

Assessing Consumer Awareness and Knowledge Gaps in Circular Construction: Evidence from Ghana

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ABSTRACT

Consumer awareness of circular construction (CC) remains a critical barrier to achieving sustainable housing and climate goals in Ghana, as limited understanding and persistent misconceptions weaken the demand for circular solutions. This study aimed to assess consumer awareness of CC, identify key knowledge gaps and perceived barriers, and examine demographic variations in awareness among urban housing decision-makers in Ghana. A structured questionnaire was developed from established CC literature, validated through expert review and pilot testing, and administered to 200 adult respondents using stratified random sampling in four cities. Data were analysed using descriptive statistics, Relative Importance Index rankings, Kruskal–Wallis tests, and thematic analysis. The results indicate that awareness of CC in Ghana is modest and uneven. Respondents showed moderate familiarity with cost-saving potential, environmental certifications, and carbon reduction benefits; however, their understanding of lifecycle benefits, material reuse principles, long-term economic advantages, and policy frameworks remained limited. The most influential barriers were concerns regarding the functional adequacy of CC buildings, perceived maintenance demands, technological complexity, market immaturity, and doubts about the durability of the recycled materials. Information deficits and cost-related concerns were ranked comparatively lower. Nevertheless, qualitative responses revealed ongoing anxiety about perceived high costs, highlighting a gap between recognised long-term savings and perceptions of short-term affordability. Awareness varied by age, education, and work experience but not by gender, occupation, housing, or city. By identifying these knowledge gaps, this study shows how awareness affects CC attitude and adoption. The findings guide policymakers in strengthening CC uptake in Ghana's built environment.

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1. Introduction

The construction sector remains one of the most resource-intensive and environmentally consequential industries globally,

accounting for 36–40% of energy consumption and 37–39% of CO₂ emissions (IEA, 2023; UNEP, 2024; GlobalABC, 2023; World Green Building Council, 2023). These pressures are particularly acute in rapidly urbanizing economies such as Ghana,

where increasing population growth, rising housing demand, and inefficient resource use intensify environmental degradation and waste generation (Government of Ghana, 2023; UN-Habitat, 2024; CIA World Factbook, 2024; Cape Coast Metropolitan Assembly, 2023). To achieve its commitments under the Paris Agreement, Nationally Determined Contributions (NDCs), and SDG 11 (Sustainable Cities and Communities), Ghana must transition from linear “take–make–dispose” construction models toward sustainable and circular alternatives (UNFCCC, 2024; Ministry of Environment, Science, Technology & Innovation, 2023; UNEP, 2023; IPCC, 2023). However, despite the proven environmental and economic benefits of circular construction (CC), adoption remains limited in Ghana largely due to low consumer awareness, misconceptions, and a weak understanding of lifecycle benefits and policy frameworks (Osmani, 2021; Charef & Lu, 2021; Zemanová, 2023; Bucur, 2023). These knowledge gaps significantly hinder the country’s transition toward sustainable construction practices.

Circular construction (CC) represents a regenerative building paradigm that prioritizes material reuse, design for adaptability, resource efficiency, and lifecycle optimization to decouple the built environment from resource depletion and waste generation (Ghisellini et al., 2016; Guerra et al., 2021; Zhang et al., 2021; Mhatre-Shah et al., 2024). In this context, consumer awareness refers to individuals’ understanding of CC principles, including cost-saving potential, durability, certifications, and environmental benefits, while knowledge gaps denote misconceptions or informational deficits that distort consumer judgment (Ametepey et al., 2015; Adams et al., 2017; Papamichael et al., 2023; Benites et al., 2022). These gaps are particularly prominent in developing economies, where sustainability literacy is low and public communication about green construction policies is limited (Ezeudu & Ezeudu, 2019; Osei-Tutu et al., 2022; Rajendra & Mohanasundaram, 2023; Gasparri et al., 2023). As a result, consumers frequently perceive CC as expensive, technically complex, or design restrictive, discouraging adoption even when CC solutions are available (Mamun et al., 2023; Malmqvist et al., 2019; Wuni, 2022; Chileshe et al., 2024). Understanding these perceptions is essential for identifying behavioural and structural barriers that undermine CC uptake in Ghana.

Prior research has made significant progress in examining supply-side, technical, and policy-related aspects of CC in Africa and beyond, including material circularity, waste minimization, and regulatory challenges (Gasparri et al., 2023; Akhimien et al., 2020; GlobalABC, 2021; Zhang et al., 2021). Studies in Ghana and other SSA countries highlight barriers such as weak enforcement of environmental policies, high upfront costs, and limited financial incentives (Ametepey et al., 2015; Tekpe et al., 2022; Osei-Tutu et al., 2022; Ezeudu & Ezeudu, 2019). Elsewhere, research indicates that misconceptions relating to durability, safety, and design flexibility also contribute to the public’s hesitation toward adopting sustainable building practices (Rajendra & Mohanasundaram, 2023; Saavedra et al., 2017; Adams et al., 2017; Malmqvist et al., 2019). However, few studies explore demand-side factors, and even fewer empirically quantify consumer awareness of CC in Ghana’s major urban centres. Existing literature prioritizes industry professionals,

overlooking the role of household decision-makers whose perceptions directly influence adoption (Bucur, 2023; Mamun et al., 2023; Benites et al., 2022; Chileshe et al., 2024). This gap underscores the need for empirical evidence on awareness levels and knowledge deficits among consumers in Ghana, which is essential for designing targeted interventions to support CC uptake.

This study bridges the identified gap by empirically examining consumer awareness of circular construction principles and assessing the knowledge gaps that hinder CC adoption in urban Ghana. Guided by the Knowledge–Attitude–Practice (KAP) model, which posits that awareness precedes attitudinal change and adoption behaviour, the study employs a cross-sectional survey design across Accra, Kumasi, Cape Coast, and Takoradi to quantify awareness levels, misconceptions, and perceived barriers (Rada et al., 2018; Zemanová, 2023; Charef & Lu, 2021; Papamichael et al., 2023). By integrating descriptive statistics, the Relative Importance Index (RII), and thematic analysis of open-ended responses, the study provides a multi-layered understanding of demand-side challenges. This perspective differs from earlier supply-focused research by placing consumers, rather than industry actors, at the centre of CC adoption analysis.

This study makes an important contribution to the circular economy and sustainable construction literature by offering one of the first empirical assessments of consumer awareness of CC in Ghana. Theoretically, it advances understanding of how awareness and perceptions shape adoption behaviour, extending the application of the KAP Model to the built environment (Rada et al., 2018; Zemanová, 2023; Benites et al., 2022; Charef & Lu, 2021). Empirically, the study provides city-level insights that can inform public education campaigns, financing reforms, and policy communication strategies tailored to Ghana’s socio-economic context. Practically, the findings offer actionable guidance to policymakers, financial institutions, developers, and sustainability professionals seeking to align consumer behaviour with Ghana’s commitments under the SDGs, NDCs, and national green building initiatives (Government of Ghana, 2023; UNEP, 2024; UN-Habitat, 2024; GlobalABC, 2023). By identifying the specific knowledge gaps that impede CC uptake, the study provides an evidence-based foundation for accelerating Ghana’s transition toward sustainable and circular built environments. The remaining sections of the paper are: the literature review, which examines past studies on CC awareness; methodology, which outlines the methodology used to investigate these relationships; results and discussion; and conclusions.

2. Literature Review

This section aims to critically examine prior research on CC awareness and adoption.

2.1 Global Landscape of Circular Construction (CC) Implementation

Circular construction (CC) has become a major global focus as a solution to environmental degradation, waste reduction, and resource efficiency in the built environment. In developed

countries such as Europe, the CC is implemented through regulation, standardized certification, and unified material recovery systems (Malmqvist et al., 2019; Benites et al., 2022; GlobalABC, 2023; UNEP, 2024). These instruments have found backing in good policy requirements, including the EU Taxonomy and the Circular Economy Action Plan, which establish the enabling conditions for circular building materials, modular design, and lifecycle-oriented procurement. Empirical research also shows how the high level of consumer literacy regarding green labels, lifecycle benefits, and principles of a circular design is at the centre of the process of facilitating the adoption of CC in Europe, Australia, and some parts of Asia (Guerra et al., 2021; Zhang et al., 2021; Mhatre-Shah et al., 2024; Adams et al., 2017). Despite this development, implementation worldwide is not universal. Circular buildings are still viewed as expensive and complicated even in more developed markets (Rajendra & Mohanasundaram, 2023; Osmani, 2021; Saavedra et al., 2017). These lessons support the value of consumer education and situational action in order to promote the use of CC.

2.2 Circular Construction in Sub-Saharan Africa and Developing Economies

The adoption of CC in developing regions, particularly in Sub-Saharan Africa (SSA), is structurally challenged by the poor enforcement of regulations, a fractured supply chain, inadequate recycling, and financial incentives (Ametepey et al., 2015; Ezeudu and Ezeudu, 2019; Gasparri et al., 2023; Tekpe et al., 2022). The works conducted in Nigeria, Kenya, South Africa, and Rwanda have shown that, although consumers in the SSA are moderately aware of their environmental concerns, they are also lowly literate about the concept of CC, including the ability to design the product, cost savings during its lifecycle, and material circularity (Mamun et al., 2023; Papamichael et al., 2023; Wuni, 2022; Chileshe et al., 2024). In addition, inadequate policy communication and ineffective interaction with housing consumers are the causes of misconceptions that still persist, such as the notion that circular buildings are costly, non-durable, or not flexible in design (Rajendra & Mohanasundaram, 2023; Adams et al., 2017; Osei-Tutu et al., 2022). Although there are some localized examples, e.g., Green Building Minimum Compliance System in Rwanda and Family Homes Fund in Nigeria, which have positively affected awareness, such initiatives are still local (Gasparri et al., 2023; Ezeudu & Ezeudu, 2019; Benites et al., 2022). The current context of SSA, hence, indicates that demand-side studies concentrated on consumer knowledge and perception of CC are in urgent need.

2.3 Consumer Awareness of Circular Construction in Ghana

A study in Ghana has generally explored CC and sustainability at the level of construction professionals, policymakers, and actors in the supply side. Research identifies primary obstacles such as low implementation of green building policies, high reliance on imported products, and few incentives to go circular (Ametepey

et al., 2015; Akhimien et al., 2020; Tekpe et al., 2022; Osei-Tutu et al., 2022). Nevertheless, there is only a limited number of research on consumer engagement in sustainable building, not to mention research on the awareness of CC in households. According to existing research, there is a lack of awareness of sustainable housing policies in Ghana, and there is a backward perception regarding what circular building materials are, how long-lasting, safe, and affordable they are (Cape Coast Metropolitan Assembly, 2023; Osmani, 2021; Guerra et al., 2021; Gasparri et al., 2023). This is worrying, considering the fast urbanization of Ghana and the increased demands to achieve climate-resilient housing targets. This is an important gap in the CC literature of Ghana because of the absence of empirical evidence on consumer-level knowledge as opposed to professional or institutional viewpoints.

2.4 Methodological Approaches in Prior Studies

Research studies that have explored the use of CCs have had varying research designs based on the target population and research purposes. Attitudes, perceptions, and awareness of CC among construction professionals or consumers often are captured using surveys (Benites et al., 2022; Adams et al., 2017; Chileshe et al., 2024). The concept of structural equation modelling (SEM and PLS-SEM) is frequently used in the research that aims at examining causal relations among various sustainability constructs, including environmental literacy, behavioural intentions, and perceived barriers (Mhatre-Shah et al., 2024; Mamun et al., 2023; Saavedra et al., 2017). The issue of drivers and challenges of CC has been studied in depth through qualitative interviews and case studies, especially in regional or institutional tiers (Gasparri et al., 2023; Tekpe et al., 2022; Akhimien et al., 2020). Although these methods are fruitful, the majority of them involve supply-chain participants, experts, or authorities.

Since this research is focused on the goal of quantifying consumer awareness and determining the knowledge gaps, the method of the cross-sectional survey is the most suitable approach to such research. It allows gathering of generalized and similar data of a large and varied sample of population spread across urban centers of the large size. This methodology has been extensively proven to be effective in behavioural and sustainability studies in the assessment of awareness, attitudes, and barriers among demographic populations (Setia, 2023; Cheung, 2014; Kara, 2023; Howell et al., 2020). Therefore, the current research paper is methodologically consistent with the existing best practices and is related to the provision of novel information among a group of the population that has been underrepresented in the study of CC.

2.5 Summary of Key Studies, Methods, Findings, and Gap

Table 1 summarizes key studies to identify prevailing methods, findings, and gaps relevant to the study's contribution.

Table 1 Summary of Studies on Circular Construction Awareness and Adoption

Authors / Year	Location	Methodology	Key Findings	Identified Gaps
Adams et al. (2017); Osmani (2021)	UK, Europe	Surveys; Interviews	Low awareness of circularity; misconceptions about durability	Focus on professionals; limited consumer perspectives
Gasparri et al. (2023).	Global Review	Systematic Review	Highlighted policy and technical barriers	No demand-side empirical evidence
Ametepey et al. (2015); Osei-Tutu et al. (2022)	Ghana	Surveys	Weak regulatory frameworks; low green literacy	Do not measure consumer awareness
Rajendra & Mohanasundaram (2023).	India	Case Study	Consumers equate recycled materials with poor quality	Limited to local context; lacks quantitative evidence
Mamun et al. (2023).	Bangladesh	PLS-SEM	Willingness to pay for green buildings rises with awareness	Focus on green buildings, not CC
Benites et al. (2022).	Europe	Mixed Methods	Awareness influenced by certifications and policies	Does not address developing countries
Chileshe et al. (2024).	SSA	Systematic Review	Drivers and barriers of sustainable construction	Limited consumer-level data
Tekpe et al. (2022).	Ghana	Case Study	Demonstrated benefits of material reuse initiatives	No large-scale survey on CC awareness

2.6 Theoretical Framework: Knowledge–Attitude–Practice (KAP) Model

This current study uses the Knowledge-Attitude-Practice (KAP) Model that assumes that knowledge is the precursor of attitudes, and attitudes determine the intentions and practices of behaviour (Rada et al., 2018; Zemanova, 2023; Charef & Lu, 2021; Papamichael et al., 2023). Within the circle of the CC, attitudes toward circular buildings are likely to develop due to the awareness of lifecycle advantages, policy frameworks, reusing the materials, and the environmental impact, which leads to changes in the adoption behaviour. The KAP Model is quite appropriate in studying consumer behaviour in developing economies, where a lack of knowledge and attitudes based on misconceptions can be a major setback to sustainable construction adoption. Based on this theoretical foundation, the research makes the study stronger in terms of its analytical background and provides a systematic explanation as to how awareness gaps lead to adoption barriers.

2.7 Research Gap and Novelty Statement

While global and regional studies have examined CC principles, policy challenges, and industry perceptions, there is a notable absence of empirical research quantifying consumer awareness of circular construction in Ghana. Existing work tends to focus on professionals, supply-chain actors, or technical and regulatory dimensions, leaving the demand side largely unexplored. The present study addresses this gap by offering one of the first multi-city, consumer-based assessments of CC awareness and knowledge gaps in Ghana. Its novelty lies in (i) focusing on household decision-makers rather than industry actors, (ii) integrating quantitative design, and (iii) applying the KAP framework to interpret behavioural implications. These contributions help clarify the role of consumer knowledge in shaping Ghana's transition toward sustainable and circular construction.

3. Methodology

This section outlines the methodology adopted to investigate consumers' knowledge deficits in Ghana.

3.1 Survey Development

The survey instrument was developed through a multi-stage process involving variable identification, expert validation, and pilot testing. First, the key constructs, consumer awareness of circular construction (CC) principles, knowledge gaps, and perceived barriers, were identified through an extensive review of previous empirical and theoretical studies in circular economy, sustainable construction, and consumer behaviour (Adams et al., 2017; Benites et al., 2022; Charef & Lu, 2021; Zhang et al., 2021). These constructs informed the initial drafting of 20 closed-ended items measured on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), capturing awareness of material reuse, lifecycle benefits, certifications, resource efficiency, and policy frameworks. To ensure content validity, the draft questionnaire was reviewed by four experts in circular construction, sustainability assessment, and environmental psychology, who evaluated item clarity, relevance, and representativeness. Their feedback led to the refinement of ambiguous statements, the removal of redundant items, and modifications to improve readability and contextual relevance.

Following expert validation, the revised instrument underwent a pilot test with 30 adult respondents residing in Accra and Kumasi, selected to reflect the study's target population. The purpose of the pilot test was to evaluate reliability, internal consistency, and response comprehension. The pilot produced a Cronbach's alpha score of 0.84, indicating satisfactory reliability for exploratory research (Kumar & Murugan, 2018). Minor adjustments were made to the sequencing of items and demographic questions based on participant feedback. This systematic development process ensured that the final instrument was both valid and reliable before full-scale data collection.

3.2 Data Collection

3.2.1 Target Population and Sampling Frame

The target population comprised adult residents (18 years and above) in four major Ghanaian cities, Accra, Kumasi, Cape Coast, and Takoradi, who were involved in decision-making regarding housing choices, whether renting, purchasing, or constructing residential property. Inclusion criteria required respondents to (i)

be 18 years or older, (ii) reside in one of the four cities for at least 12 months, and (iii) self-identify as contributing to household housing decisions. Individuals younger than 18, transient residents, or those not involved in housing-related decisions were excluded. Table 2 summarizes the respondents' demographic profile.

3.2.2 Sampling Technique

A stratified random sampling technique was employed to ensure representation across socio-economic groups. First, each city was stratified into neighbourhoods based on income classification (low-, middle-, and high-income areas). Within each stratum, households were selected using systematic random sampling with a fixed interval determined by estimated household density (Howell et al., 2020). At each selected household, one eligible respondent was randomly chosen using the Kish grid method. This approach enhanced representativeness and minimized sampling bias across demographic categories.

3.2.3 Sample Size and Response Rate

Although a population proportion formula and power analysis suggested a minimum of 385 respondents at a 95% confidence level and a 0.05 margin of error, logistical constraints and limited access yielded 250 distributed questionnaires, of which 200 were returned as valid, yielding an effective response rate of 80%. This sample size remains adequate for descriptive and nonparametric statistical analyses commonly used in awareness studies (Setia, 2023; Kara, 2023).

3.2.4 Data Collection Procedure

Data were collected between February and April 2024 using a mixed-mode approach combining face-to-face administration and digital forms distributed through community associations, housing forums, and professional networks. Respondents were informed of the study's purpose and provided verbal or written consent prior to participation. The study complied with all applicable ethical standards for human subject research. Participation was voluntary, informed consent was obtained, and respondents were assured of confidentiality. All procedures adhered to Ghana's Data Protection Act (Act 843) and institutional research guidelines.

Table 2 Summary of Respondent's Demographic Profile

Demographic Variable	Categories
Gender	Male and Female respondents
Age Range	18–20, 21–25, 26–30, 31–35, 46 and above
Education Level	Secondary, Diploma/HND, Bachelor's, Postgraduate
Years of Work Experience	1–5, 6–10, 11–15, 16–20, 21–25, 26–30, 31 years and above
Occupation	Construction-related and non-construction professions
Housing Type	Apartment, townhouse, semi-detached, detached

3.3 Data Analysis

Data analysis was conducted using SPSS (Version 26) and NVivo 12. Prior to analysis, data were screened for completeness, outliers, and inconsistencies. Missing data amounting to less than

5% of the dataset were handled using mean substitution for Likert-scale responses and listwise deletion for demographic variables, as needed. Normality assumptions were assessed using skewness and kurtosis statistics, confirming the non-normal distribution typical of ordinal Likert-scale data.

Descriptive statistics (means, standard deviations, and frequencies) were used to summarize awareness levels and demographic attributes. The Relative Importance Index (RII) was

computed to rank the perceived significance of CC awareness items, following standard procedures for ordinal datasets. To examine whether awareness levels differed significantly across demographic groups, nonparametric inferential tests, specifically the Kruskal–Wallis H test, were used because the data were ordinal and violated normality assumptions.

Qualitative responses from open-ended items were coded thematically in NVivo 12 to identify patterns of misconceptions and knowledge gaps. These qualitative insights were triangulated with quantitative results to strengthen interpretation. Finally, to enhance clarity and reproducibility. Figure 1 provides an overview of the study’s key inputs, processes, and outputs.

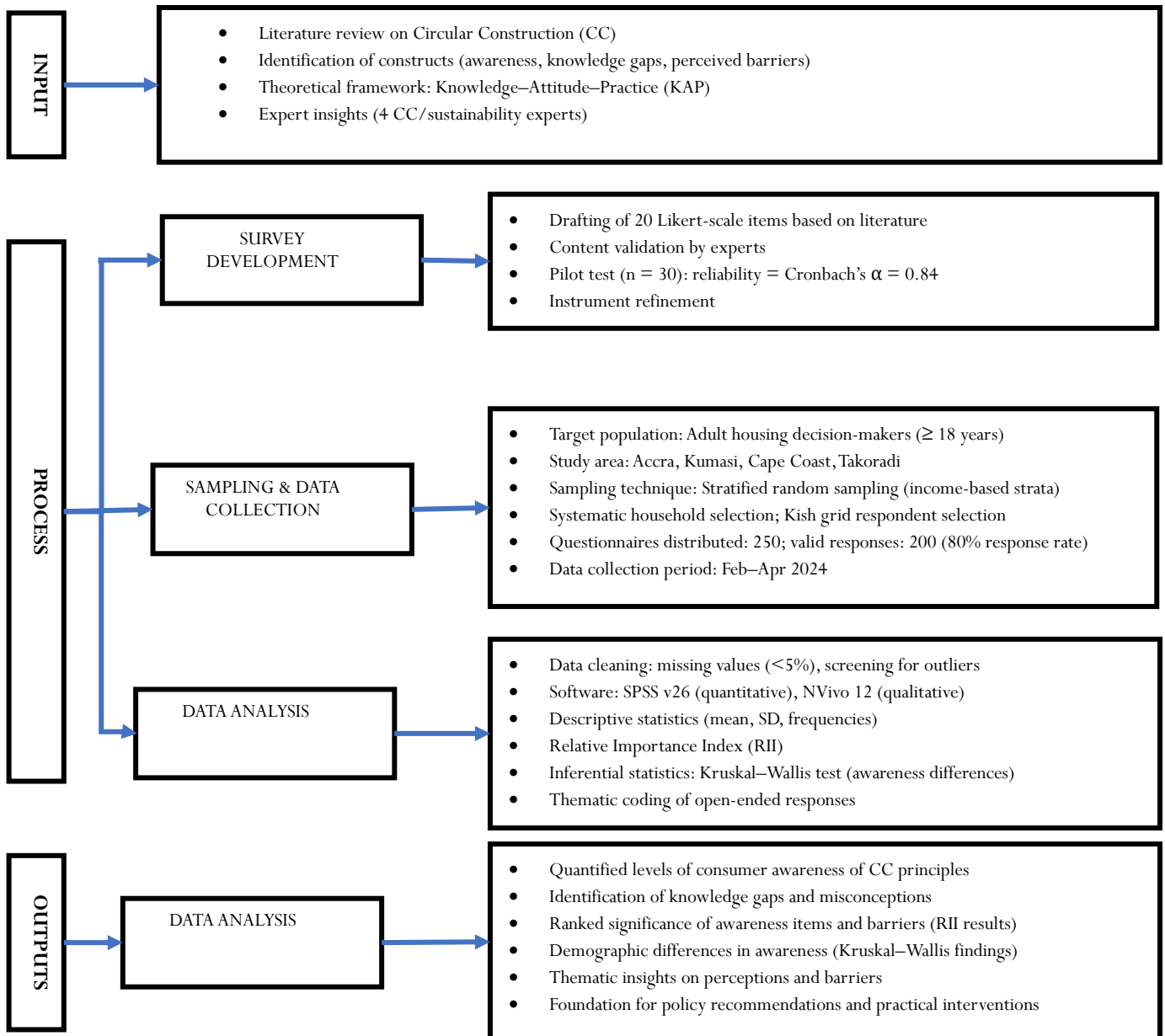


Figure 1 Methodology overview showing the key inputs, sequential processes, and outputs

4. RESULTS

This section presents the quantitative and qualitative findings of the study. Results are organized into five subsections: (i) demographic characteristics of respondents, (ii) consumer awareness of circular construction (CC) principles, (iii) perceived barriers to CC adoption, (iv) Kruskal-Wallis Tests Between Demographic Variables and Consumer, and (v) thematically coded misconceptions. All awareness items (CA1–CA20) and barrier items (BA1–BA20) have been coded to enhance clarity and consistency.

4.1 Demographic Characteristics of Respondents

A total of 200 valid responses were obtained from adult housing decision-makers across Accra, Kumasi, Cape Coast, and Takoradi. Table 3 summarizes the demographic distribution across gender, age, education, occupation, housing type, and years of work experience. Respondents were evenly distributed by gender, while the majority were aged 26–40 years (63.5%). Educational attainment was high, with 67% holding bachelor's or postgraduate degrees. Approximately 32% of respondents were employed in construction-related fields.

Table 3 Demographic Characteristics of Respondents

Demographic Characteristics	Category	Frequency	Percentage (%)
Gender	Male	99	49.5
	Female	101	50.5
Age Group of Decision-makers Regarding Housing Choices	18-20 years	16	8.0
	21-25 years	32	16.0
	26-30 years	43	21.5
	31-35 years	45	22.5
	36-40 years	39	19.5
	41-45 years	15	7.5
	46 years and above	10	5.0
Academic Qualification	Senior High School Certificate	22	11.0
	HND/Diploma	43	21.5
	Bachelor degree	87	43.5
	Master's degree	46	23.0
	PhD	2	1.0
Working Experience	1-5 years	26	13.0
	6-10 years	39	19.5
	11-15 years	31	15.5
	16-20 years	32	16.0
	21-25 years	22	11.0
	26-30 years	9	4.5
	31 years and above	41	20.5
Housing Type	Apartment	81	40.5
	Townhouse	29	14.5
	Semi-Detached house	47	23.5
	Detached house	43	21.5
Occupation	Construction/Architect/Engineering	64	32.0
	Real Estate/Property Development	38	19.0
	Government/Public Administration	24	12.0
	Retail/Service Industry	13	6.5
	Finance/Banking	11	5.5
	Education/Academia	30	15.0
	Health Care	20	10.0
Total		200	100.0

Source: Field Data, 2024

4.2 Consumer Awareness of Circular Construction Principles

Consumer awareness of circular construction (CC) was assessed using 20 coded Likert-scale items (CA1–CA20). Table 4 presents the mean scores, standard deviations, and Relative Importance

Index (RII) rankings. Overall, awareness levels were generally low to moderate across most CC principles. The highest-ranked items indicated moderate recognition of cost-saving potential (CA1), environmental certifications (CA2), and carbon-emission reduction benefits (CA4). Awareness of resource efficiency (CA3) and the future relevance of CC practices (CA5) also ranked within

the upper tier. In contrast, lower-ranked items reflected limited familiarity with lifecycle benefits (CA14), material reuse and recycling (CA15), and long-term economic advantages (CA17). Awareness of government policy frameworks (CA11), ongoing CC projects in respondents’ cities (CA7), and foundational CC concepts (CA20) remained notably low.

Standard deviation is reported alongside mean scores to indicate the variability and consistency of respondents’ awareness levels across each CC item. While the mean reflects the central tendency, the SD shows how widely responses are spread. A high

SD suggests substantial disagreement or diverse awareness among respondents, while a low SD indicates relative consensus.

Reporting SD is therefore essential for evaluating whether awareness gaps are uniformly distributed or concentrated within specific demographic groups. This information directly supports subsequent inferential analysis (Kruskal–Wallis tests) and strengthens the interpretation of awareness disparities.

Table 4 Consumer Awareness of Circular Construction Principles

Rank	Code	Awareness Item	Mean	SD	RII
1	CA1	I know that circular construction can lower operational costs over time.	2.39	1.33	0.478
2	CA2	I am familiar with the environmental certifications related to circular construction.	2.39	1.31	0.478
3	CA4	I understand the impact of circular construction on reducing carbon emissions.	2.37	1.34	0.474
4	CA3	I understand the importance of resource efficiency in circular construction.	2.35	1.18	0.470
5	CA5	I believe that circular construction is essential for future building practices.	2.33	1.37	0.466
6	CA6	I am familiar with the concept of building adaptability in circular construction.	2.29	1.34	0.458
7	CA7	I am aware of any ongoing circular construction projects in my city.	2.29	1.27	0.458
8	CA8	I am aware of the role of technology in advancing circular construction.	2.29	1.18	0.458
9	CA10	I am aware of the differences between circular and traditional construction methods.	2.22	1.19	0.444
10	CA9	I know that circular construction reduces waste during building processes.	2.22	1.26	0.444
11	CA11	I understand the role of government policies in promoting circular construction.	2.21	1.33	0.442
12	CA12	I understand how certification schemes support quality assurance in circular construction.	2.24	1.30	0.448
13	CA13	I know the potential financial incentives for investing in circular buildings.	2.16	1.14	0.432
14	CA16	I am aware of the challenges associated with implementing circular construction.	2.28	1.24	0.458
15	CA14	I understand the lifecycle benefits of circular construction.	2.15	1.16	0.430
16	CA15	I know that circular construction involves the reuse and recycling of materials.	2.15	1.25	0.430
17	CA17	I am aware of the long-term economic benefits of circular construction.	2.13	1.25	0.426
18	CA18	I have seen or heard about circular buildings in my area.	2.11	1.22	0.422
19	CA20	I am familiar with the concept of circular construction.	2.08	1.13	0.416
20	CA19	I understand how circular construction contributes to environmental sustainability.	2.07	1.11	0.414

RII=Relative Importance Index, SD=Standard Deviation

Source: Field Data, 2024

4.3 Barriers to Awareness and Adoption of Circular Construction

Respondents evaluated 20 perceived barriers to circular construction (CC) adoption (BA1–BA20). Table 5 presents the ranked mean scores and associated standard deviations. Overall, the results show that respondents perceive a wide range of obstacles, with several practical and design-related concerns emerging as the most prominent barriers. The highest-ranked barrier was the perception that circular buildings may not adequately meet respondents’ housing needs (BA12), followed by concerns regarding maintenance challenges (BA6) and the perceived complexity or advanced nature of CC technologies (BA18). Market-related concerns, including the belief that CC buildings occupy a niche market (BA13) and persistent doubts about the durability of recycled materials (BA7), also ranked highly.

Design-related perceptions formed another cluster of significant barriers, with respondents expressing reservations about design appeal (BA5), method complexity (BA11), structural safety (BA15), and availability of design variety (BA19). Institutional and regulatory barriers such as uncertain long-term benefits (BA10), inadequate incentives (BA4), limited professional capacity (BA16), and weak government support (BA9) ranked in the middle tier.

Barriers relating to information and market development, including limited availability of CC buildings (BA3), lack of information (BA2), and underdeveloped CC markets (BA20), were also acknowledged but ranked lower than practical and design-related factors. The belief that circular buildings are expensive (BA1), while still prevalent in the qualitative responses, ranked lowest among the quantified barriers.

Table 5 Perceived Barriers to Circular Construction Adoption

Rank	Code	Barrier Item	Mean	SD
1	BA12	I believe that circular buildings do not meet all my housing needs.	2.99	1.26
2	BA6	I think the maintenance of circular buildings might be challenging.	2.98	1.30
3	BA18	I think the technology used in circular construction is too advanced.	2.94	1.32
4	BA13	I think the market for circular buildings is too niche.	2.92	1.35
5	BA7	I am concerned about the durability of recycled materials.	2.91	1.36
6	BA5	I believe that circular buildings have a limited design appeal.	2.88	1.23
7	BA11	I feel that circular construction methods are too complex.	2.88	1.31
8	BA15	I believe that circular buildings might not be as safe as traditional buildings.	2.88	1.28
9	BA19	I believe that circular buildings do not offer enough variety in design.	2.88	1.33
10	BA14	I am concerned about the resale value of circular buildings.	2.86	1.32
11	BA16	I think there is a lack of skilled professionals in circular construction.	2.86	1.24
12	BA10	I am unsure about the long-term benefits of circular buildings.	2.82	1.33
13	BA4	I think there are too few incentives to invest in circular buildings.	2.81	1.40
14	BA17	I am unsure about the quality of circular buildings.	2.80	1.24
15	BA8	I believe that circular construction is still a new and untested concept.	2.79	1.29
16	BA9	I think there is insufficient government support for circular construction.	2.79	1.25
17	BA3	I feel that circular buildings are not widely available.	2.77	1.30
18	BA2	I think there is a lack of information about circular construction.	2.76	1.23
19	BA20	I think that circular construction is not yet fully developed.	2.74	1.28
20	BA1	I believe the cost of circular buildings is too high.	2.70	1.27

RII=Relative Importance Index, **SD**=Standard Deviation Source: Field Data, 2024

Standard deviation is included to indicate the degree of variability in respondents' perceptions of each barrier. While mean scores indicate the average severity of a perceived barrier, SD values indicate whether respondents generally agreed or expressed widely differing views. Higher SD values suggest divergent perceptions, often associated with varying levels of exposure to CC concepts, whereas lower SD values indicate greater consensus. Reporting SD values, therefore, enhances the interpretability of the results and supports subsequent inferential analyses.

4.4 Kruskal-Wallis Tests Between Demographic Variables and Consumer

Table 6 presents the Kruskal–Wallis H test to examine whether consumer awareness and understanding of circular construction principles differed significantly across

various demographic groups. The results show mixed patterns of significance across the assessed demographic variables. First, the analysis revealed that gender did not significantly influence consumer awareness levels ($H = 2.13$, $p = 0.144$). This indicates that male and female respondents had comparable levels of understanding of circular construction principles, suggesting that awareness initiatives are reaching both genders equally.

In contrast, the age group demonstrated a significant effect on consumer awareness ($H = 20.90$, $p = 0.002$). This implies that differences in age are associated with varying levels of awareness and understanding. Some age groups may have greater exposure to sustainability concepts due to generational differences in education, professional experience, or engagement with circular-economy practices.

Table 6 Summary of Kruskal-Wallis Tests Between Demographic Variables and Consumer Awareness & Understanding of Circular Construction Principles

Demographic Variable	df	H-Value	p-Value	Significance
Gender	1	2.13	0.144	Not Significant
Age Group	6	20.9	0.002	Significant
Educational Qualification	7	18.17	0.011	Significant
Occupation	6	11.87	0.065	Not Significant
Years of Experience	6	35.57	0.000	Significant
Type of Residence	9	12.59	0.182	Not Significant
Region	52	62.4	0.153	Not Significant

Similarly, educational qualification showed a statistically significant influence on consumer awareness ($H = 18.17$, $p = 0.011$). Respondents with higher or more specialized academic backgrounds were more likely to understand circular construction principles, possibly due to greater exposure to environmental, engineering, or sustainability-related concepts during their academic or professional training.

The results for occupation did not show a significant difference in consumer awareness ($H = 11.87$, $p = 0.065$). Although awareness levels varied slightly across occupational categories, the differences were not statistically significant. This suggests that information on circular construction principles is not limited to any profession but may be distributed across multiple sectors.

A strong and statistically significant effect was found for years of experience ($H = 35.57$, $p = 0.000$). This indicates that work experience plays a substantial role in shaping consumer awareness and understanding of circular construction principles. Individuals with greater professional experience may have encountered sustainability practices, environmental standards, or construction-related innovations more frequently, thereby increasing their awareness.

For the type of residence, the analysis showed no significant differences ($H = 12.59$, $p = 0.182$). This implies that whether respondents lived in apartments, detached houses, semi-detached homes, or townhouses had no measurable effect on their awareness of circular construction principles. Similarly, region did not significantly influence awareness levels ($H = 62.40$, $p = 0.153$), indicating that geographic location did not lead to meaningful differences in respondents' understanding.

4.5 Thematic Coded Misconceptions

The qualitative responses provided additional insight into the underlying beliefs shaping consumer resistance to circular construction (CC). Although cost-related concerns ranked comparatively low in the quantitative results, thematic coding of open-ended responses revealed persistent anxiety about short-term affordability. This confirms the quantitative–qualitative paradox identified in the study: while respondents acknowledge potential long-term savings, many remain uncertain about upfront costs and financial risk. Beyond cost perceptions, three dominant misconceptions emerged consistently across cities.

The first theme was durability concerns, with respondents expressing doubts about the structural integrity and lifespan of recycled or reused materials. Statements such as “Reused materials might degrade faster” and “I’m not sure these buildings can last as long as conventional ones” illustrate a prevailing fear that CC compromises safety and longevity. This aligns with BA7's ranking in the quantitative results and reinforces the performance-related skepticism discussed in the literature, reported in Ghana and across Sub-Saharan Africa.

The second major misconception concerns functional adequacy and design flexibility. Several respondents believed that CC buildings offer limited customization, as illustrated by comments such as “I need a home tailored to my family, not a fixed design.” This aligns with the rankings of BA12 and BA19,

confirming that consumers often associate CC with design rigidity and reduced adaptability, highlighting consumer fears about limited design options and uncertain functionality.

The third theme reflected concerns about technological complexity and maintenance demands. Respondents noted uncertainty about how CC systems operate and whether they require specialised maintenance or skills. These views align with the strong quantitative ratings for BA6 and BA18 and indicate that unfamiliarity with CC technologies contributes to perceived risk. Together, these themes demonstrate that misconceptions about durability, functionality, and technological complexity, not cost alone, shape consumer skepticism and influence CC adoption patterns in Ghana.

5. Discussion

The purpose of this discussion is to interpret the findings presented in the results section by explaining what the results reveal, why these patterns occur, and what they imply for circular construction (CC) adoption in Ghana. The discussion draws on the Knowledge–Attitude–Practice (KAP) model and situates the findings within the broader context of research conducted in Ghana, Sub-Saharan Africa (SSA), and other regions. It also links each key finding to its theoretical and practical implications.

The results reveal a generally low to moderate level of consumer awareness of circular construction (CC) in Ghana, with awareness concentrated around high-level concepts such as cost-saving potential (CA1), environmental certifications (CA2), and carbon-emission reduction benefits (CA4). These items ranked highest but scored below the midpoint of the 5-point scale, suggesting that awareness is superficial rather than comprehensive. In contrast, very low awareness was recorded for lifecycle benefits (CA14), reuse and recycling principles (CA15), and foundational CC concepts (CA20), indicating that most consumers lack an understanding of the core technical and systemic features of CC. This pattern suggests that although consumers have been exposed to general sustainability narratives, deeper knowledge related to CC design, lifecycle thinking, and policy frameworks literacy remains limited. Similar findings were reported in Ghana by Ametepey et al. (2015), who noted low levels of green literacy despite increasing public dialogue on sustainability. Studies in other SSA contexts, such as Kenya, South Africa, and Nigeria, also found that consumers tend to associate sustainability with broad environmental messaging but possess limited understanding of technical CC concepts (Osei-Tutu et al., 2022; Gasparri et al., 2023; Ezeudu & Ezeudu, 2019). Internationally, research shows that higher consumer literacy in Europe and parts of Asia is strongly influenced by regulatory visibility and familiarity with certification (Benites et al., 2022; Guerra et al., 2021), a condition that is still emerging in Ghana.

The barrier analysis further underscores the deep-rooted misconceptions that shape consumer attitudes toward CC. The highest-ranked barrier was the perception that circular buildings may not meet functional housing needs (BA12), followed by concerns about maintenance challenges (BA6), technological

complexity (BA18), market immaturity (BA13), and the durability of recycled materials (BA7). These concerns highlight that consumers question the practicality, performance, and long-term reliability of CC. Prior studies in SSA similarly report that consumers often perceive CC as technically complex, experimental, or incompatible with traditional housing expectations (Chileshe et al., 2024; Mamun et al., 2023; Rajendra & Mohanasundaram, 2023). This reinforces a broader trend in developing economies, where risks related to reliability, safety, and quality outweigh potential cost savings. Interestingly, the belief that circular buildings are expensive (BA1) ranked lowest in the quantitative results, despite persistent cost anxiety in the qualitative feedback. This divergence indicates that, while cost remains psychologically salient, it is overshadowed by performance-related concerns in this study. This finding contrasts with international studies, which repeatedly cite cost as the foremost barrier (Adams et al., 2017; Saavedra et al., 2017), but aligns with some emerging economies, where consumers prioritize perceived safety and functional adequacy over economic considerations.

The Kruskal–Wallis tests revealed significant differences across age, education, and years of experience, suggesting that demographic factors shape awareness. Older respondents, those with higher education, and individuals with longer work experience demonstrated higher levels of awareness. These results are consistent with studies in Ghana and other SSA contexts that show that exposure to environmental standards and professional engagement influence awareness of sustainable construction (Tekpe et al., 2022; Ametepey et al., 2015). The absence of significant differences in gender, occupation, region, and housing type suggests that CC awareness is equally low across demographic groups not directly linked to education or professional tenure. To situate these findings within the broader literature, Table 7 compares the main results with previous studies already cited in this manuscript.

Table 7 Comparative Analysis of Findings with Prior Studies

Theme	Current Study (Ghana)	Ghana / SSA Studies	International Studies	Consistency / Contribution
Awareness of lifecycle benefits	Low (CA14)	Low literacy (Ametepey et al., 2015; Osei-Tutu et al., 2022)	Moderate–high in Europe (Benites et al., 2022)	Confirms SSA trend; adds new consumer-level evidence
Certification awareness	Moderate (CA2, CA12)	Limited awareness (Tekpe et al., 2022)	High regulatory familiarity (Guerra et al., 2021)	Demonstrates Ghana’s transitional stage
Perceived durability issues	High concern (BA7)	High in SSA (Chileshe et al., 2024)	Lower in developed markets	Reinforces misconception theory
Market immaturity	High (BA13, BA20)	Common across SSA (Gasparri et al., 2023)	Less prominent in the EU	Highlights Ghana’s unique adoption challenges
Cost barriers	Low quantitative ranking but high qualitative salience	High-cost concern (Osei-Tutu et al., 2022)	High globally (Adams et al., 2017)	Reveals a unique pattern: function-related fears outweigh cost
Policy literacy	Low (CA11)	Weak policy visibility (Ezeudu & Ezeudu, 2019)	Stronger in the EU (Benites et al., 2022)	Confirms limited communication in Ghana

Using the Knowledge–Attitude–Practice (KAP) Model, which provides a behavioural explanation for CC adoption patterns, the findings were further interpreted. The low awareness of CC principles, particularly lifecycle benefits and reuse concepts, indicates a weak “knowledge” base among consumers. This deficiency fosters misconceptions about durability, safety, and functional adequacy, shaping negative “attitudes” toward CC and lowering readiness for adoption (“practice”). The prominence of performance-related barriers such as BA12 and BA6 suggests that inadequate knowledge fosters risk-averse attitudes, consistent with the KAP proposition that knowledge deficits can amplify negative perceptions (Rada et al., 2018; Zemanová, 2023). The feedback loop within the KAP model also explains why limited visibility of CC projects (CA7) reinforces low awareness: without exposure, positive attitudes cannot develop, and adoption behaviours remain stagnant.

The study’s findings have several important practical implications. For policymakers, the low awareness of CC policy frameworks highlights the need for clear and accessible communication strategies. National awareness campaigns, community outreach programs, and simplified certification labels could help address knowledge gaps. In line with successful initiatives in Rwanda and South Africa, demonstration projects could be established in major Ghanaian cities to familiarize consumers with CC technologies (Gasparri et al., 2023; Simpeh & Smallwood, 2018). For the construction industry, integrating consumer education into marketing, offering guided tours of CC buildings, and showcasing design flexibility could address pervasive misconceptions. Financial institutions could support adoption by developing green financing instruments, such as low-interest mortgages or rebates for CC features, which have been effective in other contexts (Mamun et al., 2023).

From a theoretical standpoint, the study extends the KAP model by demonstrating that behavioural resistance is more driven by perceived performance risks than by economic concerns in emerging markets. This challenges the conventional cost-centric framing of CC adoption and positions functionality-related perceptions as equally significant. The findings contribute to the circular construction literature by providing one of the first consumer-level empirical datasets in Ghana and by expanding the traditionally supply-focused understanding of CC barriers.

The study also has several limitations. The sample size of 200, though adequate for nonparametric analysis, is smaller than recommended for large-scale national assessments. The overrepresentation of respondents working in construction-related fields may inflate baseline awareness levels. The cross-sectional design prevents tracking changes over time, and the urban-focused sample excludes rural perspectives. Future research should employ longitudinal designs to monitor awareness evolution, experimental interventions to measure the impact of targeted education, and PLS-SEM modelling to examine causal pathways from knowledge to practice.

Generally, the discussion demonstrates that consumer awareness of circular construction in Ghana remains fragmented and that misconceptions, particularly about functionality and durability, play a central role in shaping adoption behaviour. By addressing these knowledge gaps, stakeholders can support Ghana's transition toward sustainable and circular built environments.

6. CONCLUSION

This study provides one of the first empirical assessments of consumer awareness of circular construction (CC) in Ghana, revealing a fragmented understanding of CC principles and persistent misconceptions that hinder its adoption. Although respondents demonstrated partial awareness of cost-saving and environmental benefits, deeper knowledge, particularly regarding lifecycle thinking, material reuse, and policy frameworks, remained limited. These findings underscore that awareness gaps, rather than cost alone, constitute a major barrier to CC uptake among Ghanaian consumers. Theoretically, the study advances the application of the Knowledge–Attitude–Practice (KAP) model in the built environment by demonstrating how insufficient knowledge fosters negative attitudes towards CC and shapes consumer skepticism. By highlighting the role of perceived functional and durability risks, the study extends existing CC literature, which has traditionally emphasized financial barriers. The results, therefore, provide new demand-side insights into a research area previously dominated by supply-side analyses of professionals and institutions. Practically, the findings carry important implications for policymakers, industry leaders, and financial institutions. For government stakeholders, the low awareness of CC policy frameworks calls for stronger communication strategies, simplified certification schemes, and the implementation of visible demonstration projects in major cities. For industry practitioners, addressing misconceptions about durability, maintenance, and design flexibility is essential to improving consumer acceptance. Developers and contractors can support adoption by integrating consumer education into marketing and showcasing diverse CC building typologies.

Financial institutions also have a critical role in reducing perceived risks by offering targeted green financing products and incentives that make CC options more accessible. For academia, the study highlights the need for curriculum enhancements, public awareness collaborations, and interdisciplinary research involving behavioural science, construction management, and environmental policy. Educational institutions can contribute by embedding CC concepts within architecture, engineering, and sustainability programs and engaging students in CC demonstration initiatives. As the study offers valuable insights, some limitations must be acknowledged. The sample size, urban focus, and cross-sectional design limit generalizability and the ability to track changes in awareness over time. Future research should employ longitudinal designs, experimental awareness interventions, and advanced modelling techniques, such as PLS-SEM, to examine causal pathways among awareness, attitudes, and adoption. Therefore, this study establishes a foundational understanding of consumer-level awareness gaps in circular construction within Ghana. By addressing these gaps through targeted policy actions, educational reforms, and industry engagement, stakeholders can accelerate the transition towards a more sustainable and circular built environment. Future research building on this baseline will be essential to enhancing CC adoption and supporting Ghana's broader environmental and climate-resilience objectives.

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Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper

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