---|---|---|
| 1 | Financial Barriers | 3.2 | 40 |
| 2 | Awareness and Education | 2.5 | 31.2 |
| 3 | Regulatory and Policy | 1.8 | 22.5 |

The factor analysis, presented in Table 9, identified three main barriers to the implementation of circular economy (CE) practices in the Nigerian construction industry. Financial barriers, explaining 40.0% of the variance, are the most significant, including high initial costs, lack of funding, and perceived risks associated with new technologies [20], [46]. Awareness and education barriers accounted for 31.2% of the variance, highlighting the critical need for knowledge and training on CE benefits and practices [8]. This includes insufficient training programs and limited dissemination of successful case studies [29]. Regulatory and policy barriers, which explained 22.5% of the variance, involve weak enforcement of environmental laws and a lack of supportive regulations [9], [29]. Addressing these barriers requires financial incentives, educational initiatives, and stronger regulatory frameworks to foster an enabling environment for CE adoption.

### 4.7 Qualitative Data Analysis

The qualitative interviews provided deep insights into the challenges and opportunities for implementing circular economy (CE) practices in the Nigerian construction industry. Key themes included regulatory challenges, economic incentives, and cultural attitudes. Respondents criticized current regulatory frameworks for lacking the necessary stringency to enforce waste management and recycling consistently, advocating for comprehensive policies, mandatory waste segregation, and penalties for non-compliance [20]. Economic incentives like subsidies, tax breaks, and grants were identified as crucial to mitigating financial barriers, as high initial costs deter companies

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from adopting CE practices despite long-term benefits [8]. Cultural attitudes towards waste and recycling were seen as both barriers and opportunities; while a lack of recycling culture poses a challenge, increased public awareness and education could shift perceptions towards sustainability. Suggested measures included educational campaigns for professionals and the public, integrating sustainability education into school curricula, and engaging community leaders to promote CE.

## 5. Discussion

The findings of this study provide a detailed understanding of the adoption and challenges of implementing circular economy (CE) practices in the Nigerian construction industry. The results reveal a combination of progress and persistent barriers that reflect both the industry's current capacity and its potential for growth. This discussion critically evaluates these findings in light of relevant literature, offering a broader perspective on their implications.

The study revealed moderate levels of adoption of CE practices such as waste segregation and the use of recycled materials. Only 50% of respondents reported consistent waste segregation practices, while 25% frequently used recycled materials. These findings align with Ajayi et al. [15], who highlighted similar gaps in waste management practices within the construction industry. Additionally, Adams et al. [9] noted that the use of recycled materials remains in its infancy, particularly in developing countries like Nigeria. This study confirms that infrastructural and logistical barriers, such as the limited availability of quality recycled materials and insufficient economic incentives, significantly hinder broader adoption of these practices.

The study identified three major barriers to CE implementation: lack of awareness, high costs, and insufficient regulatory support. Regression analysis showed that awareness is a significant positive predictor of CE adoption, a finding consistent with Ajayi et al. [15], who emphasized that awareness campaigns are crucial to promoting sustainable practices. Financial constraints were the most significant barrier, with 80% of respondents rating cost-related factors as moderately to very significant. This finding is in line with the observations of Adams et al. [9], who identified financial limitations as a major obstacle to CE implementation in developing countries. These constraints, exacerbated by high initial costs and limited funding opportunities, highlight the necessity for government interventions such as subsidies, tax breaks, and grants to offset these barriers [29].

Regulatory challenges also emerged as a significant barrier, accounting for 22.5% of the variance in the factor analysis. This aligns with previous studies, such as those by Smith et al. [46] and Ajayi et al. [15], which noted that weak enforcement mechanisms and a lack of supportive policies often undermine CE practices. Effective regulatory frameworks can play a pivotal role in facilitating compliance and encouraging sustainable practices. Strengthening these frameworks to include mandatory waste segregation, recycling, and penalties for non-compliance is critical for advancing CE adoption in the construction industry.

Cultural attitudes toward waste and recycling were also identified as both a challenge and an opportunity. While the qualitative data indicated a lack of recycling culture, it also suggested that public awareness and education campaigns could significantly shift perceptions toward sustainability. This is consistent with Adams et al. [9], who demonstrated the efficacy of integrating sustainability education into school curricula and community programs in driving cultural change. In the Nigerian context, similar educational initiatives could help bridge the gap in public attitudes and foster a culture of sustainability.

The positive perception of CE practices among industry professionals, as demonstrated by the high percentage of respondents (85%) who viewed them as moderately to very important, reflects a growing recognition of their importance for the future of the construction industry. This finding resonates with previous studies [8], [46], which noted a global trend of increasing awareness and favorable attitudes toward sustainability. The readiness of Nigerian professionals to adopt CE practices is a promising sign, suggesting that with appropriate support and resources, the industry is well-positioned to transition toward more sustainable practices.

The study underscores the need for a coordinated, multi-faceted approach to address the barriers identified. Comprehensive

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educational programs are essential to enhance awareness and build capacity among construction professionals, while financial incentives can alleviate the cost-related challenges. Robust regulatory frameworks are needed to provide clear guidelines and enforce compliance. Additionally, investments in research and development of cost-effective technologies and materials aligned with CE principles could further reduce barriers to adoption and promote innovation within the industry.

In summary, the findings of this study highlight both the opportunities and challenges associated with CE adoption in the Nigerian construction industry. Addressing these challenges through targeted interventions, such as education, financial support, and regulatory enhancements, can significantly advance the industry's sustainability performance. These insights contribute to the growing body of knowledge on CE practices and provide actionable recommendations for policymakers and practitioners in Nigeria and similar contexts, laying the groundwork for more sustainable construction practices globally.

## 6. Conclusion

This study provided a detailed analysis of circular economy (CE) practices within the Nigerian construction industry, revealing moderate awareness and implementation, particularly in areas like waste segregation and the use of recycled materials. The research identified significant barriers: a lack of awareness (75% of respondents), high implementation costs (80%), and inadequate regulatory support. Regression analysis demonstrated that awareness, regulatory support, and company size are positive predictors of CE adoption, while perceived costs are a deterrent. Factor analysis further highlighted financial, awareness and education, and regulatory and policy barriers as critical obstacles.

Despite these challenges, 85% of respondents acknowledged the importance of CE practices for the industry's future, indicating a positive outlook toward sustainability. The study's findings have crucial implications for stakeholders. For construction firms, embracing CE practices can improve resource efficiency and reduce waste, leading to long-term cost savings. Investment in training and advanced technologies like Building Information Modeling (BIM) and modular construction methods can facilitate this transition.

Policymakers are urged to create supportive environments through stringent regulatory frameworks that mandate waste segregation and recycling, coupled with financial incentives like subsidies, tax breaks, and grants to offset the high costs of CE adoption. Additionally, public awareness campaigns and educational programs are essential to shift cultural attitudes towards sustainability.

Future research should monitor CE implementation progress over time, explore emerging technologies, and examine the socio-economic impacts of CE practices, including job creation and environmental sustainability. Comparative studies with other developing countries could offer insights into context-specific challenges and opportunities. Integrating CE principles from the design phase of construction projects and focusing on supply chain management for sourcing recycled materials are also recommended.

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