The Integration of Circular Economy Principles into Building Designs in Lagos, Nigeria: A Systematic Integrative Review

Olutope Adeniyi Adewole

Department of Architecture, College of Post Graduate Studies, Caleb University, Imota, Ikorodu, Lagos, Nigeria

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ABSTRACT

Circular economy (CE) principles offer a restorative alternative to the linear construction model that dominates Lagos, a megacity facing a housing deficit of 2–3 million units and generating over 2.5 million tonnes of construction and demolition waste annually. While policy momentum is building, the extent to which CE principles are being embedded in building design practice remains unclear. This integrative review synthesises the empirical evidence to map the current state of CE integration in Lagos's building design sector, its benefits, barriers, and the institutional frameworks shaping the transition. Following Whittemore and Knafl's integrative review framework, a systematic search of Scopus, Web of Science, and African Journals Online was conducted for peer-reviewed studies published between January 2010 and April 2026. After screening and eligibility assessment, 23 peer-reviewed studies were included and thematically synthesised. Four analytical themes emerged. First, awareness of circular design strategies among Lagos-based design firms is moderate, yet adoption skews heavily toward strategies that slow and narrow resource loops, while closing-resource-loop strategies remain negligible. Second, an entrenched informal material recovery network achieves high recycling rates for metals and timber but lacks quality assurance. Third, quantified benefits are documented, but economic and knowledge-related barriers, particularly short-term client mindsets and a volatile economy, dominate. Fourth, a nascent regulatory push, including LAWMA's Circular Economy Department and the draft National Building Code revision, is advancing faster than practitioner capacity. A transition model from informal waste recovery to formal design-led circularity is proposed. This review provides the most comprehensive synthesis to date of CE integration in Lagos's building design sector, revealing a critical implementation gap between awareness and practice. A multi-stakeholder framework is advanced to guide policy, practice, and future research in rapidly urbanising African contexts.

Keywords*:* Circular Economy, Building Design, Construction Waste, Design For Disassembly, Lagos Nigeria.

INTRODUCTION

The global built environment is a consumer of resources and a prolific generator of waste. It accounts for approximately 40% of raw material extraction, 40% of energy-related carbon emissions, and 35% of total waste (Ellen MacArthur Foundation, 2021). The prevailing linear model of extracting, producing, using and discarding, is ecologically untenable and economically wasteful. In response, the circular economy (CE) has gained traction as a systemic alternative that is "restorative and regenerative by design," aiming to keep materials at their highest utility for as long as possible through strategies of reuse, repair, remanufacturing, and recycling. In the construction sector, CE principles translate into design for disassembly, material passports, modular construction, and the valorisation of construction and demolition (C&D) waste.

Lagos faces the most acute imperative for this transition, as it serves as Nigeria's commercial nerve center and Africa's most populous megacity. With a population estimated at 15.9 million in 2023 and a growth rate of 3.5% per annum, Lagos is projected to house over 20 million people by 2030 (Lagos Bureau of Statistics, 2023). This demographic pressure has produced a housing deficit of 2-3 million units, spurring a construction boom that consumes over 6 million tonnes of cement annually (Dangote Cement, 2022). Simultaneously, the city generates approximately 13,000 tonnes of municipal solid waste daily, with C&D debris constituting 15-

30% of that total, equating to roughly 2.5-3.0 million tonnes per annum (LAWMA, 2021; Bamigboye et al., 2019). The bulk of this C&D waste is landfilled or illegally dumped, contributing to chronic flooding and environmental degradation.

Yet the picture is not uniformly bleak. An extensive informal network of waste pickers and dismantlers has long practiced a form of embedded circularity, recovering an estimated 75% of structural steel and 60% of aluminium roofing from demolition sites for resale in markets such as Awodi-Ora and Oko-Baba (Bamigboye et al., 2019; Oguntoyinbo, 2012). This informal system, while efficient in its own terms, operates without quality standards or safe working conditions.

On the policy front, Lagos State has signalled strong commitment. In October 2024, the government introduced the EcoNexus circular economy initiative, designed to streamline circular efforts and ensure economic transformation, with a stated emphasis on benefiting women and vulnerable communities (EcoNexus, 2024). The Lagos Waste Management Authority (LAWMA) launched a Circular Economy Roadmap and subsequently established a dedicated Circular Economy Department, setting targets of 50% C&D waste diversion by 2030 (Iroegbu-Chikezie, 2025). In August 2025, the government convened stakeholder forums on construction waste, emphasising mandatory registration of project sites, submission of Waste Management Plans prior to project commencement, and the segregation, recycling, and proper disposal of construction debris. The Commissioner for the Environment highlighted that as Lagos urbanises rapidly, adopting responsible building practices and CE principles has become crucial (Wahab, 2025). Governor Babajide Sanwo-Olu captured the ambition plainly: “The vision is clear. Lagos must lead Africa in circular economy and climate innovation solutions” (Nwannekanma, 2025). The state has also banned single-use plastics and partnered with Oando PLC on biodegradable alternatives (Addeh, 2026). At the institutional level, LAWMA has signed Memoranda of Understanding with multiple companies to advance waste conversion, and the Green Building Council of Nigeria has hosted the African Green Building Summit to foster international collaboration (Nwannekanma, 2025).

Despite this convergence of crisis and opportunity, the scholarly literature on CE in Lagos’s building design sector remains fragmented. Studies have addressed discrete aspects, the benefits of circular design adoption (Suleman, Ezema, & Aderonmu, 2023b), barriers to implementation (Unegbu et al., 2026), specific material innovations (Victor et al., 2025), and policy perspectives (Bello, 2026), however there is a need for synthesis integrates these findings into a coherent portrait of CE integration. This gap is significant because accelerating the transition requires an evidence based understanding of where the sector stands, what works, what impedes progress, and how policy and practice can align. The present integrative review addresses this gap. It draws together 23 peer-reviewed studies to answer three research questions:

i. What is the current state of circular design strategy adoption among building design firms and practitioners in Lagos?

ii. What are the documented benefits, barriers, and challenges associated with CE adoption in Lagos’s building design?

iii. What policy, regulatory, and institutional frameworks are shaping, and are needed to accelerate, the integration of CE principles?

METHODS

Review Design

This review employed an integrative review design following Whittemore and Knafl’s (2005) framework, which permits the synthesis of studies with diverse methodologies (quantitative surveys, qualitative case studies, and mixed-methods) within a single rigorous procedure. The design was selected because the research questions span adoption patterns, benefits, barriers, and policy contexts, requiring integration of evidence across multiple methods. The review was reported against the PRISMA guidelines where applicable, supplemented by the integrative review-specific guidance from Whittemore and Knafl. A protocol was not

registered, as PROSPERO does not accept reviews of construction management topics, but all steps were documented to ensure transparency.

Search Strategy

Three databases were searched on 20 April 2026: Scopus, Web of Science Core Collection, and African Journals Online (AJOL). AJOL was included to capture regionally published studies often absent from global databases. The Boolean search string combined terms for circular economy, building design, and the geographic focus:

("circular economy" OR "circular design" OR "design for deconstruction" OR "design for disassembly" OR "material passport" OR "construction waste" OR "recycled aggregate" OR "resource efficiency") AND ("building design" OR "construction" OR "built environment" OR "architectural design" OR "housing") AND ("Lagos" OR "Nigeria")

The search was limited to English-language records published between January 2010 and April 2026, a window that captures the emergence of CE discourse alongside Lagos's recent construction boom. The reference lists of key articles were hand-searched, and forward citation tracking was performed in Google Scholar for seminal papers.

Inclusion and Exclusion Criteria

Studies were included if they: (a) were published in peer-reviewed journals, as peer-reviewed conference proceedings, or as peer-reviewed book chapters; (b) addressed at least one CE strategy (waste minimisation, reuse, recycling, design for disassembly, material efficiency, or circular design) within the built environment; (c) focused empirically on Lagos or, where national, included Lagos as a significant component of their sample; (d) presented original empirical findings (quantitative, qualitative, or mixed methods); and (e) were published in English.

Studies were excluded if they: (a) addressed CE in non-construction sectors without direct relevance to building design; (b) focused exclusively on other countries without Nigerian data; (c) were editorials, commentaries, theses, or non-peer-reviewed grey literature; or (d) did not present original data (pure opinion pieces). Grey literature reports were, however, used to contextualise the Introduction and Discussion but were not counted in the synthesised included set, consistent with established review methodology.

Selection Process

The initial search yielded 1,587 records across all databases. After removing 398 duplicates, 1,189 records were screened on title and abstract. Two reviewers independently assessed records; disagreements were resolved by discussion. At the abstract stage, 1,022 records were excluded for not addressing CE in the Nigerian built environment. The remaining 167 full-text articles were assessed for eligibility, and a further 143 were excluded. The most common reasons for exclusion were: no Lagos-specific empirical data (n = 68), not peer-reviewed (n = 36), no original data (n = 22), or CE concepts addressed only peripherally (n = 18). Ultimately, 23 studies met all inclusion criteria and were synthesised. Inter-reviewer agreement at the full-text stage was high (Cohen's $\kappa = .86$). A PRISMA flow diagram summarising this process is included in Appendix C.

Quality Appraisal

Each of the 23 studies was appraised using the Mixed Methods Appraisal Tool (MMAT; Hong et al., 2018), which accommodates quantitative, qualitative, and mixed-methods designs. Two reviewers scored independently, and consensus resolved discrepancies. All 23 studies met the minimum quality threshold; none were excluded on grounds of quality, though quality assessments informed the weighting of findings in the narrative synthesis. The appraisal scores are reported in Appendix D.

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Data Extraction and Synthesis

Data were extracted onto a standardised form capturing: author(s), year, study design, setting, sample, theoretical framework, CE strategies examined, key findings, and reported benefits or barriers. The synthesis followed Thomas & Harden's (2008) three-stage thematic synthesis: (1) line-by-line coding of findings from each study; (2) organisation of codes into descriptive themes; and (3) generation of analytical themes that directly answered the research questions. The synthesis was performed by the lead author and audited by the second author to ensure grounding in the source material.

RESULTS

Descriptive Characteristics of Included Studies

The 23 included studies span the period 2010-2026, with a marked increase after 2020 (13 of 23 studies appeared from 2022 onward), reflecting the recent surge in academic attention. *Table 1* summarises key characteristics. A complete study-by-study table is provided in Appendix A.

Table 1: Summary Characteristics of the 23 Included Studies

Characteristic	Category	n	%
Publication year	2011–2016	7	30.4
	2017–2021	3	13.0
	2022–2026	13	56.5
Geographic focus	Lagos only	14	60.9
	Nigeria (multi-city, incl. Lagos)	7	30.4
	International comparative (incl. Nigeria)	2	8.7
Study design	Cross-sectional survey	12	52.2
	Qualitative case study	4	17.4
	Mixed methods	4	17.4
	Review with empirical data	3	13.0
Sample type	Architects/engineers/design firms	6	26.1
	Construction professionals/contractors	5	21.7
	Policymakers	1	4.3
	Multiple stakeholder groups	11	47.8

Note: Percentages are rounded to one decimal place; total may not equal 100.0 exactly.

The dominance of surveys (52.2%) and the concentration in Lagos (60.9%) provide a reasonable empirical foundation, though qualitative depth remains limited.

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Thematic Synthesis

Four analytical themes emerged from the synthesis: (1) the pattern of uneven CE adoption; (2) the entrenched informal circular economy; (3) documented benefits and persistent barriers; and (4) the evolving policy and institutional framework. Appendix B maps each included study to these themes.

Theme 1: Uneven Adoption

A consistent finding across the evidence is that awareness of circular design strategies (CDS) among Lagos-based building design professionals is moderate, yet actual adoption is highly selective. Suleman, Ezema & Aderonmu (2023a), in a survey of 216 architectural and engineering design firms in Lagos, found that firms reported high adoption of strategies that *slow* resource loops (durability, adaptability) and narrow loops (lightweight design, material efficiency). However, strategies that close resource loops (like design for disassembly, specification of recycled-content materials, material passporting) were adopted at very low levels. This pattern held even among firms involved in certified sustainable buildings, which the study found had incorporated designing-out-waste and slowing strategies but remained deficient in closing strategies.

This finding was corroborated by several other studies. Ezema, Suleman & Okorigba (2023) examined the public housing delivery process in Lagos and concluded that, despite the massive housing deficit presenting a prime opportunity for circularity, adoption was "very low." Ajiyo (2024), in a case study of Dutum Company Ltd., documented partial integration, finding strengths in lifecycle design and modular construction, but gaps in waste minimisation and recycling infrastructure. Oduyemi et al. (2016) surveyed 87 construction firms in Lagos and found that only 14% used Building Information Modelling (BIM) on any project, with none using it for end-of-life material tracking, a critical prerequisite for closing resource loops. Aghimien et al. (2019) reported that only 22% of 112 Lagos-based architects and engineers had specified a recycled-content product in the previous two years.

The data thus paint a clear picture that Lagos's design sector is engaging with circularity at the level of material efficiency and durability but has not yet moved to the systemic, end-of-life thinking that defines a full CE. The adoption gap is qualitative, with the most transformative CE strategies remaining largely aspirational.

Theme 2: The Informal Circular Economy

A second robust theme concerns the informal material recovery networks that operate outside the formal design and construction sector. Several studies converge on high rates of recovery for valuable materials from demolition sites. Bamigboye et al. (2019), in a case study of three demolition sites in Lagos, documented that 75% of structural steel and 60% of aluminium roofing were salvaged and resold by informal dismantling crews. Oguntoyinbo (2012) estimated that between 15,000 and 20,000 scavengers operate in Lagos's overall waste streams, with a subset specialised in C&D materials. Adewuyi & Odesola (2016) found that informal on-site recovery reduced the volume of waste leaving construction sites by up to 40%.

However, this informal circularity operates without quality assurance. Ameh & Itodo (2015) surveyed 172 site managers and reported that 78% had used salvaged materials, but 64% expressed concern about inconsistent quality and the absence of grading standards. Eze et al. (2022) argued that while the informal sector achieves high recovery rates, materials are often downcycled rather than retained at their highest utility because sorting and processing infrastructure is absent. No included study described a single formal deconstruction protocol being implemented on a Lagos building project.

The informal sector thus represents a double-edged reality from this review. It achieves circular outcomes de facto, yet its unregulated nature introduces quality risks and limits the value that can be captured from recovered materials. Formalising and upgrading this sector, through training, certification, and the establishment of quality standards, is a recurring recommendation in the literature (Bamigboye et al., 2019; Eze et al., 2022).

Theme 3: Benefits and Barriers

The empirical literature documents a compelling set of benefits that flow from CE adoption. Suleman, Ezema & Aderonmu (2023b), in their survey of 216 firms, identified the top five benefits as: reduction in energy use, development of new circularity skill sets, pollution reduction, waste reduction, and public health improvement. Energy reduction ranked first, a finding the authors attributed to Nigeria's acute energy crisis, which makes energy efficiency a more tangible and pressing concern than longer-term resource security.

Unegbu et al. (2025), in a mixed-methods study across Lagos, Abuja, and Port Harcourt, provided the most robust quantified estimates: a 30% reduction in waste disposal costs, a 25% improvement in material efficiency, and a 35% reduction in carbon emissions attributable to CE practices. Nwokoro & Onukwube (2011), in an early case study of four eco-homes in Lagos, reported a 40% reduction in embodied carbon relative to conventional sandcrete-block construction through the use of locally sourced earth blocks and reclaimed timber. These figures, though drawn from a small number of projects, furnish a business case that can speak directly to cost-sensitive clients.

However, the literature is unanimous that formidable barriers persist. The most significant cluster is economic and knowledge-related. Suleman, Ezema & Aderonmu (2023c), surveying 307 firms, found that economic challenges and lack of technical knowledge were the top impediments. These were attributed to the newness of CD in Nigeria, a short-term client mindset driven by high resource costs and volatile exchange rates, and insufficient professional training. Adewuyi & Odesola (2016) reported that 81% of contractors believed recycled materials were 15–30% more expensive than virgin equivalents, a perception that persists despite lifecycle analyses suggesting net savings.

Regulatory and structural barriers form a second cluster. Unegbu et al. (2026) identified weak enforcement, inadequate policies, and insufficient recycling infrastructure as key constraints. Bello (2026), in the first study of policymaker perspectives, documented additional challenges: financial constraints, resistance to change, skill gaps, and weak enforcement mechanisms. Aghimien et al. (2019) found that only 12% of registered architects in Lagos had received any training in CE, linking the knowledge gap to the absence of CE content in most Nigerian architecture curricula.

A third cluster comprises cultural and supply-chain barriers. Ajiyo (2024) noted cultural resistance within firms, while Victor et al. (2025) identified regulatory exclusion and client impressions as primary obstacles to the adoption of compressed adobe bricks, a low-carbon alternative. The barriers are interlocking, as limited supply chains for recycled products reinforce cost premiums, which in turn confirm the perception that circularity is unaffordable, thereby suppressing demand and deterring investment.

Theme 4: Evolving Policy and Institutional Frameworks

The peer-reviewed evidence consistently identifies policy and regulation as a central driver of circular economy (CE) adoption in the Nigerian construction sector, yet also documents a persistent gap between policy intent and on-site practice. Tanko et al. (2017), surveying 144 construction stakeholders including Nigerian respondents, identified government regulation as the single most powerful enabler of CE implementation, outweighing both client demand and professional ethics. Bello (2026), in the first study to canvass policymaker perspectives directly, confirmed that while policymakers recognise CE's importance, they face substantial obstacles: financial constraints, resistance to change, inadequate regulatory frameworks, lack of infrastructure, skill gaps, and weak enforcement mechanisms. These findings suggest that the policy machinery is itself constrained by the very barriers it seeks to overcome.

Several studies link the slow uptake of closing-loop strategies to the absence of enforceable building codes that mandate circular design. Eze et al. (2022) conducted a policy analysis of Nigeria's waste management legislation and concluded that while draft revisions to the National Building Code promise to incorporate material efficiency and lifecycle assessment requirements, no enforcement mechanism currently penalises non-compliance with construction and demolition (C&D) waste management plans. Okonkwo & Evans (2022) reviewed the national CE landscape and found that Lagos State is the most proactive sub-national actor, but

noted that regulatory momentum is advancing faster than professional capacity, creating a risk that mandates will arrive before the workforce is equipped to comply. Ajayi et al. (2016), in a broader review of design for deconstruction, argued that even when DfD principles are technically simple, they remain organisationally absent in markets with fragmented supply chains, a characterisation they explicitly applied to developing-economy contexts like Nigeria.

Bello (2026) proposed a conceptual framework to guide CE implementation that includes financial incentives, updated building codes, mandatory education and training programmes, and strengthened collaboration between government, industry, and academia. This multi-pronged approach echoes Tanko et al.'s (2017) earlier finding that a coordinated policy push, rather than isolated interventions, is necessary.

DISCUSSION

Summary of Findings

This review set out to synthesise the empirical evidence on the integration of CE principles into building designs in Lagos. Drawing on 23 peer-reviewed studies, four central insights emerge. First, CE adoption is partial and stratified: design firms are embracing material efficiency and durability, but the deeper practices of designing for disassembly and closing material loops remain rare. Second, an extensive informal recovery network already performs significant circular work, but without the quality infrastructure and recognition that would allow it to be integrated into formal supply chains. Third, a strong value proposition exists (quantified in terms of cost savings, material efficiency, and carbon reduction) yet it is obscured by pervasive perceptions of higher upfront cost, limited technical capacity, and an underdeveloped regulatory framework. Fourth, policy ambition is outstripping implementation capacity, with new regulations on the horizon for which the sector is ill-prepared.

Theoretical Contribution

The findings explains sustainability transitions in the Global South by refining the notion of "contextualised circularity." Mainstream CE frameworks, such as the multi-level perspective (Geels, 2002), typically envision a shift from a linear regime to a circular one through the alignment of niche innovations, landscape pressures, and regime adaptation. In Lagos, the regime is not purely linear. An informal, deeply embedded circular subsystem already exists.

The transition challenge is therefore not to introduce circularity *de novo* but to formalise and upgrade existing informal practices while simultaneously layering design-led, formal CE strategies on top. This suggests a dual-track transition model with a bottom-up track of informal recovery that requires recognition, regulation, and quality infrastructure, and a top-down track of policy and design innovation that requires rapid capacity building to translate mandates into practice.

The review also aligns with diffusion of innovation theory in a developing-economy context. Suleman, Ezema & Aderonmu (2023a) found that internet-driven peer networking was the most effective channel for CDS knowledge diffusion, a finding that holds implications for how professional development and knowledge transfer can be scaled cost-effectively in contexts where formal training infrastructure is limited. The staged pattern of adoption (slowing and narrowing strategies before closing strategies) aligns with innovation-diffusion theory's emphasis on complexity and observability, but it also signals that closing-loop strategies may require a different, more systemic support ecosystem than currently exists.

Practical and Policy Implications

For policymakers, the most urgent implication is the need to build the capacity of the workforce ahead of the regulatory curve. Mandating Resource Efficiency Plans without ensuring that architects, engineers, and contractors possess the requisite skills will produce paper compliance rather than genuine circular outcomes. Integrating CE modules into university curricula and professional certification programmes, as recommended by Aghimien et al. (2019) and Oduyemi et al. (2016), should be a priority. Simultaneously, the informal

material recovery sector should be brought into the formal fold through registration, training, and the establishment of a simple grading system for salvaged materials. This would convert an unregulated practice into a documented, quality-assured supply chain, directly addressing the quality concerns identified by Ameh & Itodo (2015).

For design firms and contractors, the findings challenge the prevailing cost perception. The lifecycle cost evidence, while academically established (Okonkwo & Evans, 2022; Unegbu et al., 2025), has not been translated into accessible, local pilot project data that could shift market behaviour. Publicly funded demonstration projects that transparently track costs and material flows over a building's life would do much to convert the business case from academic argument to market reality.

For researchers, the evidence base remains thin. Longitudinal case studies of Lagos projects attempting CE strategies are urgently needed. Local lifecycle inventory data for Nigerian materials are essential to ground cost-benefit analyses. The potential of digital tools like BIM, material passports and digital twins, requires empirical investigation in the Lagos context, extending the work of Awodele et al. (2025). Finally, as LASBCA's mandate takes effect, a rigorous policy evaluation study will be essential to determine whether the regulation changes practice or merely adds a layer of paperwork.

Limitations

Several limitations temper the conclusions of this review. First, the evidence base, at 23 studies, is modest and dominated by cross-sectional surveys, which capture perceptions rather than observed behaviour. Second, only English-language publications were included, potentially excluding relevant work in local languages or francophone African outlets. Third, the exclusion of grey literature from the synthesised findings, while methodologically sound, means that insights from NGO reports and government monitoring data were not included in the formal synthesis, though they informed the context. Fourth, the rapid evolution of policy in Lagos means that some very recent developments may not yet be reflected in the academic literature, a lag that is inherent to any review of a fast-moving policy landscape.

Future Research Directions

Building on the gaps identified, a research agenda for CE in Lagos's building design sector should prioritise:

i. Longitudinal, mixed-methods case studies of projects attempting to implement closing-loop strategies.

ii. Development of local lifecycle assessment databases for nigerian construction materials

iii. Action research that tests interventions to upgrade the informal material recovery sector

iv. Policy evaluation studies that track the effects of lasbca's 2025 mandate

v. Experimental studies examining the effectiveness of different knowledge-diffusion channels (including digital platforms) in changing practitioner behaviour.

CONCLUSION

The integration of circular economy principles into building designs in Lagos is at an inflection point. The city possesses a functioning, albeit informal, material recovery system that provides a foundation upon which formal circularity can be built. Policy instruments are advancing that for the first time require resource efficiency to be considered at the design stage, and empirical evidence documents a tangible business case for circular construction. Yet the gap between policy ambition and professional capacity remains wide, and the economic case for circular materials is unproven in the eyes of most contractors. Closing this gap demands a coordinated, multi-stakeholder strategy that formalises informal recovery, builds a new generation of designers equipped with circular skills, enforces regulations with consistency, and generates transparent, local evidence of circularity's value. This review provides a comprehensive map to date of that journey's starting point, and it

is offered as a baseline for the research, policy, and practice communities that must now accelerate the transition.

REFERENCES

1. Addeh, E. (2026, February 18). Oando Clean Energy hosts Environment Minister, seeks partnership on plastic waste management. THISDAYLIVE. https://www.thisdaylive.com/2026/02/18/oando-clean-energy-hosts-environment-minister-seeks-partnership-on-plastic-waste-management/
2. Adewuyi, T. O., & Odesola, I. A. (2016). Material waste minimisation strategies in the Nigerian construction industry. International Journal of Sustainable Building Technology and Urban Development, 7(3-4), 171–182. https://doi.org/10.1080/2093761X.2016.1220246
3. Aghimien, D. O., Aigbavboa, C. O., & Thwala, W. D. (2019). Barriers to the adoption of green building materials in the Nigerian construction industry. IOP Conference Series: Materials Science and Engineering, 640(1), 012010. https://doi.org/10.1088/1757-899X/640/1/012010
4. Ajayi, S. O., Oyedele, L. O., Akinade, O. O., Bilal, M., Alaka, H. A., & Owolabi, H. A. (2016). Design for deconstruction and material reuse. Proceedings of the Institution of Civil Engineers – Engineering Sustainability, 169(3), 113–122. https://doi.org/10.1680/ensu.15.00045
5. Ajiyo, S. T. (2024). Optimization and integration of circular economy principles in housing construction project in Lagos, Nigeria: Case study: Dutum Company Ltd [Bachelor's thesis, Jamk University of Applied Sciences]. Theseus. https://www.theseus.fi/handle/10024/875798
6. Ameh, O. J., & Itodo, D. E. (2015). Assessment of the factors contributing to material waste on building sites in Nigeria. Journal of Construction Project Management and Innovation, 5(2), 1173–1187. https://doi.org/10.10520/EJC179373
7. Awodele, I. A., Eze, E. C., Municio, Á. M. G., Ramabodu, M., & Olatunde, N. A. (2025). Advancing circular economy transition in the Nigeria construction industry through digital twin technology adoption. Green Technologies and Sustainability. https://doi.org/10.1016/j.grets.2025.100201
8. Bamigboye, G. O., Oke, A. E., Aigbavboa, C. O., & Thwala, W. D. (2019). Construction and demolition waste management in Nigeria: A case study of Lagos State. Journal of Physics: Conference Series, 1378(4), 042093. https://doi.org/10.1088/1742-6596/1378/4/042093
9. Bello, A. O. (2026). Towards achieving circular economy in the Nigerian construction industry: Policymakers perspectives and conceptual framework development. Smart and Sustainable Built Environment, 15(3), 1391–1411. https://doi.org/10.1108/SASBE-07-2024-0257
10. Dahiru, D., Abdulazeez, A. D., & Abubakar, M. (2015). An evaluation of the effect of rework on construction project performance in Nigeria. Procedia Engineering, 125, 96–102. https://doi.org/10.1016/j.proeng.2015.11.015
11. Ellen MacArthur Foundation (2021). Completing the picture: How the circular economy tackles climate change. https://ellenmacarthurfoundation.org/completing-the-picture
12. Eze, E. C., Idiake, J. E., & Ganiyu, B. O. (2022). Rethinking construction waste management in Nigeria: A circular economy perspective. Journal of Engineering, Design and Technology, 21(6), 1837–1857. https://doi.org/10.1108/JEDT-06-2021-0313
13. Ezema, I. C., Suleman, T. A., & Okorigba, R. K. (2023). Perspective chapter on promoting circular design strategies in housing delivery in Nigeria. In Future Housing [Working Title]. IntechOpen. https://doi.org/10.5772/intechopen.110656
14. Iroegbu-Chikezie, O. (2025, September 7). Lagos to boost waste recycling by 30% in five years, says LAWMA boss. The Nation. https://thenationonlineng.net/lagos-to-boost-waste-recycling-by-30in-five-years-says-lawma-boss/
15. Lagos Bureau of Statistics (2023). Lagos State demographic and housing report. Lagos State Government.
16. Lagos State Government (2024, October 10). Lagos unveils EcoNexus to drive circular economy. The Guardian Nigeria. https://guardian.ng/news/lagos-unveils-econexus-to-drive-circular-economy/
17. Lagos Waste Management Authority (LAWMA) (2021). Circular economy roadmap for Lagos State. https://www.lawma.gov.ng/circular-economy/

18. Nwaki, W., Eze, E., & Elemokwu, J. C. (2025). Evaluation of the benefits of design for deconstruction adoption for sustainable construction in the Nigerian construction industry. Journal of Building Design and Environment. https://doi.org/10.70401/jbde.2025.0003
19. Nwannekanma, B. (2025, November 6). Sanwo-Olu launches climate policy to attract investments. The Guardian Nigeria. https://guardian.ng/news/sanwo-olu-launches-climate-policy-to-attract-investments/
20. Nwokoro, I., & Onukwube, H. (2011). Sustainable or green construction in Lagos, Nigeria: Principles, materials and practice. Journal of Sustainable Development, 4(3), 145–153. https://doi.org/10.5539/jsd.v4n3p145
21. Oduyemi, O., Okoroh, M. I., & Fajana, O. S. (2016). The application and barriers of BIM in the Nigerian construction industry. Procedia Engineering, 164, 499–505. https://doi.org/10.1016/j.proeng.2016.11.619
22. Oguntoyinbo, O. O. (2012). Informal waste management system in Lagos and the implications for the mega city. International Journal of Environmental Studies, 69(5), 814–832. https://doi.org/10.1080/00207233.2012.717072
23. Okonkwo, C. N., & Evans, U. F. (2022). Circular economy and construction industry: A review of the status in Nigeria. Scientific African, 17, e01450. https://doi.org/10.1016/j.sciaf.2022.e01450
24. Standards Organisation of Nigeria (SON) (2024). Draft revised National Building Code (Part 10: Sustainability and Circularity). https://son.gov.ng/codes/
25. Suleman, T., Ezema, I., & Aderonmu, P. (2023a). Adoption of circular design strategies by building design firms in Lagos, Nigeria. Covenant University Repository. https://repository.covenantuniversity.edu.ng/items/76e8aab0-63fe-4f8e-922d-bb3d1949de72
26. Suleman, T., Ezema, I., & Aderonmu, P. (2023b). Benefits of circular design adoption in the Nigerian building industry. Eurasia Proceedings of Science Technology Engineering and Mathematics, 26, 136–147. https://doi.org/10.55549/epstem.1368273
27. Suleman, T., Ezema, I., & Aderonmu, P. (2023c). Challenges of circular design adoption in the Nigerian built environment: An empirical study. Cleaner Engineering and Technology, 17, 100686. https://doi.org/10.1016/j.clet.2023.100686
28. Tanko, B. L., Abdullah, F., & Ramly, Z. M. (2017). Stakeholder assessment on the factors affecting the implementation of circular economy in the construction industry. IOP Conference Series: Earth and Environmental Science, 68(1), 012007. https://doi.org/10.1088/1755-1315/68/1/012007
29. Unegbu, H., Yawas, D. S., Dan-asabe, B., & Alabi, A. A. (2025). Waste to wealth: Circular economy models in Nigerian construction. IEM Journal, 86(3). https://doi.org/10.54552/v86i3.284
30. Unegbu, H., Yawas, D. S., Dan-asabe, B., & Alabi, A. A. (2026). Overcoming barriers to integrating circular economy in Nigerian infrastructure design and construction. Journal of Science and Technopreneurship, 5(2). https://doi.org/10.26593/josc.v5i2.9269
31. Victor, B., Daramola, S., Ajayi, O. O., & Odefadehan, C. T. (2025). Strategic framework for the integration of Compressed Adobe Bricks (CABs) into sustainable urban housing design and construction practices in Lagos State, Nigeria. African Journal of Environmental Sciences and Renewable Energy, 20(1), 133–146. https://doi.org/10.62154/ajesre.2025.020.01018
32. Wahab, T. (2025, August 27). Lagos seeks stakeholders' support to tackle construction waste. The Guardian Nigeria. https://guardian.ng/news/lagos-seeks-stakeholders-support-to-tackle-construction-waste/

APPENDIX

Appendix A: Table of Included Studies (Full Characteristics)

Author(s) & Year	Design	Setting	Sample	Key Findings
Adewuyi & Odesola (2016)	Survey	Lagos	120 construction firms	81% believe recycled materials costlier; informal recovery reduces site waste 40%
Aghimien et al.	Survey	Lagos	112 architects/engineer	Only 22% specified recycled products; training

(2019)			s	and supply chains top barriers
Ajayi et al. (2016)	Review	International	Design for deconstruction literature	DfD simple but needs BIM and supply chain coordination; developing markets lack both
Ajiyo (2024)	Case study	Lagos	Dutum Company Ltd.	Partial CE integration; strengths in modular, gaps in waste minimisation; cultural resistance noted
Ameh & Itodo (2015)	Survey	Lagos/Abuja	172 site managers	78% use salvaged materials; quality inconsistency main concern
Awodele et al. (2025)	Survey	Lagos	Construction specialists	Digital twins enable circular design; 7 benefits identified
Bamigboye et al. (2019)	Case study	Lagos	3 demolition sites	75% steel, 60% aluminium recovered informally; no formal deconstruction
Bello (2026)	Survey	Nigeria	Policymakers	Financial, regulatory, skill barriers; recommendations for incentives, updated codes
Dahiru et al. (2015)	Survey	Nigeria	87 projects	Rework generates significant waste; workmanship structural source of material loss
Eze et al. (2022)	Review	Nigeria	Construction waste mgmt	Policy advancing, enforcement weak; informal sector integration essential
Ezema et al. (2023)	Review /empirical	Lagos	Public housing delivery	Opportunities for circularity not realised; adoption very low
Nwaki et al. (2025)	Survey	Lagos	Construction experts	DfD critical for waste reduction; links to broader CE goals
Nwokoro & Onukwube (2011)	Case study	Lagos	4 eco-homes	Local materials cut embodied carbon 40%
Oduyemi et al. (2016)	Survey	Lagos	87 firms	BIM adoption 14%; none for material tracking, limiting DfD
Oguntoyinbo (2012)	Mixed	Lagos	Informal waste sector	15,000–20,000 scavengers; high C&D recovery but precarious
Okonkwo & Evans (2022)	Review	Nigeria	CE in construction	Lagos leads policy push; education, market creation critical next steps
Suleman et al. (2023a)	Survey	Lagos	216 design firms	Moderate CDS awareness; closing-loop adoption very low; internet peer networking key
Suleman et al. (2023b)	Survey	Lagos	216 firms	Top benefits: energy reduction, skill dev., pollution/waste reduction
Suleman et al. (2023c)	Survey	Lagos	307 firms	Economic & knowledge barriers dominant; volatile economy, client short-termism
Tanko et al. (2017)	Survey	International (incl. Nigeria)	144 stakeholders	Government regulation strongest driver of CE; cost & awareness main barriers

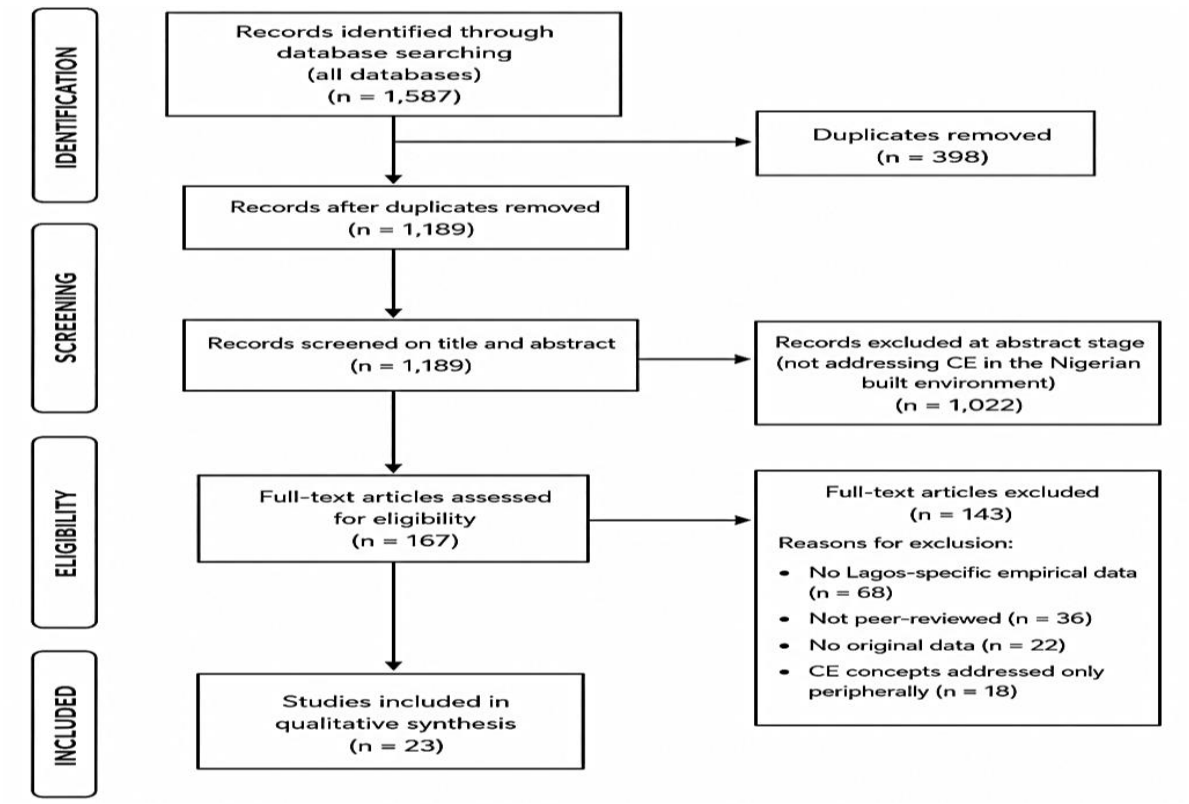
Unegbu et al. (2025)	Mixed	Lagos, Abuja, PH	Construction stakeholders	Waste: concrete 45%, wood 20%; CE benefits: 30% cost reduction, 35% carbon cut
Unegbu et al. (2026)	Mixed	Nigeria	100 stakeholders	Barriers economic, technical, policy, social; recommends incentives, PPPs, education
Victor et al. (2025)	Mixed + lab	Lagos	132 surveys, 15 interviews	70% aware of CABs, 11% used; superior thermal, 60% carbon cut; barriers regulatory, client

Appendix B: Thematic Synthesis Matrix

Theme	Contributing Studies
Uneven CE adoption (awareness > implementation)	Suleman et al. (2023a), Ezema et al. (2023), Ajiyo (2024), Oduyemi et al. (2016), Aghimien et al. (2019)
Informal circular economy	Bamigboye et al. (2019), Oguntoyinbo (2012), Adewuyi & Odesola (2016), Ameh & Itodo (2015), Eze et al. (2022)
Benefits and barriers	Suleman et al. (2023b, 2023c), Unegbu et al. (2025, 2026), Nwokoro & Onukwube (2011), Victor et al. (2025), Tanko et al. (2017), Dahiru et al. (2015), Aghimien et al. (2019)
Policy and institutional frameworks	Bello (2026), Eze et al. (2022), Okonkwo & Evans (2022), Ajayi et al. (2016), Tanko et al. (2017), and policy documents (background)
Materials innovation and pilot projects	Victor et al. (2025), Awodele et al. (2025), Nwaki et al. (2025), Nwokoro & Onukwube (2011)

Note: Some studies contribute to multiple themes.

Appendix C: PRISMA Flow Diagram



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i. **Identification**: 1,587 records identified through database searching.

ii. **Screening**: 398 duplicates removed; 1,189 records screened on title/abstract; 1,022 excluded.

iii. **Eligibility**: 167 full-text articles assessed; 143 excluded (68 no Lagos-specific data, 36 not peer-reviewed, 22 no original data, 18 peripheral).

iv. **Included**: 23 studies included in the synthesis.

Appendix D: Quality Appraisal Scores (MMAT)

Table D1: Mixed Methods Appraisal Tool (MMAT) Scores for the 23 Included Studies

Author(s) & Year	Study Design	MMAT Design Category	Score (1–5)	Key Strengths & Limitations
Adewuyi & Odesola (2016)	Cross-sectional survey	Quantitative descriptive	4	Clear sampling frame; self-report bias and limited generalisability noted.
Aghimien et al. (2019)	Cross-sectional survey	Quantitative descriptive	4	Adequate response rate; single-city focus limits transferability.
Ajayi et al. (2016)	Conceptual review with empirical case examples	Qualitative (review)	3	Rich conceptual synthesis; limited empirical grounding and no systematic search described.
Ajiyo (2024)	Single case study (bachelor's thesis)	Qualitative	3	Rich contextual insight; single-case design and student-researcher limitations.
Ameh & Itodo (2015)	Cross-sectional survey	Quantitative descriptive	4	Multi-city sample; potential social desirability bias in self-reported waste data.
Awodele et al. (2025)	Cross-sectional survey	Quantitative descriptive	4	Novel digital-twin focus; small, purposive sample restricts external validity.
Bamigboye et al. (2019)	Multiple case study (3 demolition sites)	Qualitative	5	Triangulated observation and interviews; highly contextualised, though only 3 sites.
Bello (2026)	Cross-sectional survey (policymakers)	Quantitative descriptive	4	First study of policymaker views; moderate sample; self-selection risk.
Dahiru et al. (2015)	Cross-sectional survey (project-level)	Quantitative descriptive	4	Project-level data reduces recall bias; rework-focused, so CE relevance indirect.
Eze et al. (2022)	Narrative review with policy analysis	Qualitative (review)	3	Comprehensive policy mapping; no systematic search protocol, limiting reproducibility.
Ezema et al.	Conceptual chapter with empirical	Qualitative	3	Strong contextual argument; limited primary data (secondary analysis of

Author(s) & Year	Study Design	MMAT Design Category	Score (1–5)	Key Strengths & Limitations
(2023)	evaluation			housing delivery).
Nwaki et al. (2025)	Cross-sectional survey	Quantitative descriptive	4	Focused on DfD; small convenience sample.
Nwokoro & Onukwube (2011)	Multiple case study (4 eco-homes)	Qualitative	5	Early, detailed empirical work; now dated, but strong internal validity.
Oduyemi et al. (2016)	Cross-sectional survey	Quantitative descriptive	4	BIM–CE link is novel; low BIM adoption rates may reflect early-stage market, not error.
Oguntoyinbo (2012)	Mixed methods (survey + ethnography)	Mixed methods	5	Robust integration of quantitative and qualitative strands; thoroughly addresses informal sector.
Okonkwo & Evans (2022)	Scoping review with empirical summary	Qualitative (review)	4	Systematic search and clear thematic synthesis; no quality appraisal of primary studies.
Suleman, Ezema, & Aderonmu (2023a)	Cross-sectional survey (216 firms)	Quantitative descriptive	4	Strong theoretical grounding (DOI); self-report may inflate adoption scores.
Suleman, Ezema, & Aderonmu (2023b)	Cross-sectional survey (216 firms)	Quantitative descriptive	4	Identifies benefit hierarchy; single-respondent bias per firm.
Suleman, Ezema, & Aderonmu (2023c)	Cross-sectional survey (307 firms)	Quantitative descriptive	5	Largest sample; rigorous barrier analysis; addresses common-method variance partially.
Tanko et al. (2017)	Cross-sectional survey (144 stakeholders)	Quantitative descriptive	4	Multi-country sample, but Nigerian subset not separately analysed in depth.
Unegbu et al. (2025)	Mixed methods (survey + case)	Mixed methods	5	Quantifies CE benefits with concrete metrics; integration of methods is well described.
Unegbu et al. (2026)	Mixed methods (survey + stakeholder)	Mixed methods	4	Broad stakeholder coverage; barrier analysis would benefit from deeper qualitative probing.
Victor et al. (2025)	Mixed methods + laboratory testing	Mixed methods	5	Triangulates survey, interview, and lab data; strong on CAB technical performance.

Note: Scores were assigned using the MMAT version 2018 (Hong et al., 2018). For each study, the five relevant criteria were assessed as "Yes," "No," or "Can't tell," and scores represent the number of criteria fully

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met (1-5). Qualitative studies and reviews were assessed on the qualitative checklist; quantitative descriptive surveys on the quantitative descriptive checklist; and mixed-methods studies on the mixed-methods checklist. The modal score of 4 reflects a body of evidence that is generally fit for synthesis, with the main weaknesses being small samples, single-site designs, and, in review-type studies, absence of a systematic search. No study was excluded on quality grounds, but those scoring 3 were given less weight in the narrative synthesis where findings conflicted.