
**ENVIRONMENTAL IMPACT ASSESSMENT OF DRY
CONSTRUCTION SYSTEM IN SELECTED PERI- URBAN
RESIDENTIAL PROJECTS IN SOUTHWEST NIGERIA**

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Article Received: 02 April 2026

Article Revised: 22 April 2026

Published on: 12 May 2026

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ABSTRACT

This study investigated the environmental consequences of implementing dry construction systems in specific peri-urban residential projects in South-West Nigeria, concentrating on assessing their sustainability performance through the lens of Environmental Impact Assessment (EIA) and life-cycle analysis. The project aimed to develop ecologically sustainable building options that allow quick housing supply while reducing ecological disruption in rapidly expanding urban peripheries. The research used a mixed-method methodology, including literature review, case study analysis, and environmental performance assessment. Peri-urban settings were analyzed to evaluate construction processes, material use, waste production trends, energy implications, and regulatory compliance related to dry construction systems in contrast to traditional building techniques. Key environmental factors were emphasized, including water use, construction waste production, embodied carbon, site disruption, noise pollution, and operating energy requirements. Research indicates that dry construction technologies provide substantial environmental benefits throughout the building period, such as less on-site waste, limited water use, expedited project completion, and reduced dust and noise pollution. These attributes are especially advantageous in peri-urban areas where environmental management infrastructure is deficient. The research also revealed trade-offs, particularly the elevated embodied energy linked to prefabricated components and possible rises in operational cooling requirements if climate-responsive design strategies are insufficiently included. The study emphasized legal and institutional deficiencies in Nigeria's EIA system,

notably the inadequate integration of life-cycle assessment approaches in project appraisal procedures. The research indicates that dry building systems are a feasible and sustainable option for peri-urban residential growth in South-West Nigeria, contingent upon suitable legislative changes, climate-responsive design techniques, and enhanced environmental governance. This study enhances previous knowledge by situating dry building within the dynamics of Nigerian peri-urban areas and offering evidence-based suggestions for incorporating life-cycle environmental assessment into sustainable construction methods.

KEYWORDS: Dry construction system. Environmental Impact Assessment, Peri Urban, South west, Nigeria, Construction, Sustainability.

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1.0. INTRODUCTION

The construction sector is internationally acknowledged as a significant contributor to environmental deterioration due to substantial material use, elevated energy usage, trash production, and ecological disruption. Sustainable construction techniques have increasingly gained importance, notably via the adoption of novel building technologies like dry construction systems, which prioritize prefabrication, modularity, material efficiency, and minimized wet trade processes. Dry construction techniques use lightweight materials, prefabricated panels, steel framework, gypsum boards, timber-based systems, and modular components built with less reliance on water, cement, and in-situ casting. These techniques are progressively seen as feasible substitutes for traditional masonry building, particularly in swiftly urbanizing areas of the Global South. In Nigeria, accelerated population growth, urban development, and housing shortages have heightened building efforts, especially in the peri-urban areas of the southwestern states, including Lagos, Ogun, Oyo, Osun, Ondo, and Ekiti. These regions undergo rapid land conversion, infrastructural development, and residential growth, often without sufficient environmental planning regulations. Consequently, environmental issues associated with construction, including air and noise pollution, land degradation, excessive material extraction, waste creation, and carbon emissions, have become more evident (Abah et al., 2024; Alade et al., 2025). The National Environmental Standards and Regulations Enforcement Agency (NESREA) has consistently underscored extensive non-

compliance with Environmental Impact Assessment (EIA) mandates in construction projects, accentuating the pressing necessity for more environmentally sustainable construction practices in Nigeria. The Environmental Impact Assessment (EIA) is an essential planning and decision-making instrument aimed at forecasting, assessing, and alleviating the possible negative environmental consequences of development projects prior to their execution and comming up with proper mitigation solutions to tackle possible negative drawbacks on these projects. In the Nigerian construction industry, Environmental Impact Assessments (EIAs) are becoming more vital owing to escalating environmental hazards linked to traditional construction techniques that mainly depend on cement-intensive masonry, in-situ concrete manufacturing, and considerable material transportation. These procedures are associated with elevated embodied energy, greenhouse gas emissions, and the production of construction waste (Unegbu & Yawas, 2024). Life Cycle Assessment (LCA) studies in Nigeria indicate that traditional building materials substantially contribute to climate change, resource depletion, and pollution, highlighting the pressing need for alternative low-impact construction solutions. Dry building solutions provide significant environmental benefits compared to conventional wet construction techniques. Research indicates that dry building significantly lowers embodied carbon, construction duration, on-site waste production, and water consumption, while enhancing material efficiency, quality control, and overall sustainability performance. Modular and prefabricated systems enhance precise production, reduce material waste, and improve end-of-life recyclability, closely correlating with circular economy concepts. In Nigeria, recent studies on sustainable construction emphasize the increasing significance of new building technologies, such as modular construction, prefabrication, and material optimization, in tackling environmental sustainability issues (Unegbu & Yawas, 2025; Akadiri, 2025). Peri-urban residential developments in Southwest Nigeria provide a crucial setting for evaluating the environmental impacts of building techniques. Transitional zones, situated between urban centers and rural areas, are marked by inadequate regulatory enforcement, irregular land acquisition methods, and insufficient infrastructural development. As a consequence, building operations in these regions often occur with insufficient environmental protections, leading to heightened air pollution, ecological disruption, and trash buildup. Empirical research in Lagos and its peri-urban areas demonstrates that building activities substantially increase particulate matter levels and deteriorate air quality, hence threatening human health and the environment (Owolabi et al., 2024). Nigeria's increasing dedication to sustainable development objectives, climate change mitigation methods, and green building efforts requires the methodical assessment of developing construction

technology. Recent studies highlight that the effective execution of sustainable building in Nigeria need both regulatory endorsement and empirical proof showcasing environmental performance advantages (Akadiri, 2025; Alade et al., 2025). Notwithstanding the prospective benefits of dry building techniques, there exists a significant deficiency of localized empirical studies evaluating their environmental effects in Nigeria's peri-urban residential setting. Most current studies concentrate on either traditional materials or overarching sustainability frameworks, resulting in a notable study deficiency concerning the environmental efficacy of dry building methods in actual project contexts.

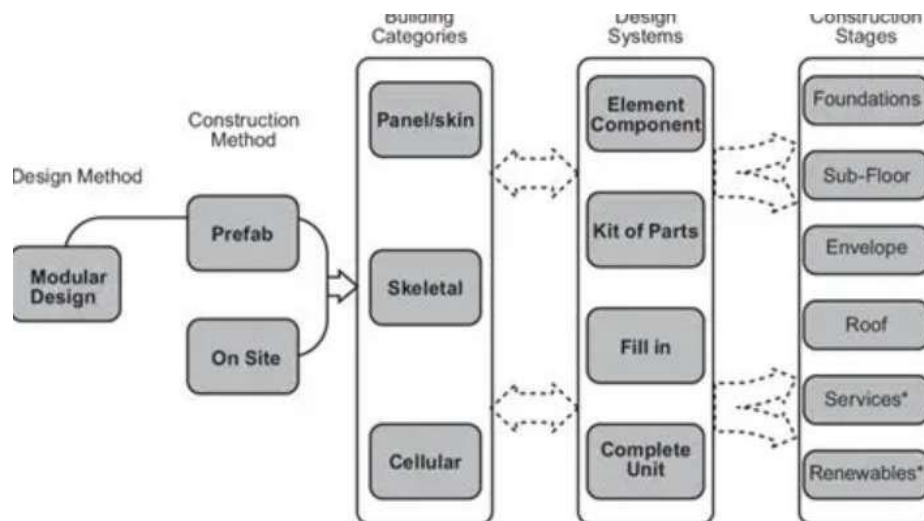


Figure 1: Dry wall construction Analysis Source: Ellen Mac Arthur Foundation.

The Aim of this research is to assess the environmental impacts of dry construction systems in selected peri-urban residential projects in Southwest Nigeria, with a view to promoting sustainable construction practices.

Similarly, This research seeks to achieve this Aim through the following objectives

To identify and evaluate the main environmental impact factors related to the use of dry building techniques in peri-urban residential projects.

To evaluate the environmental efficacy of dry building techniques vs traditional wet construction methods in peri urban reions.

To assess the degree to which dry building technologies enhance environmental sustainability in peri-urban residential development in Southwest Nigeria.

1.2. PROBLEM STATEMENT

Dry building systems are one of the alternative construction techniques that have been urged to be considered as a result of the increased need for inexpensive housing in peri-urban regions of Southwest Nigeria. These methods, which depend on prefabricated and mechanically built components rather than conventional wet techniques, are often touted as ecologically friendly because to the decreased amount of water that is used, the shorter amount of time that is required for construction, and the minimal amount of trash that is produced on-site (Kibert, 2016). Despite this, there is still a lack of understanding about the environmental effects of dry building within the unique ecological, regulatory, and socio-economic context of Southwest Nigeria. The insufficient technical proficiency in life-cycle environmental assessment among local practitioners may impede precise impact prediction and monitoring. In the absence of thorough environmental performance benchmarks and empirical data pertinent to Southwest Nigeria, policymakers and developers are devoid of the necessary evidence to ascertain whether dry construction systems genuinely facilitate sustainable development or merely transfer environmental impacts from the construction site to the production and disposal stages.

2.0. LITERATURE REVIEW

Dry construction systems, also known as prefabrication, modular construction, or off-site construction (OSC), entail the production of building components in regulated factory settings, followed by on-site assembly with limited reliance on wet processes like concrete casting or mortar application. Advocates contend that these techniques augment building efficiency, diminish waste production, and elevate environmental efficacy (MDPI systematic review, 2025). The environmental implications of dry construction differ markedly across contexts, and the existing literature indicates both advantages and challenges that necessitate thorough assessment prior to widespread implementation—particularly in developing economies like Nigeria, where regulatory, material, and infrastructural limitations diverge from those in developed nations.

2.1. EVOLUTION OF DRY CONSTRUCTION SYSTEM IN THE NIGERIAN CONSTRUCTION INDUSTRY

The progression of dry construction systems within the Nigerian construction sector signifies a gradual but substantial transition from conventional wet construction methods to more industrialized, efficient, and cost-effective building processes. Nigeria's building business has

traditionally been defined by block-and-mortar methods, which are marked by significant material waste, extended construction durations, substantial worker reliance, and escalating project expenses. Nevertheless, fast urbanization, increasing housing shortages, and surging material costs—especially since the early 2000s—exerted significant demand for alternative construction methods that might provide houses more rapidly and cheaply. From 2020 to 2025, current empirical research has increasingly focused on dry building, prefabrication, and modular systems in Nigeria. Research demonstrates that dry building methods started receiving organized academic and industrial focus in the mid-to-late 2010s, but garnered more scrutiny from 2020 forward owing to heightened concerns around affordability and sustainable housing provision. Ashiru and Anifowose (2021) emphasize that dry building techniques may diminish construction durations by as much as 70% relative to traditional approaches, thus reducing labor expenses, financial obligations, and project overheads. Ashiru and Anifowose (2021). Recent evaluations of prefabrication methods in Lagos State has highlighted the economic efficacy of off-site production and on-site assembly, seeing decreases in material waste, enhanced productivity, and comprehensive cost optimization. (Osunkoya et al., 2025) .The increasing significance of dry building in Nigeria is directly associated with its role as a cost-efficient solution to the country's housing need. By reducing wet operations like curing and on-site casting, dry solutions mitigate delays and enhance site efficiency. Prefabricated components produced in regulated settings provide improved material management, reduced rework, and reliable budgeting. These attributes have made dry construction especially appealing for mass housing initiatives and peri-urban residential projects where cost-effectiveness is paramount. Notwithstanding its apparent economic benefits, the development of dry building in Nigeria is still in a transitional phase. Adoption is hindered by restricted public knowledge, insufficient technical skills, lack local production capabilities, and traditional industrial procedures that prioritize conventional technologies. Moreover, funding arrangements, building rules, and professional training frameworks remain mostly designed for conventional construction systems. Consequently, dry building has not attained complete mainstream integration but is progressively expanding as a component of wider modernization initiatives within the Nigerian construction sector.

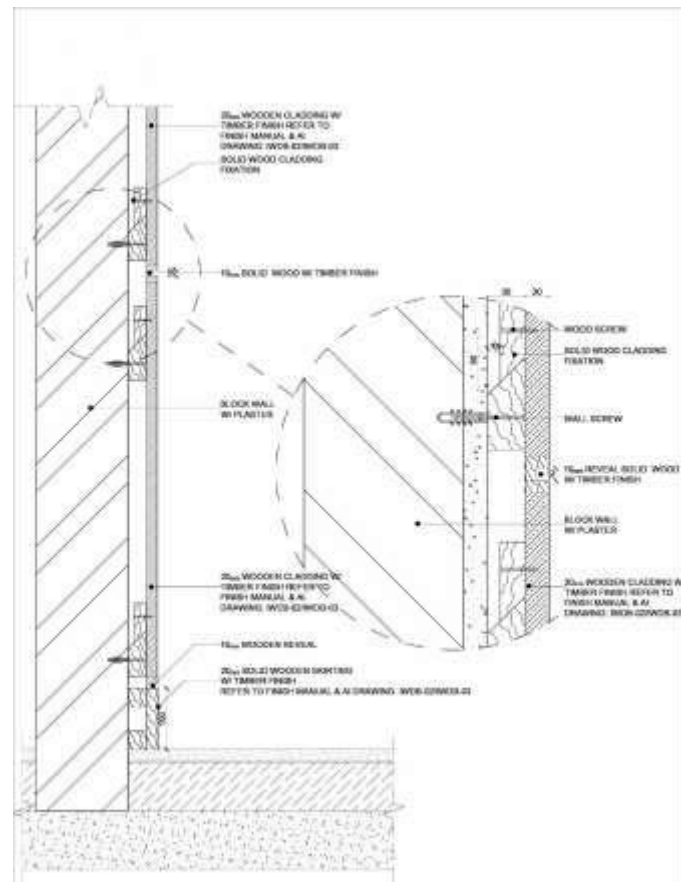


Figure 2; Typical dry wall section Source: Ellen Mac Arthur Foundation.

2.2. DRY CONSTRUCTION AND ENVIRONMENTAL ASSESSMENT CHALLENGES IN DEVELOPING COUNTRIES

Despite the widespread promotion of the economic and operational benefits of dry systems, substantial obstacles in environmental evaluation hinder sustainable use of these materials in developing environments. A significant difficulty pertains to the lack of localized life-cycle assessment (LCA) data. Environmental Impact Assessment (EIA) frameworks increasingly prioritize life-cycle thinking, acknowledging that environmental implications include not just on-site construction but also raw material extraction, manufacture, transportation, use, and end-of-life disposal. In several poor nations, including Nigeria, there exists a scarcity of environmental product declarations (EPDs) and localized databases that document the embodied energy and carbon metrics of prefabricated materials. Consequently, practitioners often depend on generic worldwide information that may not accurately represent local industrial circumstances, energy compositions, or transportation infrastructures. This methodological deficiency may provide imprecise assessments of embodied emissions linked to dry building materials, including light-gauge steel, gypsum boards, fiber-cement panels, and synthetic insulation the need for sustainable material evaluation frameworks that are rooted in

the local environment inside Nigeria. Ibitoye (2025) environmental performance cannot be presumed primarily on technical advancement; instead, it must be evaluated in relation to contextual production processes, resource availability, and waste management capabilities. A fundamental principle relevant to dry construction systems is that environmental sustainability should be empirically validated within the local production and regulatory context, rather than assumed based on global literature. Ibitoye (2025). A second significant difficulty pertains to legislative and institutional constraints in environmental governance. EIA systems in several developing nations were initially designed for conventional brick-and-mortar development and infrastructure initiatives. As a result, they often lack clear criteria for assessing contemporary off-site building methods, embodied carbon measurement, and intricate composite materials. The need for regional performance standards and context-specific sustainability indicators. Imported environmental evaluation instruments often inadequately reflect the conditions of emerging countries, including informal building methods, infrastructure deficiencies, and resource limitations. This conclusion is especially pertinent to dry building techniques, since their environmental impacts may vary considerably in Nigerian contexts compared to industrialized industrial environments. Olaoye (2023) . Furthermore, the environmental advantages often associated with dry building, including waste minimization, may be somewhat counterbalanced by end-of-life management difficulties in underdeveloped nations. Although prefabrication minimizes on-site material waste by precise production, it presents engineered materials that may pose challenges for recycling within current waste management systems. Composite boards, treated panels, and synthetic insulation sometimes need specialist recycling facilities, which are typically scarce or absent in several peri-urban areas. In these situations, demolition or restoration debris may eventually be deposited in open dumps or inadequately managed landfills, leading to soil and groundwater pollution. The environmental benefits realized during construction may be compromised during the disposal phase in the absence of circular economy procedures. Moreover, limitations in technical ability among EIA practitioners provide additional obstacles. Comprehensive environmental evaluation of dry building systems requires multidisciplinary expertise, including material science, carbon accounting, and systems modeling. Nonetheless, professional training and regulatory practices in several emerging environments continue to adhere to traditional construction principles. The skills gap may lead to EIAs that only address immediate site-level impacts—such as noise, dust, and erosion—while neglecting embodied carbon, supply-chain emissions, and long-term waste consequences. Thus, the environmental profile of dry building may be either exaggerated or

inadequately examined.

The peri-urban milieu adds an additional layer of complication. Southwest Nigeria's peri-urban regions exhibit rapid land-use transformations, infrastructure inadequacies, informal housing, and ineffective environmental oversight systems. Implementing dry building technologies in such environments without comprehensive environmental evaluation frameworks may result in unforeseen ecological repercussions. The transportation of prefabricated components across extensive distances may elevate fuel consumption and emissions, especially in cases with poor logistics networks. Likewise, inadequate enforcement of environmental standards may permit the incorrect disposal of dry construction waste materials, so compromising sustainability goals.

2.3. LIFE CYCLE ENVIRONMENTAL PERFORMANCE OF DRY CONSTRUCTION SYSTEMS

Off-site fabrication and prefabrication may increase material efficiency via precise production and decreased site waste (Gibb & Isack, 2022). However, these savings are typically outweighed by the high embodied energy involved with the industrial processing of materials such as light-gauge steel, gypsum boards, composite panels, and engineered wood products. Manufacturing emissions greatly enhance the carbon intensity of prefabricated systems in situations where energy production is reliant on fossil fuels, such as in Nigeria (Häkkinen & Belloni, 2019). As a result, the environmental advantages found in temperate, low-carbon industrial economies may not be immediately applicable to Sub-Saharan African situations. Transportation hampers environmental performance results. Long-distance transportation raises greenhouse gas emissions and life-cycle carbon footprints since many dry building components are imported or manufactured in small industrial centers. logistical and supply-chain inefficiencies in underdeveloped nations might reduce the environmental benefits generally associated with modular construction. Poor road infrastructure and fragmented distribution networks magnify the effects of transportation in Nigeria's peri-urban areas. Abanda and Byers (2016) Operational performance in tropical climates involves significant environmental trade-offs. Lightweight dry building envelopes may have lower thermal mass than traditional masonry systems, thereby increasing cooling energy consumption in hot and humid climates. Without appropriate insulation measures tailored to local climatic conditions, energy savings gained during construction may surpass those realized during operation. This is especially important in Southwest Nigeria, where high temperatures and humidity need constant mechanical ventilation and cooling in poorly constructed lightweight

buildings. End-of-life concerns can expose fundamental flaws in the environmental performance of dry systems in poor nations. Although many dry components are theoretically recyclable, recycling rates vary depending on the local waste management infrastructure. In Nigeria, professional building and demolition waste recycling facilities are few, and material recovery processes are mostly informal. sustainability promises linked with current building materials sometimes imply the availability of sophisticated recycling chains, which are missing in many African urban and peri-urban settings. Consequently, materials meant for cyclical reuse may eventually contribute to landfill buildup and environmental damage. Ibitoye (2025) Furthermore, institutional evaluation systems often fail to identify upstream embodied implications. environmental assessment techniques in Nigeria have typically prioritized obvious, site-based consequences such as erosion, dust, and vegetation loss, while ignoring industrial emissions, embodied carbon, and supply chain externalities. Olaoye (2023) This regulatory gap inhibits complete examination of dry building technologies and may mistakenly favor systems that shift environmental responsibilities spatially rather than eradicate them. Despite these obstacles, the literature does not discount dry building entirely. Instead, it focuses on contextual optimization. When local manufacturing capacity is strengthened, renewable energy penetration rises, and recycling systems improve, dry construction systems show measurable reductions in total material waste, shorter construction cycles, and potential long-term resource efficiency. As a result, environmental performance is determined by industrial ecology, regulatory enforcement, infrastructural preparedness, and climate-responsive design techniques, rather than the technology itself. Empirical life-cycle statistics in the Nigerian construction sector are sparse, leading to ambiguity in policy and practice. The lack of localized environmental information impedes comparison study between traditional masonry systems and dry building alternatives. Ibitoye (2025) emphasizes the need of context-sensitive performance assessment in preventing the misapplication of sustainability narratives generated from foreign case studies. adaptive environmental assessment models include embodied carbon measures and long-term material recovery concerns into national evaluation processes. Olaoye (2023)

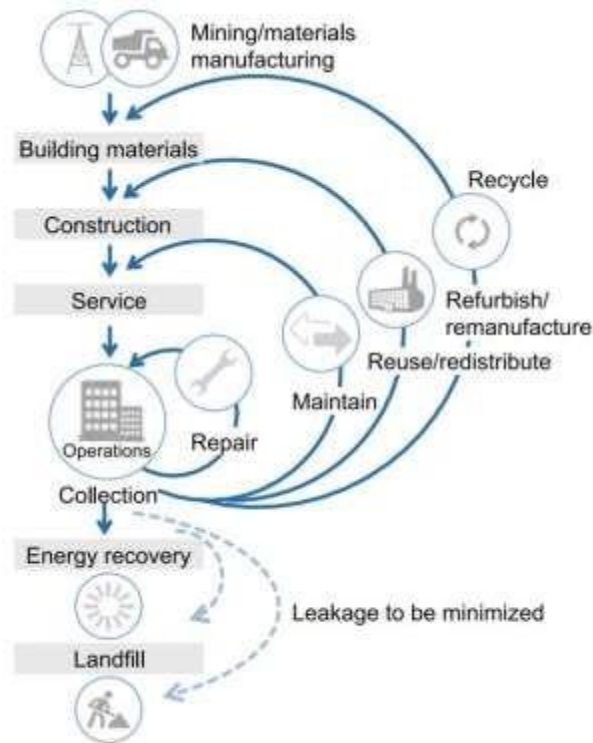


Figure 3; Life cycle Analysis of Dry construction systems Source: Ellen Mac Arthur Foundation

2.4. DRY CONSTRUCTION SYSTEM IN THE PERI URBAN ENVIRONMENT

The peri-urban environment, marked by fast population increase, diverse land use, inadequate infrastructure, and rising housing demand, poses distinct problems and possibilities for the use of novel building technologies, including dry construction techniques. Dry construction, defined as the off-site fabrication and on-site assembly of building components with minimum or no wet processes (such as mortar or cast-in-place concrete), is associated with enhanced construction efficiency and possible environmental benefits. Nonetheless, its implementation and efficacy in peri-urban areas, especially in developing nations such as Nigeria, are influenced by complex socio-economic and environmental factors that affect both acceptance and results. Peri-urban areas, situated at the boundary between urban centers and rural peripheries, often experience informal settlement growth, inadequate infrastructural development, and significant housing shortages. These regions often undergo rapid, unregulated expansion, exerting strain on traditional building techniques that are sluggish, resource-demanding, and ecologically detrimental. Dry building technologies, including prefabricated and modular techniques, are being advocated as options that may expedite housing delivery while minimizing on-site consequences, including decreased trash production

and shorter construction durations (Albaadani et al., 2025). A significant benefit of dry building in peri-urban areas is its capacity to enhance environmental performance compared to traditional wet construction methods. Research on modular and prefabricated building indicates that regulated industrial production may substantially decrease material waste and enhance resource efficiency, aligning with sustainable development objectives in urbanizing environments (Osunkoya et al., 2025). In rapidly developing peri-urban areas, unregulated waste from conventional building may intensify land degradation, water contamination, and informal dumping—issues often aggravated by inadequate waste management infrastructure. The accuracy of dry construction and its reduction of surplus materials provide a potential benefit in environmental management, especially in areas where local authorities are unable to adequately control or manage construction waste. In peri-urban areas of Southwest Nigeria, EIAs for dry construction projects must include not only on-site effects (e.g., trash, dust, noise) but also wider systemic implications, including supply chain emissions, material lifecycle ramifications, and infrastructure compatibility. Considering the intricacies of peri-urban development dynamics and resource limitations, research on dry building should use mixed methodologies to include both quantitative environmental metrics and qualitative community insights.

Moreover, the implementation of dry systems may enhance the concepts of circular economy and resource efficiency in peri-urban areas. These technologies promote material lifespan and diminish the need for raw resource extraction by facilitating the reuse or adaptation of prefabricated components for future alterations, aligning with overarching notions of sustainable urban development (Albaadani et al., 2025).

3.0 THEORETICAL REVIEW

The theoretical underpinnings for this research revolves around dry building systems and environmental evaluations which are based on sustainability science, life-cycle thinking, and innovation adoption frameworks. These frameworks describe how building technologies interact with environmental, economic, and institutional systems, as well as the need of thorough environmental assessment for developing construction techniques like dry construction. Sustainability theory is central to this theoretical landscape, emphasizing the need of balancing ecological preservation with economic growth and social well-being. This corpus of thought, based on the concepts of sustainable development, proposes that building processes should reduce environmental degradation while contributing to economic progress and human well-being. Sustainability theory necessitates that environmental assessments for dry

construction building technology system taking into account both immediate construction impacts and the long-term implications of material usage, energy consumption, and waste creation (Unegbu & Yawas, 2025). In addition, the life-cycle approach enriches environmental impact assessments by pushing for cradle-to-grave review of building processes. According to Life-Cycle Assessment (LCA) theory, the complete environmental effect of a building system can only be properly recorded if all stages from raw material extraction and prefabrication to transportation, use phase, and end-of-life disposal are taken into account. This viewpoint moves the evaluation emphasis from on-site waste and direct resource consumption to upstream embodied emissions and downstream material destiny in dry building systems that rely on prefabrication and off-site production making it an effective standpoint for dry construction. Theoretically, 'clean' on-site procedures may be offset by considerable upstream or downstream consequences if not carefully assessed. Another significant theoretical lens is the Triple Bottom Line (TBL) theory (economic, environmental, and social value), which has been frequently used in sustainable building research. Although TBL was initially established for business sustainability, modifications in construction demonstrate that environmental performance is inextricably linked to economic feasibility and social ramifications. This notion states that every new technique, such as dry building, must provide environmental advantages while being economically efficient and socially acceptable. In Nigeria, where housing affordability is a major policy problem, TBL theory helps to explain why cost-effective options like dry building are appealing although environmental measures must still be properly evaluated. The Diffusion of Innovations hypothesis adds to the theoretical framework by describing how new building processes spread throughout an industry. According to this hypothesis, the acceptance rate of innovations such as dry building is determined by perceived relative benefit, compatibility with present practices, complexity, trialability, and observability. In the Nigerian construction context, perceived cost savings and shorter construction times are relative advantages, whereas limited local data on environmental impacts and insufficient regulatory frameworks can reduce observability and stymie wider adoption (Rogers, 2003, as discussed in sustainable construction literature). Furthermore, notions about institutional and regulatory adaptability are relevant. They believe that formal policy changes, stakeholder pressure, and the incorporation of new information all contribute to the evolution of environmental assessment systems. Within this approach, Environmental Impact Assessment (EIA) systems are seen not as technological instruments, but as socio-institutional processes driven by governance capacity, regulatory norms, and professional practice. In developing countries such as Nigeria, institutional theory helps to

explain why EIA practices may lag behind technological innovations such as dry construction: existing regulatory instruments are frequently structured around traditional wet methods and do not adequately incorporate indicators for embodied emissions, prefabrication impacts, or end-of-life concerns. This institutional gap has practical implications for how well environmental problems in dry systems are detected and handled (Olaoye, 2023). Finally, contextualized sustainability theory emphasizes the value of localized evaluation. Ibitoye (2025) emphasizes that ideas established in global north settings cannot be applied directly to Nigerian construction without modification, since changes in material supply chains, energy systems, and waste management infrastructures profoundly impact environmental consequences. As a result, local sustainability theories place an emphasis on context-specific environmental performance measurements and adapted assessment frameworks. Together, these theoretical viewpoints provide a solid framework for studying dry building systems. They support comprehensive environmental impact assessment methodologies that go beyond immediate on-site consequences and include life-cycle emissions, institutional preparedness, innovation adoption dynamics, and local socioeconomic factors. Integrating these theories improves the conceptual rigor of research into the environmental implications of dry building and helps to establish context-appropriate evaluation frameworks for peri-urban residential projects in Southwest Nigeria.

4.0 EMPIRICAL REVIEW

Empirical research on dry construction and its environmental performance in developing countries, particularly Nigeria, has grown in recent years, reflecting an increased interest in sustainable building approaches, modular construction practices, and environmental governance in the construction sector. This body of work reveals specific empirical patterns related to material waste reduction, sustainable material adoption, regulatory barriers, and the broader environmental implications of alternative construction methods, all of which are directly relevant to evaluating dry construction systems in peri-urban residential projects. sustainable building approaches, such as off-site manufacturing and contemporary materials, may have a major impact on environmental outcomes in the built environment. socioeconomic impact assessment of sustainable construction in Nigeria, reveals that sustainable technologies not only improved environmental protection but also supported economic growth and job creation, demonstrating that technological adoption can be beneficial when aligned with broader policy goals. Unegbu and Yawas (2025) Furthermore, that metropolitan regions in Nigeria are adopting sustainable construction methods quicker than rural ones, indicating

spatial diversity in real adoption trends. Empirical data from Lagos State also suggest that methods like prefabrication and modular building, which are key components of dry construction systems, have meaningful impacts on project sustainability measures. The assessment of prefabrication and modular construction adoption in Lagos with particular focus on the peri urban areas of Lagos states, finds that it decreased construction waste, had lower carbon footprints, and improved project delivery efficiency compared to conventional techniques. Osunkoya et al. (2025). However, the same study found practical limitations such as high initial capital expenditures, limited local knowledge, and insufficient regulatory backing, which may restrict environmental performance despite theoretical benefits. These results imply that, although empirical data supports the environmental benefit of dry systems, their success is heavily dependent on contextual enabling variables. Furthermore, life-cycle assessment (LCA) research in Nigeria give valuable empirical insights into how alternative materials compare to environmental standards. bamboo and recycled steel, reveals that certain materials outperformed others in terms of minimizing global warming potential and resource depletion. Unegbu, Yawas, Dan-asabe, and Alabi (2024) Although this study does not concentrate just on dry building systems, it emphasizes the relevance of material selection as a key empirical aspect in evaluating dry techniques, where designed components often substitute traditional materials. Beyond materials and building processes, empirical research reveal institutional and regulatory issues that influence environmental results. empirical study demonstrates that, while internationally recognized frameworks such as LEED and EDGE perform well across design, construction, and operational phases, their applicability in the Nigerian context is limited due to insufficient integration of social sustainability and localized environmental factors Olaoye's (2023). This conclusion empirically indicates a typical gap in environmental assessment practices: worldwide methodologies must be adapted to represent localized building contexts, which has a direct influence on the empirical evaluation of dry construction consequences in Nigeria. Additional empirical research on sustainable building supports the idea that awareness, cost, technical capability, and governmental support are all important predictors of environmental performance results. Oyewole and Ootobo (2025) strong demand for sustainable building materials, are valid repacutions for dry construction buildings and structures. but poor understanding and technical preparedness for wider use; cost considerations were paramount Olaoye's (2023). material waste control approaches are highly associated with lower on-site waste, yet larger systemic waste concerns persist. These empirical findings indicate that local professional capability and sector preparation impact the real-world environmental performance of new building technologies like dry systems.

Table 1; comparative analysis between dry and wet construction systems.

ASSESSMENT CRITERIA	DRY CONSTRUCTION SYSTEMS	CONVENTIONAL (WET) CONSTRUCTION SYSTEMS
CONSTRUCTION METHODOLOGY	Prefabricated or factory produced components are assembled on-site using minimum water.	Casting, brickwork, and plastering are all done on-site, and water-based technologies are used extensively.
MATERIAL COMPOSITION	Light gauge steel, gypsum boards, fiber cement panels, engineered lumber, composite panels.	Sandcrete blocks, reinforced concrete, mortar, bricks, and cast-in-situ concrete.
ON SITE WASTE GENERATION	Minimized owing to precise production and modular dimensions.	Increased waste resulting from on-site cutting, breakage, and excessive material ordering.
CONSTRUCTION SPEED	Accelerated by off-site manufacturing and expedited assembly.	Progress is impeded by curing time, successive building phases, and reliance on weather conditions.
LABOUR REQUIREMENTS	Demands proficient labor for installation and technical accuracy.	More labor-intensive but capable of using semi-skilled or local labor.
INITIAL CAPITAL COST	Typically elevated initial costs attributable to prefabrication and specialty materials.	Typically reduced starting expenses in underdeveloped nations owing to the accessibility of local materials.
DURABILITY	Contingent upon material quality; vulnerable to corrosion or moisture damage if not maintained.	Typically resilient and well-suited to regional climatic conditions.
THERMAL PERFORMANCE (TROPICAL CLIMATE)	Lightweight systems may possess less thermal mass, thus elevating cooling requirements in the absence of insulation.	The substantial thermal mass of concrete and masonry can regulate interior temperatures.
DURABILITY	Contingent upon material quality; vulnerable to corrosion or moisture damage if not maintained.	Typically resilient and suitably acclimatized to regional climatic conditions.
ENVIRONMENTAL IMPACT DURING CONSTRUCTION PHASE	Minimized local site disturbance and reduced construction duration.	Increased immediate environmental disruption on-site.
LIFE CYCLE ENVIRONMENTAL PERFORMANCE	The environmental advantages are contingent upon the energy sources used in local production and the existing recycling infrastructure.	The manufacture of cement significantly elevates carbon emissions; yet, the materials are often recyclable within the local context.
END OF LIFE CONSIDERATIONS	The environmental advantages are contingent upon the energy sources used in local production	The manufacture of cement significantly elevates carbon emissions, however the

	and the existing recycling infrastructure.	components are often reusable within local contexts.
PROFICIENCY NIGERIA	IN Emerging; low institutional familiarity and inadequate evaluation frameworks.	Extensively acquainted; thoroughly included into construction regulations and Environmental Impact Assessment practices.

4.1.CASE STUDY 1; MODULAR AFFORDABLE HOUSING DEVELOPMENT, IBEJU LEKKI

A notable instance of dry construction use in South-West Nigeria is seen in the burgeoning residential projects in Ibeju-Lekki, situated in the peri-urban growth zone of Lagos. The fast urbanization of the Lekki Free Trade Zone area has created significant demand for inexpensive homes, leading developers to use modular and light-gauge steel building methods to expedite delivery schedules. In 2024, the federal government approved the initiative and started groundwork led by the Federal Ministry of Housing and Urban Development under President Bola Ahmed Tinubu's administration, aiming for tens of thousands of units countrywide. As of August 2025, the housing project at Ibeju-Lekki achieved 80% completion, with more than 700 dwelling units constructed and prepared for commissioning, contributing to a Phase One objective of 2,000 units. (Wikipedia, 2025). In this context, designated private housing developers have used prefabricated wall panels, lightweight steel frame systems, fiber-cement boards, and factory-manufactured roofing assemblies for low- to middle-income housing units. The primary impetus has been the acceleration of construction and the diminishment of reliance on on-site workers. Conventional house blocks that typically need 12–18 months for completion using sandcrete blocks and cast-in-situ concrete were completed within 6–9 months utilizing dry building techniques. The project exhibited quantifiable decreases in on-site trash production, minimum water use relative to traditional curing methods, and decreased dust emissions throughout the building phase. These effects are especially pertinent in peri-urban Ibeju-Lekki, where infrastructure, including water supply and waste management systems, is inadequately developed. Nonetheless, the environmental study indicated heightened embodied carbon linked to prefabricated steel components and the extensive transit of materials from industrial centers both within and outside Lago State. This scenario exemplifies a key discovery in dry building research: whereas local environmental disturbances are markedly reduced, upstream industrial emissions and logistical effects need thorough assessment within Environmental Impact Assessment (EIA) frameworks. In peri-urban Lagos, where fast growth often surpasses regulatory enforcement, including life-cycle

concerns into project clearance procedures constitutes a significant deficiency.

4.2. CASE STUDY 2; PREFABRICATED EDUCATIONAL FACILITY, ADO EKITI ST ANDREWS PRIMARY SCHOOL OKE ILA

The project included the building of five (5) classroom units at St. Andrews Primary School, executed under the Federal Ministry of Education and sponsored by the Universal Basic Education Commission (UBEC, 2024). In response to increasing enrollment pressure in satellite communities, a private educational provider adopted prefabricated classroom blocks using insulated sandwich panels and light steel structural systems. The adoption of dry construction in this case was driven primarily by the need for rapid deployment and cost predictability. The project involved the installation of pre-engineered modular classroom units fabricated off-site and assembled within weeks on prepared foundations. Compared to conventional masonry classrooms, the dry system significantly shortened project duration and minimized disruption to ongoing academic activities. From an environmental standpoint, the project achieved lower construction-phase noise levels, reduced material wastage, and minimal site excavation. (UBEC, 2024) This was particularly beneficial in peri-urban Ado-Ekiti, where surrounding land use includes small-scale agriculture and residential settlements sensitive to construction disturbances. However, post-occupancy observations indicated higher indoor heat gain during peak dry seasons, necessitating additional mechanical ventilation and cooling interventions. This outcome highlights the climatic sensitivity of lightweight dry systems in tropical environments. The case demonstrates that environmental performance in peri-urban settings must consider not only construction-phase benefits but also operational energy demand over the building's life cycle.

5.0 CONCLUSION

This research investigated the use of dry building technologies in the peri-urban areas of South-West Nigeria, specifically focusing on housing and educational facilities in locations such as Ibeju-Lekki, Lagos State, and Ado-Ekiti, Ekiti State. The study rigorously evaluated the environmental consequences, socio-economic significance, and sustainability prospects of dry construction methods relative to traditional wet construction techniques, contextualizing the examination within modern environmental impact assessment (EIA) and life-cycle sustainability paradigms. The results indicate that dry construction systems—defined by prefabrication, lightweight structural elements, decreased water consumption, and limited on-site material mixing—provide considerable benefits in peri-urban areas facing infrastructure

deficiencies, swift population expansion, and housing shortages. Recent empirical studies from global and African contexts (2020–2025) demonstrate that dry construction diminishes on-site waste production, accelerates project completion, reduces dust and noise pollution, and decreases water usage during construction (Akinade et al., 2020; Darko & Chan, 2021; Li et al., 2022). These characteristics are especially pertinent in peri-urban South-West Nigeria, where inadequate waste management systems and insufficient water infrastructure exacerbate the environmental impacts of traditional building methods. This study verifies that dry construction enhances resource efficiency and adheres to circular economy principles, particularly when combined with material recovery systems and modular design strategies (Benachio et al., 2020; Akanbi et al., 2021). Minimized material waste and enhanced accuracy via factory fabrication promote environmental predictability and facilitate adherence to sustainability requirements increasingly highlighted in sustainable development discussions (United Nations Environment Programme [UNEP], 2023). In peri-urban South-West Nigeria, governance and regulatory capability are additional contextual factors affecting results. Insufficient implementation of environmental rules and restricted technical ability among planning authorities may impede the efficient oversight of both conventional and dry building projects (Afolabi et al., 2021). To enhance environmental advantages, institutional changes are essential to integrate life-cycle thinking, green construction standards, and sustainability performance measures into approval procedures and procurement systems.

5.1. RECOMMENDATIONS

Given these findings, it is recommended that future policy development, planning regulations, and project implementation frameworks integrate strategic measures to improve the environmental performance and contextual appropriateness of dry construction systems in peri-urban South-West Nigeria, including but not limited to the following:

1. Institutional Incorporation of Life-Cycle Assessment (LCA)

The protocols for Environmental Impact Assessment (EIA) in Nigeria should be broadened to officially include life-cycle assessment approaches. This would guarantee that embodied carbon, manufacturing emissions, transportation effects, operational energy consumption, and end-of-life factors are comprehensively assessed instead of concentrating just on on-site construction impacts.

2. Formulation of Climate-Responsive Design Standards

National and state building regulations must include explicit directives for the tropical

adaptation of dry construction systems. These should include insulation efficacy, passive cooling techniques, moisture management, solar orientation, and thermal comfort to mitigate elevated operating energy requirements in hot and humid conditions.

3. Advancement of Local Manufacturing Centers

The government should promote the creation of regional prefabrication and modular component manufacturing facilities in South-West Nigeria. Localized manufacturing will reduce transportation-related emissions, decrease costs, provide job opportunities, and strengthen supply chain resilience.

4. Financial Incentives for Sustainable Construction

Tax refunds, reductions of import duties on sustainable prefabrication equipment, green construction subsidies, and low-interest financing programs should be implemented to incentivize developers to use ecologically friendly dry building technology.

5. Enhancement of Regulatory Agency Competence

Planning authorities, environmental officers, and building control agencies need to get technical training in dry construction systems, embodied carbon accounting, and sustainability evaluation tools to enhance their monitoring and enforcement capabilities.

6. Incorporation into Affordable Housing Policies

Dry building techniques have to be officially included into federal and state affordable housing initiatives to expedite housing provision while preserving environmental protections in swiftly growing peri-urban areas.

7. Implementation of Performance Monitoring Frameworks

A consistent post-occupancy assessment methodology must be established to assess energy performance, indoor environmental quality, structural durability, and user satisfaction in dry built buildings throughout time.

8. Enhancing Waste Management Regulations

Policies must require material recovery, reuse, and recycling practices in dry building supply chains to adhere to circular economy principles and reduce construction and demolition waste.

9. Research and Development Collaborations

Collaborative research projects among universities, professional organizations, and construction companies should be promoted to evaluate locally obtained alternative materials appropriate for dry building systems in tropical regions.

10. Public Awareness and Stakeholder Involvement

Awareness campaigns must be implemented to inform developers, contractors, investors, and community stakeholders about the environmental and economic advantages of dry building methods to mitigate opposition to technical change.

11. Integration with Urban Planning Frameworks

Peri-urban master plans must include modular and prefabricated building methodologies into zoning, land use planning, and infrastructure development strategies to facilitate sustainable urban growth.

12. Standardization and Quality Assurance Protocols

National quality assurance standards for dry building components must be established to guarantee structural integrity, fire resistance, acoustic performance, and environmental compliance.

13. Promotion of Renewable Energy Integration

Dry construction projects have to include renewable energy technologies, such rooftop solar panels and energy-efficient mechanical systems, to mitigate operational energy consumption and improve sustainability performance.

14. Formulation of Sustainable Procurement Policies

Public sector construction contracts must emphasize ecologically friendly building systems, particularly dry construction methods, by establishing explicit green procurement requirements.

15. Enhancing Data Acquisition and Environmental Documentation

A unified database for environmental performance should be created to record embodied carbon levels, material use, energy consumption, and environmental impacts of building projects in peri-urban South-West Nigeria. This will facilitate evidence-based policymaking and ongoing enhancement.

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