Assessing the Climate Resilience of Interlocking Stabilized Soil Block Buildings in Southwestern Nigeria

Ayegbayo A.D.*, Farinde A.A., Onyejemeli G.C., Oyeshola O.L., Adepoju M.Y., Dada S. J., Shaji E.M., Olawore J.O., Akporubare B.E., Coker R., Ibironke E.T.

Department of Architecture, Caleb University, Imota, Ikorodu, Lagos

***Corresponding Author**

DOI: https://doi.org/10.47772/IJRISS.2026.100601305

Received: 04 July 2026; Accepted: 10 July 2026; Published: 17 July 2026

ABSTRACT

Climate change in tropical regions, manifested through rising temperatures, extreme rainfall, and flooding, threatens housing stock and occupant well-being. Conventional sandcrete blocks, while widely used, contribute significantly to carbon emissions and offer poor thermal performance. This thesis investigates the resilience of Interlocking Stabilized Soil Blocks (ISSBs) as a sustainable, climate-adaptive building alternative in tropical climates. Through a mixed-methods approach synthesizing literature, experimental data, and case studies of ISSB housing in Southwestern Nigeria, the research extends beyond the documented cost advantages (Ibitoye, 2022) to examine performance under climate stress. Findings reveal that ISSBs exhibit superior thermal mass, reducing indoor temperatures and enhancing Indoor Environmental Quality (IEQ) as advocated by Asaju (2022). Their inherent durability, interlocking system, and use of local laterite soil improve resistance to flood damage and enable faster recovery, while reduced cement content lowers embodied carbon, positioning ISSBs as both a mitigation and adaptation strategy. However, barriers including poor public perception and limited policy support persist. The thesis concludes that ISSB technology offers a viable pathway for climate-resilient, affordable housing in Nigeria and recommends targeted policy interventions, sensitization campaigns, and long-term performance monitoring.

Keywords: Building resilience, Climate change, Climate-responsive architecture, Interlocking Stabilized Soil Blocks (ISSBs), Sustainable construction, Thermal performance, Tropical regions

INTRODUCTION

Background to the Study

The global climate crisis has emerged as the most pressing challenge of the twenty-first century, with its impacts disproportionately felt in tropical regions of the developing world. According to the Intergovernmental Panel on Climate Change (IPCC, 2022), rising global temperatures, increased frequency of extreme weather events, and sea-level rise pose existential threats to communities, economies, and infrastructure across the Global South. Sub-Saharan Africa is identified as particularly vulnerable due to limited adaptive capacity, rapid urbanization, and heavy reliance on climate-sensitive sectors. Within this context, the built environment, accounting for approximately 39% of global energy-related carbon dioxide emissions, represents both a significant contributor to climate change and a critical sector for adaptation and mitigation strategies (UNEP, 2023).

Nigeria, as the most populous country in Africa with over 220 million people, faces a complex intersection of challenges: rapid urbanization, a chronic housing deficit estimated at over 20 million units, and escalating vulnerability to climate change impacts (Federal Ministry of Works and Housing, 2021). The country's major cities, particularly Lagos, Ibadan, and Port Harcourt, are experiencing intensifying urban heat island effects, recurrent flooding, and deteriorating indoor environmental quality. These challenges are compounded by the widespread use of conventional building materials, predominantly sandcrete blocks, which are characterized by high embodied energy, poor thermal insulation properties, and significant carbon emissions associated with cement production (Oyelami & Van Roy, 2016). The cement industry alone accounts for approximately 8% of global CO_2 emissions, with Nigeria being one of Africa's largest cement producers (Ibitoye, 2022).

In response to these interconnected challenges, there has been growing interest in alternative, sustainable building materials capable of addressing both the housing deficit and climate change imperatives. Among these, Interlocking Stabilized Soil Blocks (ISSBs) have gained recognition as a viable, eco-friendly alternative to conventional sandcrete blocks. ISSBs are produced by compressing a mixture of locally available laterite soil, a small proportion of cement (typically 5-10%), and water, using manual or hydraulic presses to create interlocking blocks that do not require mortar for wall construction (Bales et al., 2009; Jagadish, 2007). This technology, originally developed in Colombia and subsequently popularized across various developing countries, offers multiple advantages: reduced cement consumption, elimination of mortar requirements, enhanced thermal comfort, and potential for significant cost savings (Ibitoye, 2022; Adegun & Adedeji, 2017). Research by Ibitoye (2022) demonstrates that ISSBs are approximately 30% cheaper than sandcrete blocks due to lower material costs and reduced cement use, while studies by Afolami and Oyebamiji (2017) have documented occupants' perceptions of thermal comfort in estates built with laterite interlocking blocks.

The concept of building resilience to climate change has become central to contemporary discourse in architecture and urban planning. Building resilience refers to the capacity of buildings and communities to anticipate, withstand, adapt to, and recover from the adverse effects of climate change (UN-Habitat, 2020). In tropical regions, climate-responsive architecture must address multiple stressors: extreme heat, heavy precipitation, flooding, humidity, and intense solar radiation. Thermal performance is particularly critical, as rising ambient temperatures directly affect indoor comfort, health, and the productivity of building occupants. Research by Asaju (2022) has demonstrated the significant relationship between Indoor Environmental Quality (IEQ) and academic performance in learning environments, highlighting the importance of thermally comfortable spaces.

Despite these documented advantages, the adoption of ISSB technology in Nigeria remains limited, with patronage described as "low-slung" compared to conventional sandcrete blocks (Ibitoye, 2022). This paradox, where a demonstrably superior and cost-effective technology fails to achieve widespread market penetration, necessitates investigation into the barriers and facilitators of adoption. Furthermore, while economic advantages have been well documented, there is a notable gap in empirical research specifically examining the resilience of ISSB buildings to climate change impacts in tropical contexts. Questions remain regarding long-term durability under extreme weather, performance in flood scenarios, thermal efficacy under intensifying heat waves, and overall contribution to climate-responsive architecture. This thesis addresses this gap by systematically investigating the resilience of ISSB buildings to climate change impacts in tropical regions, anchored in the foundational work of Ibitoye (2022) and Asaju (2022), and contributing to emerging research on climate-responsive architecture (Laibi et al., 2025; Musene, 2025; Neya et al., 2024).

Statement of the Problem

Nigeria faces a multifaceted housing crisis characterized by a massive deficit of affordable, quality housing and escalating vulnerability to climate change impacts. The conventional approach to housing delivery, dominated by sandcrete block construction, is increasingly recognized as unsustainable both environmentally and climatically. Sandcrete block production is resource-intensive, consuming large quantities of cement and water, emitting significant greenhouse gases, and yielding buildings with poor thermal performance that exacerbates indoor heat stress (Anosike & Oyebade, 2012; Oyelami & Van Roy, 2016). This situation is further complicated by the fact that Nigeria's urban population is projected to reach 60% by 2050, intensifying demand for housing and infrastructure (World Bank, 2023).

Interlocking Stabilized Soil Blocks (ISSBs) have been proposed as a sustainable alternative that can address both the housing deficit and environmental sustainability goals. Studies by Ibitoye (2022) and others have demonstrated that ISSBs offer substantial cost advantages, up to 30% cheaper than sandcrete blocks, due to the elimination of mortar, reduced cement content, and use of locally available soil. Furthermore, the embodied carbon footprint of ISSBs is significantly lower, contributing to climate change mitigation objectives. However, adoption remains low despite these proven benefits, raising questions about the factors constraining uptake.

Beyond the adoption challenge, a more critical gap exists in the understanding of ISSB buildings' resilience to climate change impacts. While thermal comfort benefits have been qualitatively suggested (Afolami & Oyebamiji, 2017), there is insufficient empirical evidence on: (a) quantitative thermal performance under extreme tropical heat; (b) structural integrity and durability under heavy rainfall and flooding; (c) comparative resilience across multiple climate stressors; and (d) socio-economic dimensions of resilience, including occupant well-being and recovery capacity following climate-related events. The problem is compounded by the lack of comprehensive research synthesizing these dimensions thermal performance, structural durability, environmental sustainability, and economic viability into a coherent framework for assessing ISSB resilience. Existing studies have tended to focus on isolated aspects without systematically connecting these to the broader climate resilience agenda (Ibitoye, 2022; Afolami & Oyebamiji, 2017). Moreover, the policy and institutional frameworks necessary to promote ISSB adoption and ensure climate-resilient building practices remain underdeveloped in Nigeria. This study addresses these interconnected problems by investigating the resilience of ISSB buildings to climate change impacts in tropical regions, using Southwestern Nigeria as a case study.

Aim and Objectives of the Study

Aim: To investigate the resilience of Interlocking Stabilized Soil Block (ISSB) buildings to climate change impacts in tropical regions and provide evidence-based recommendations for promoting ISSB technology as a climate-responsive and sustainable construction approach.

Objectives:

1. To assess the thermal performance of ISSB buildings under tropical climatic conditions in comparison to conventional sandcrete block buildings.

2. To examine the socio-economic dimensions of ISSB resilience, including occupant satisfaction, health, well-being, and post-disaster recovery capacity.

3. To identify the barriers and facilitators to the adoption of ISSB technology in Nigeria.

4. To develop a framework for assessing and promoting building resilience to climate change in tropical regions using ISSB technology as a model.

Research Questions

1. What is the thermal performance of ISSB buildings under tropical climatic conditions, and how does it compare to conventional sandcrete block buildings?

2. What are the socio-economic dimensions of ISSB resilience, including occupant satisfaction, health, well-being, and the economic implications for post-disaster recovery?

3. What are the key barriers and facilitators to the adoption of ISSB technology in Nigeria?

4. What framework can be developed to assess and promote building resilience to climate change in tropical regions using ISSB technology as a model?

Significance of the Study

This study contributes to knowledge, policy, and practice by advancing theoretical understanding of building resilience and climate-responsive architecture in tropical contexts through synthesis and extension of work by scholars including Ibitoye (2022) and Asaju (2022). The findings inform evidence-based policy development at national, state, and local levels, supporting integration of ISSB technology into Nigeria's housing policy, building codes, and climate action plans while contributing to Sustainable Development Goals 11 (Sustainable Cities and Communities) and 13 (Climate Action). For practitioners, the research provides empirical evidence to guide material selection and design decisions, while socio-economically, it supports efforts to provide quality, climate-resilient housing for low- and middle-income populations with implications for occupant health, productivity, and well-being. Environmentally, the study contributes to climate change mitigation by quantifying the benefits of low-carbon, resource-efficient ISSB construction, providing a model replicable in other developing countries facing similar challenges.

Scope of the Study

The study is geographically focused on Southwestern Nigeria, comprising the states of Lagos, Ogun, and Oyo, selected due to high population density, rapid urbanization, documented vulnerability to climate change impacts, and the presence of ISSB housing developments that serve as case study sites. Thematically, the research investigates ISSB resilience through thermal performance measurement and analysis; structural durability assessment under climate stressors; environmental sustainability life-cycle analysis; socio-economic dimensions including occupant perceptions and well-being; and examination of adoption barriers and facilitators. Temporally, the study covers the period from 2015 to 2026, reflecting the timeframe during which significant ISSB housing developments have been implemented and relevant climate data is available. Methodologically, the study employs a mixed-methods approach combining field surveys and questionnaires for occupant data, physical measurements of thermal and environmental parameters, experimental testing of ISSB material properties, archival and documentary analysis of housing projects, and comparative analysis with conventional sandcrete block buildings. The study focuses exclusively on ISSBs as the primary building material under investigation, examining resilience to heat stress, heavy rainfall, and flooding the most pronounced climate impacts in the study region. Other sustainable building materials are referenced but not systematically evaluated, and other climate stressors such as wind storms or sea-level rise are not addressed in detail.

Definition of Terms

Building Resilience: The capacity of buildings and occupants to anticipate, withstand, adapt to, and recover from the adverse effects of climate change and other hazards (UN-Habitat, 2020). In this study, building resilience encompasses thermal, structural, environmental, and socio-economic dimensions.

Climate Change: Long-term shifts in temperature, precipitation, and weather patterns, primarily driven by anthropogenic greenhouse gas emissions (IPCC, 2022), with focus on impacts relevant to buildings in tropical regions.

Climate-Responsive Architecture: An approach to building design that responds to local climate conditions, utilizing passive design strategies, appropriate materials, and site-specific solutions to minimize energy consumption and maintain occupant comfort (Olgyay, 1963).

Embodied Carbon: The total greenhouse gas emissions associated with the extraction, manufacturing, transport, and assembly of building materials over their life cycle (UNEP, 2023).

Indoor Environmental Quality (IEQ): The conditions inside a building that affect occupant health, comfort, and well-being, including thermal comfort, air quality, lighting, and acoustics (Asaju, 2022).

Interlocking Stabilized Soil Blocks (ISSBs): Compressed soil blocks stabilized with a small proportion of cement (typically 5-10%) and designed with interlocking features for mortar-less wall construction (Ibitoye, 2022).

Sandcrete Blocks: A conventional building material composed of cement, sand, and water, formed into blocks of standard sizes (Ibitoye, 2022).

Sustainable Construction: The practice of designing, constructing, and operating buildings in a manner that minimizes environmental impact, conserves resources, and promotes social and economic well-being (UNEP, 2023).

Thermal Comfort: The condition of mind expressing satisfaction with the thermal environment, assessed through subjective evaluation (ISO 7730).

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VI June 2026

Thermal Performance: The ability of building materials and assemblies to regulate heat transfer, influencing indoor temperature, energy consumption, and occupant comfort (Musene, 2025).

Tropical Region: Geographic areas between the Tropic of Cancer and the Tropic of Capricorn, characterized by consistently warm temperatures and high humidity. Southwestern Nigeria lies within the tropical region.

LITERATURE REVIEW

Climate Change and Tropical Built Environments

Tropical regions are characterized by consistently warm temperatures, high humidity, and distinct wet and dry seasons, presenting unique challenges for building design and construction. Climate change is exacerbating these challenges, with tropical regions experiencing pronounced impacts including rising temperatures, increased frequency of extreme weather events, and sea-level rise (IPCC, 2022). Global average temperatures have risen by approximately 1.1°C above pre-industrial levels, with tropical regions warming at comparable rates. Urban areas in tropical countries are particularly vulnerable to the urban heat island effect, which elevates temperatures above surrounding rural areas. In Nigeria, mean annual temperatures have increased by approximately 1.5°C over the past 50 years, with southern coastal regions experiencing heightened vulnerability to flooding and coastal erosion (NIMET, 2021). The relationship between climate change and the built environment is bidirectional: buildings contribute approximately 39% of global energy-related CO_2 emissions, while simultaneously being vulnerable to climate impacts (UNEP, 2023). This dual imperative underpins the focus on climate-responsive architecture and sustainable construction materials in tropical contexts. Oyelami and Van Roy (2016) highlight that tropical soils, particularly laterites, offer opportunities for low-carbon construction but require careful evaluation under local climatic conditions.

Concept of Building Resilience

Building resilience refers to the capacity of buildings and occupants to anticipate, withstand, adapt to, and recover from adverse events, including climate change impacts and natural disasters (UN-Habitat, 2020). The concept has evolved from ecological origins (Holling, 1973) to encompass structural, functional, environmental, socio-economic, and institutional dimensions. Bosher and Dainty (2019) argue that building resilience requires a systems-thinking approach considering interdependencies between buildings, infrastructure, and social systems. In tropical urban contexts, where informal settlements and limited institutional capacity compound climate vulnerabilities, resilience is particularly critical. Meerow et al. (2016) emphasize that resilience is not a fixed attribute but a dynamic process evolving through learning and adaptation. Building resilience is central to achieving Sustainable Development Goals 11 (Sustainable Cities) and 13 (Climate Action), particularly in regions where adaptive capacity is limited.

Interlocking Stabilized Soil Blocks (ISSBs)

ISSBs are produced by compressing a mixture of locally available soil, a stabilizing agent (typically 5-10% cement), and water using manual or hydraulic presses. The interlocking mechanism allows for mortar-less wall construction, significantly reducing material and labor requirements (Bales et al., 2009; Jagadish, 2007). The technology originated in Colombia in the 1950s and gained international recognition through UN-Habitat and EPFL promotion in the 1970s and 1980s (Adam & Agib, 2001). Production involves soil selection and testing, mixing with stabilizer, compaction, and curing. Lateritic soils, common in tropical regions, are generally preferred due to their high clay and iron oxide content (Oyelami & Van Roy, 2016). Ibitoye (2022) identified Hollow and Solid Interlocking Stabilized Soil Blocks as the most common types in Southwestern Nigeria and demonstrated cost advantages of approximately 30% compared to sandcrete blocks due to mortar-less construction, reduced cement content, and use of local materials. Despite these benefits, adoption in Nigeria remains low due to poor public perception and limited awareness (Ibitoye, 2022).

Mechanical and Structural Performance of ISSBs

Compressive strength is the most critical mechanical property for load-bearing applications. Properly produced ISSBs can achieve compressive strengths ranging from 2.5 to 10 MPa, depending on soil type, stabilizer content, and production method (Laibi et al., 2025; Oyelami & Van Roy, 2016). Sandcrete blocks typically achieve 2.5-7 MPa (Anosike & Oyebade, 2012). Laibi et al. (2025) found that stabilized blocks achieved approximately 10 MPa, suitable for load-bearing construction. Increasing cement content improves strength but increases cost and embodied carbon; Bales et al. (2009) recommended 5-7% cement content for residential construction. Higher compaction pressure reduces porosity and improves strength (Venkatarama Reddy, 2015). Musene (2025) found that ISSBs retained approximately 78% of their strength after 24 hours of water immersion, indicating adequate water resistance. Adegun and Adedeji (2017) concluded that appropriately stabilized earth blocks offer adequate resistance to erosion and moisture damage when properly constructed.

Thermal Performance and Indoor Comfort

Earth-based materials exhibit favorable thermal properties compared to conventional materials. Thermal conductivity ranges from 0.3 to 1.0 W/m·K for earth blocks compared to 0.8 to 1.5 W/m·K for sandcrete blocks (Musene, 2025; Laibi et al., 2025). Lower thermal conductivity reduces heat flow from exterior to interior, improving insulation. Thermal mass moderates indoor temperature fluctuations by absorbing heat during the day and releasing it at night. Olgyay (1963) emphasized the importance of thermal mass in tropical architecture. Afolami and Oyebamiji (2017) found that occupants of laterite interlocking block buildings reported high satisfaction with indoor temperatures. Musene (2025) found that ISSBs exhibited the lowest thermal conductivity (0.354 W/m·K) among tested materials, maintaining temperatures 2-3°C cooler during peak heat periods. Neya et al. (2024) found that thermal comfort time varied linearly with cement content, indicating a trade-off between structural and thermal performance. Asaju (2022) demonstrated that thermal comfort was a significant predictor of academic performance, underscoring the importance of thermally comfortable spaces.

Moisture Resistance, Flooding, and Durability

Moisture is a critical factor affecting earth-based construction in tropical climates. Cement-stabilized blocks exhibit significantly improved water resistance compared to unstabilized blocks due to reduced porosity (Jagadish, 2007). Musene (2025) found that properly stabilized ISSBs retained approximately 78% of compressive strength after 24 hours of water immersion. Laibi et al. (2025) observed that blocks maintained structural integrity after short-term immersion but showed degradation with prolonged exposure. The interlocking mechanism may contribute to moisture resistance by reducing mortar joints, which are potential water infiltration pathways (Bales et al., 2009). Daniel et al. (2018) noted that properly constructed earth buildings had demonstrated durability in Nigerian climates. Adegun and Adedeji (2017) argued for holistic approaches integrating material selection, design, and community planning to address flood risks.

Climate-Responsive Design Strategies

Climate-responsive design seeks to harmonize buildings with their climatic context, minimizing energy consumption through passive means. Olgyay (1963) established foundational principles including orientation, shading, ventilation, and material selection. Passive cooling strategies in tropical regions include building orientation to minimize solar gain, cross-ventilation, shading devices, and materials with favorable thermal properties. Natural ventilation is particularly important in humid tropical climates where evaporative cooling is limited (Olgyay, 1963). Moisture management requires adequate roof overhangs, gutters, and drainage systems. In Nigeria, limited adoption of passive design principles reflects prioritization of cost over thermal performance (Oyelami & Van Roy, 2016). Asaju (2022) emphasized the human-centered dimension, demonstrating that IEQ directly affects human performance and well-being.

Sustainable Construction Materials in Tropical Regions

Sustainable construction materials minimize environmental impact throughout their life cycle while providing adequate performance and durability. Cement accounts for approximately 8% of global CO_2 emissions (Ibitoye, 2022), making cement reduction a priority. ISSBs use 5-10% cement compared to 15-20% in sandcrete blocks, offering significant embodied carbon reductions (Oyelami & Van Roy, 2016). Use of local materials reduces transport-related impacts and supports local economies (Adegun & Adedeji, 2017). Bredenoord et al. (2020)

found that community-based ISSB production created employment and built local capacity. Ganou Koungang et al. (2023) reported that biosourced earth blocks in Cameroon provided approximately 96% comfort with AC and delivered ~100 kWh annual energy savings per test cell. Durability is critical; studies indicate ISSBs can provide service lives comparable to conventional materials when properly produced and constructed (Laibi et al., 2025; Musene, 2025).

Empirical Review

Studies by Ibitoye

Ibitoye (2022) conducted a comparative analysis of ISSBs and sandcrete blocks in Southwestern Nigeria, finding ISSBs approximately 30% cheaper due to mortar-less construction, elimination of rendering, and reduced cement use. The study identified HISSBs and SISSBs as the most common types and recommended increased agencies and public sensitization to promote adoption. Ibitoye (2023) examined demographic characteristics of ISSB housing estates, finding they predominantly served lower- to middle-income households, demonstrating relevance to affordable housing. Ibitoye's work on Yoruba architectural vocabularies (2022) documented traditional building techniques, arguing for integration of indigenous knowledge with modern sustainable technologies.

Studies by Asaju

Asaju (2022) investigated IEQ and academic performance at Caleb University, Lagos, finding thermal comfort the most significant predictor of performance, with gender influencing perceptions. Asaju (2025) extended this to examine gender and academic performance specifically. Forthcoming work on net-zero buildings (2026) and construction waste management further contributes to sustainable construction discourse, aligning with the broader objectives of climate-resilient building practices.

Studies by Other Scholars

Olatunji, Maduagwu, and Balogun (2024) confirmed ISSBs improve housing quality in flood-prone areas with lower heat transfer rates. Laibi et al. (2025) found stabilized blocks achieved a thermal attenuation factor of 2.24 and compressive strength of ~10 MPa in humid tropical climates. Musene (2025) found ISSBs had the lowest thermal conductivity (0.354 W/m·K) among tested materials and retained ~78% strength after water immersion. Neya et al. (2024) examined thermal comfort in hot arid climates, finding comfort time varied linearly with cement content. Ganou Koungang et al. (2023) reported biosourced earth blocks achieved ~96% comfort with AC and ~100 kWh annual energy savings. Adegun and Adedeji (2017) synthesized evidence on earthen materials in Africa, concluding significant advantages in cost, thermal comfort, and environmental impact. Afolami and Oyebamiji (2017) found high occupant satisfaction with laterite interlocking block buildings. Daniel et al. (2018) documented stabilized earth adoption in Jos, Nigeria, noting demonstrated durability. Bredenoord et al. (2020) provided international perspective on ISSB practices in Thailand, Cambodia, and Nepal.

Research Gap

Several significant research gaps persist. First, while economic advantages of ISSBs are well documented (Ibitoye, 2022), limited empirical research specifically examines resilience to climate change impacts in tropical contexts. Existing studies focus on isolated performance aspects without systematically evaluating building resilience across multiple climate stressors. Second, thermal performance has been studied primarily through occupant perceptions or laboratory testing; field-based comparative studies measuring actual conditions in ISSB versus conventional buildings are needed. Third, durability under extreme weather events, particularly flooding, requires field-based research assessing performance after actual flood events. Fourth, socio-economic dimensions of ISSB resilience occupant well-being, health outcomes, post-disaster recovery are under-researched despite Asaju's (2022) foundational work on IEQ. Fifth, barriers and facilitators to ISSB adoption lack systematic analysis of technical, economic, institutional, and socio-cultural factors. Finally, a comprehensive framework for assessing building resilience to climate change in tropical regions, integrating thermal, structural, environmental, socio-economic, and institutional dimensions, is needed. This thesis aims to address these gaps by investigating ISSB resilience across multiple dimensions and developing a resilience assessment framework.

INTERNATIONAL JOURNAL OF RESEARCH AND INNOVATION IN SOCIAL SCIENCE (IJRISS)
ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VI June 2026

METHODOLOGY

Introduction

This chapter presents the methodology adopted for investigating the resilience of Interlocking Stabilized Soil Block (ISSB) buildings to climate change impacts in tropical regions, using Southwestern Nigeria as a case study. The chapter outlines the research design, study area, population and sampling, sample size determination, data collection methods (questionnaires and interviews), data analysis techniques, validity and reliability measures, and ethical considerations.

Research Design

The study employs a mixed-methods research design, specifically a convergent parallel design, in which quantitative and qualitative data are collected concurrently, analyzed separately, and then integrated during interpretation (Creswell & Plano Clark, 2018). This design is appropriate because the research requires both breadth (through quantitative survey data) and depth (through qualitative exploration of occupant experiences and stakeholder perspectives).

The mixed-methods design comprises two primary components:

1. **Survey Component:** Quantitative data collection through structured questionnaires administered to occupants of ISSB housing estates.

2. **Qualitative Component:** Semi-structured interviews with key informants, including architects, builders, developers, government officials, and long-term occupants.

Study Area

The research is conducted in Southwestern Nigeria, comprising the states of Lagos, Ogun, and Oyo. This region was selected due to: (a) its tropical climate representative of many tropical regions, with mean annual temperatures of 25-32°C and annual rainfall of 1,500-2,500mm (NIMET, 2021); (b) rapid urbanization and significant housing demand; (c) presence of ISSB housing developments documented by Ibitoye (2022); and (d) existing research base by Ibitoye (2022), Asaju (2022), and others.

Population and Sampling

The population comprises two categories: (a) households residing in ISSB housing estates in Southwestern Nigeria (approximately 2,500 households); and (b) key informants including architects, engineers, developers, and government officials.

A multi-stage sampling strategy was employed:

Stage 1: Case Study Site Selection. Purposive sampling was used to select three ISSB housing estates based on: (a) construction with ISSBs, (b) occupancy for at least two years, (c) presence of comparable sandcrete buildings, and (d) accessibility. Selected estates were in Lagos (coastal, high flood risk), Ogun (transitional), and Oyo (inland, higher temperatures).

Stage 2: Household Selection. Systematic random sampling was used to select households from a list of occupied units in each estate.

Stage 3: Key Informant Selection. Purposive sampling was used to select 20 key informants including architects (5), engineers (4), developers (4), government officials (3), and long-term occupants (4).

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VI June 2026

Sample Size Determination

The sample size for the household survey was determined using Yamane's formula (Yamane, 1967), which is widely used for determining sample sizes from finite populations:

$$\mathbf{n = N / (1 + Ne^2)}$$

Where:

- n = sample size
- N = population size
- e = margin of error (expressed as a decimal)

For this study:

- N = 2,500 households (estimated total population of households in ISSB housing estates in Southwestern Nigeria)
- e = 0.05 (5% margin of error, providing 95% confidence level)

Calculation:

$n = 2500 / (1 + 2500 \times 0.05^2)$

$n = 2500 / (1 + 2500 \times 0.0025)$

$n = 2500 / (1 + 6.25)$

$n = 2500 / 7.25$

$n = 344.83$

n ≈ 345 households

To account for potential non-response and incomplete questionnaires, the sample was increased by 10%, resulting in a target sample of **380 households**. The distribution across estates was proportional to the number of occupied units in each estate, as shown in Table 3.1:

Table 3.1: Sample Distribution Across Estates

Estate	Location	Occupied Units	Proportion (%)	Sample Size
Estate A	Lagos State	1,200	48	182
Estate B	Ogun State	800	32	122
Estate C	Oyo State	500	20	76
Total		**2,500**	**100**	**380**

Data Collection Methods

Questionnaire Survey

A structured questionnaire was administered to occupants of ISSB housing estates. The questionnaire comprised five sections:

Section A: Demographic Information. Age, gender, household size, education, income, and length of residence.

Section B: Thermal Comfort Perception. Occupants' perceptions of indoor temperature, humidity, air movement, and overall comfort using 5-point Likert scales (Very Poor to Excellent), adapted from Afolami and Oyebamiji (2017) and Asaju (2022).

Section C: Building Performance and Durability. Perceptions of building durability, water resistance, maintenance requirements, and observed deterioration.

Section D: Climate Change Impacts. Experience of flood events, heat stress, and other climate-related building issues.

Section E: Socio-Economic Dimensions. Effects of building conditions on health, productivity, well-being, satisfaction, and willingness to recommend ISSB construction.

The questionnaire was pilot-tested with 30 respondents, achieving a Cronbach's alpha coefficient of 0.82.

Key Informant Interviews

Semi-structured interviews were conducted with 20 key informants using an interview guide covering: technical experiences and challenges; factors influencing ISSB adoption; policy and institutional support; perceptions of ISSB resilience; and recommendations for scaling up. Interviews lasted 45-60 minutes, were audio-recorded with consent, and transcribed verbatim.

Observation Checklist

A structured checklist was used during site visits to document building characteristics, construction quality, and environmental conditions, providing contextual data to complement questionnaires and interviews.

Data Collection Procedure

Data collection was conducted over a 10-month period (March 2025 to December 2025):

Phase 1 (Month 1-2): Instrument development and pilot testing.

Phase 2 (Month 2-3): Site engagement and obtaining permissions.

Phase 3 (Month 3-6): Questionnaire administration to 380 households, with follow-up visits for non-respondents.

Phase 4 (Month 4-7): Key informant interviews with 20 participants.

Phase 5 (Month 7-8): Data verification, cleaning, and coding.

Data Analysis

Quantitative Data Analysis (Questionnaires)

Data were coded and entered into SPSS version 27. **Descriptive statistics** (frequencies, percentages, means, standard deviations) were computed for demographic variables and Likert-scale responses. **Inferential**

statistics (chi-square tests, t-tests, ANOVA) were used to examine associations and compare means between groups. **Exploratory factor analysis** was conducted to identify underlying dimensions of occupant satisfaction and perceived resilience.

Qualitative Data Analysis (Interviews)

Interview transcripts were analyzed using thematic analysis (Braun & Clarke, 2006) following six phases: familiarization, coding, theme search, theme review, theme definition, and findings writing. NVivo software facilitated coding and theme development. Themes were identified both deductively (from research objectives) and inductively (emerging from the data).

Integration of Findings

Quantitative and qualitative findings were integrated through: (a) **triangulation** to confirm or refute conclusions; (b) **complementarity** using qualitative findings to explain quantitative results; and (c) **expansion** using qualitative findings to explore dimensions not captured quantitatively.

Validity and Reliability

Quantitative Validity and Reliability: The questionnaire was based on established instruments and pilot-tested for clarity. Cronbach's alpha of 0.82 confirmed internal consistency. The sampling strategy supports generalizability within the region.

Qualitative Credibility: Triangulation with questionnaire data, member checking, and peer debriefing were employed. **Transferability:** Thick description enables assessment of applicability to other contexts. **Dependability:** Research process documented for replication. **Confirmability:** Audit trail maintained.

Ethical Considerations

Ethical approval was obtained from the institutional research ethics committee. Principles observed included: (a) informed consent from all participants; (b) confidentiality and anonymity; (c) voluntary participation with right to withdraw; (d) non-maleficence (avoiding harm); (e) beneficence (generating community benefits); and (f) cultural sensitivity.

Limitations of the Methodology

Limitations include: (a) reliance on self-reported data, though triangulation mitigates this; (b) cross-sectional design capturing perceptions at a single point in time; (c) findings may not be fully generalizable to other tropical regions; and (d) language barriers may have affected some responses.

DATA PRESENTATION, ANALYSIS, AND FINDINGS

Introduction

This chapter presents the data collected from 365 occupants of ISSB housing estates and 20 key informants across Southwestern Nigeria. The chapter is organized into four sections: demographic characteristics, questionnaire findings, key informant interview findings, and summary of findings. Data are presented using descriptive statistics including frequencies, percentages, means, and standard deviations.

Questionnaire Response Rate

A total of 380 questionnaires were administered, with 365 fully completed and returned, representing a response rate of 96.1%. Distribution across estates was: Estate A (Lagos) – 175 responses (48.0%), Estate B (Ogun) – 117 responses (32.0%), and Estate C (Oyo) – 73 responses (20.0%).

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VI June 2026

Demographic Characteristics of Respondents

Table 4.1: Demographic Profile of Respondents

Variable	Category	Frequency	Percentage (%)
Age	18-25 years	28	7.7
	26-35 years	103	28.2
	36-45 years	126	34.5
	46-55 years	69	18.9
	56 years and above	39	10.7
Gender	Male	150	41.1
	Female	213	58.4
	Prefer not to say	2	0.5
Education	No formal education	7	1.9
	Primary	18	4.9
	Secondary	61	16.7
	Diploma/NCE	67	18.4
	Bachelor's degree	142	38.9
	Postgraduate	70	19.2
Income	Below ₦50,000	41	11.2
	₦50,000-₦100,000	86	23.6
	₦101,000-₦200,000	115	31.5
	₦201,000-₦300,000	67	18.4
	Above ₦300,000	56	15.3

Variable	Category	Frequency	Percentage (%)
Household Size	1 person	19	5.2
	2-3 persons	107	29.3
	4-5 persons	155	42.5
	6-7 persons	58	15.9
	8+ persons	26	7.1
Residence Length	<1 year	28	7.7
	1-2 years	73	20.0
	3-4 years	148	40.5
	5-6 years	76	20.8
	7+ years	40	11.0
Tenure	Owner-occupier	260	71.2
	Tenant	94	25.8
	Other	11	3.0

The mean age of respondents was 41.3 years (SD = 12.7), mean household income was ₦187,500, and mean household size was 4.2 persons (SD = 1.8).

Thermal Comfort Perception

Table 4.2: Thermal Comfort Ratings

Variable	Mean	SD	Good/Excellent (%)
Indoor Temperature	3.91	1.12	73.7
Indoor Humidity	3.66	1.23	65.4
Air Movement/Ventilation	3.72	1.18	64.9
Overall Thermal Comfort	3.82	1.16	69.6

Scale: 1=Very Poor to 5=Excellent

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VI June 2026

The majority of respondents rated thermal comfort positively, with 69.6% rating overall thermal comfort as Good or Excellent. When compared to sandcrete buildings, 74.5% reported their ISSB home was "Much cooler" (42.7%) or "Somewhat cooler" (31.8%). During the hottest part of the day (12 pm-4 pm), 64.7% reported being comfortable or very comfortable. Only 8.8% "Always" required cooling devices, while 44.9% "Sometimes" used them.

Building Performance and Durability

Table 4.3: Building Performance Ratings

Statement	Mean	SD	Agree/Strongly Agree (%)
Overall building quality	4.01	1.08	70.4
Maintained structural integrity	3.93	1.04	76.4
Walls appear strong and durable	3.97	1.02	77.5
Adequate protection during rainfall	3.83	1.08	71.8
No water penetration during rainfall	3.71	1.16	66.3
Minimal maintenance required	3.63	1.17	61.9

Scale: 1=Strongly Disagree to 5=Strongly Agree

The majority of respondents reported no wall deterioration (55.6%) and no repairs needed (63.8%). Among those with issues, minor surface cracking (19.2%) and dampness/staining (12.6%) were most common.

Climate Change Impacts

Table 4.4: Flood Experience and Impact

Response	Frequency	Percentage (%)
Flood Experience		
Never	173	47.4
Once	66	18.1
2-3 times	52	14.2
4-5 times	41	11.2
>5 times	33	9.0
Building Response to Flooding (among those who experienced)		
No damage, walls intact	140	72.9

Response	Frequency	Percentage (%)
Water staining only	33	17.2
Minor damage	11	5.7
Major structural damage	5	2.6

Table 4.5: Heat Wave Experience and Performance

Response	Frequency	Percentage (%)
Heat Wave Experience		
Never	42	11.5
Rarely	55	15.1
Occasionally	142	38.9
Frequently	104	28.5
Very frequently	22	6.0
Performance During Heat Waves		
Much more comfortable	105	28.8
More comfortable	133	36.4
About the same	60	16.4
Less comfortable	22	6.0
Much less comfortable	8	2.2

Overall, 52.6% of respondents had experienced flooding, with 72.9% of those reporting no wall damage. During heat waves, 65.2% reported their ISSB home was more comfortable compared to other buildings.

Socio-Economic Dimensions and Overall Satisfaction

Table 4.6: Satisfaction and Socio-Economic Indicators

Statement	Mean	SD	Agree/Strongly Agree (%)
Positive effect on health	3.70	1.10	66.3
Positive effect on productivity	3.66	1.12	63.8
Satisfied with overall performance	3.80	1.09	70.1

Statement	Mean	SD	Agree/Strongly Agree (%)
Good value for money	3.73	1.06	66.6
Would recommend to others	3.92	1.02	74.8
Would choose for the next home	3.86	1.05	71.8

Scale: 1=Strongly Disagree to 5=Strongly Agree

Overall quality of life was rated Good or Excellent by 69.0% of respondents (mean = 3.76, SD = 1.08).

Table 4.7: Perceived Advantages and Disadvantages

Advantage	%	Disadvantage	%
Thermal comfort	78.9	Lack of awareness	38.1
Affordability	62.7	Moisture issues	26.6
Durability	54.5	Thermal discomfort	15.6
Low maintenance	42.7	Durability concerns	14.8

Table 4.8: Suggested Improvements

Improvement	Percentage (%)
More awareness and education	71.0
Government support/incentives	63.0
Better moisture protection	48.8
Better quality control	45.2
More aesthetic options	36.7

Key Informant Interview Findings

Thematic analysis of 20 key informant interviews revealed five major themes:

Thermal Performance Advantages

All 20 informants confirmed the superior thermal performance of ISSBs. Architects reported indoor temperatures 3-4°C cooler than adjacent sandcrete buildings. Developers noted 40-50% energy savings for occupants due to reduced cooling requirements.

"The thermal performance is remarkable. We consistently see indoor temperatures 3-4 degrees Celsius cooler than adjacent sandcrete buildings during peak heat periods." – Architect A

Durability and Flood Resilience

Seventeen informants expressed confidence in ISSB durability when properly constructed. Flood resilience was noted, with interlocking systems reducing water infiltration pathways. However, quality control concerns were emphasized.

"When properly stabilized and constructed, ISSB buildings are remarkably durable. We have buildings that have stood for over 15 years with minimal maintenance." – Engineer D

Adoption Barriers

All 20 informants identified a lack of awareness and negative public perception as primary barriers. Knowledge gaps among contractors and inadequate building codes were also cited by 15 informants.

"The biggest barrier is perception. People associate earth-based materials with poverty and traditional buildings." – Architect G

Policy Recommendations

Recommended interventions included: public awareness campaigns (18 informants), building code reform (14 informants), and government incentives (12 informants).

"We need a coordinated national campaign demonstrating the benefits of ISSBs. Showcase successful projects, train builders, and educate the public." – Developer J

Future Outlook

Sixteen informants expressed optimism about ISSB's future adoption, emphasizing the need for sustained effort in awareness and quality control.

"I see ISSBs becoming mainstream within the next decade, but only if we address the awareness and quality control challenges." – Engineer N

Summary of Key Findings

Thermal Performance: 69.6% rated overall thermal comfort as Good or Excellent. ISSB homes were perceived as cooler by 74.5% of respondents compared to sandcrete buildings. Only 8.8% always required cooling devices.

Durability and Flood Resilience: 70.4% rated building quality as Good or Excellent. 55.6% reported no deterioration, and 63.8% required no repairs. Among those who experienced flooding (52.6%), 72.9% reported no wall damage.

Socio-Economic Impact: 66.3% reported positive health effects, 63.8% reported positive productivity effects. Overall satisfaction was 70.1%, with 74.8% willing to recommend ISSB construction.

Barriers: Lack of awareness (38.1%) and moisture issues (26.6%) were the most cited disadvantages. Key informants emphasized public perception and quality control as primary challenges.

Recommendations: Awareness campaigns (71.0%) and government support (63.0%) were the most frequently suggested improvements, aligning with Ibitoye's (2022) recommendation for increased public sensitization.

SUMMARY: CONCLUSION AND RECOMMENDATIONS

Introduction

This chapter presents a summary of the study, draws conclusions based on the findings, and offers recommendations for policy, practice, and future research. The chapter addresses the six research objectives and corresponding research questions outlined in Chapter One.

Summary of the Study

This study investigated the resilience of Interlocking Stabilized Soil Block (ISSB) buildings to climate change impacts in tropical regions, using Southwestern Nigeria as a case study. The research was motivated by the dual challenges of a chronic housing deficit and escalating climate change vulnerability in Nigeria, coupled with the limited adoption of ISSB technology despite its documented advantages.

The study employed a mixed-methods research design, collecting data through structured questionnaires administered to 365 occupants of ISSB housing estates across three sites in Lagos, Ogun, and Oyo States, as well as semi-structured interviews with 20 key informants, including architects, engineers, developers, and government officials. The research was anchored in the foundational work of Ibitoye (2022) on the cost advantages of ISSBs and Asaju (2022) on Indoor Environmental Quality.

Key findings revealed that ISSB buildings demonstrate significant resilience to climate change impacts across multiple dimensions. Thermally, 69.6% of respondents rated overall thermal comfort as Good or Excellent, with 74.5% reporting their ISSB home was cooler than sandcrete buildings. Structurally, 70.4% rated building quality as Good or Excellent, and among those who experienced flooding, 72.9% reported no wall damage. Socio-economically, 66.3% reported positive health effects, and 74.8% were willing to recommend ISSB construction to others.

However, the study also identified persistent barriers to adoption, primarily a lack of public awareness (38.1%) and moisture issues (26.6%). Key informants emphasized that negative perceptions associating earth materials with poverty, knowledge gaps among contractors, and inadequate building codes hinder widespread adoption.

Conclusion

Based on the findings of this study, the following conclusions are drawn:

1. ISSB buildings demonstrate strong thermal resilience in tropical climates. The superior thermal performance of ISSBs, characterized by lower indoor temperatures and reduced reliance on mechanical cooling, makes them well-suited to address the challenges of rising temperatures and urban heat islands in tropical regions. This finding aligns with Musene (2025) and Laibi et al. (2025).

2. ISSB buildings exhibit adequate structural durability and flood resilience. The majority of buildings maintained structural integrity, with minimal deterioration and repairs required. The interlocking system and proper stabilization provide resistance to water penetration, though quality control remains essential.

3. ISSB buildings deliver positive socio-economic outcomes. Occupants reported improved health, productivity, and overall satisfaction, indicating that ISSBs contribute to occupant well-being beyond their material properties.

4. Adoption of ISSB technology in Nigeria remains constrained by perceptual and institutional barriers. Despite proven benefits, lack of awareness, negative public perception, inadequate building codes, and limited technical capacity impede widespread adoption.

5. ISSB technology represents a viable pathway for climate-resilient, affordable housing. The convergence of thermal performance, structural durability, environmental sustainability, and socio-economic benefits positions ISSBs as a strategic solution for addressing Nigeria's housing and climate challenges simultaneously.

Recommendations

Policy Recommendations

1. Develop a National ISSB Promotion Strategy. The Federal Ministry of Works and Housing should develop a comprehensive strategy for promoting ISSB technology, including targets for ISSB adoption in public housing projects and integration into the National Housing Policy.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VI June 2026

2. Update Building Codes and Standards. Building codes should be updated to explicitly recognize ISSB technology and establish clear quality standards for soil selection, stabilization, compaction, and construction techniques. This would provide regulatory certainty and confidence for developers and officials.

3. Provide Incentives for ISSB Construction. Government should consider tax incentives, subsidies, or reduced approval fees for ISSB construction projects to make the technology economically advantageous and encourage private sector investment.

Practice Recommendations

4. Implement Public Awareness Campaigns. Government agencies, professional bodies, and ISSB promoters should collaborate on coordinated public sensitization campaigns demonstrating the benefits of ISSB technology through case studies, demonstration projects, and media engagement.

5. Strengthen Technical Training and Capacity Building. Training programs for architects, engineers, builders, and block producers should be established to ensure proper ISSB production and construction techniques. Community-based training centers, as advocated by Bredenoord et al. (2020), should be promoted.

6. Improve Moisture Protection Measures. Design guidelines should emphasize moisture protection strategies including adequate foundation design, roof overhangs, proper drainage, and surface treatments to address occupant concerns about moisture issues.

Research Recommendations

7. Conduct Longitudinal Performance Studies. Long-term studies tracking ISSB building performance over 10-20 years are needed to assess durability under evolving climate conditions and inform life-cycle cost analysis.

8. Investigate Optimized Stabilization Formulations. Research on alternative stabilizers (lime, geopolymers) and optimal cement content for different soil types in Nigeria could improve performance while reducing environmental impact, as suggested by Neya et al. (2024).

9. Expand Geographical Coverage. Similar studies should be conducted in other regions of Nigeria and other tropical countries to assess the generalizability of findings and identify region-specific factors influencing ISSB performance and adoption.

10. Assess Life-Cycle Environmental Impacts. Comprehensive life-cycle assessment studies quantifying the embodied carbon, operational energy, and end-of-life impacts of ISSB buildings compared to conventional construction would strengthen the environmental case for adoption.

Contribution to Knowledge

This study makes several contributions to knowledge:

Theoretical Contribution: The study advances understanding of building resilience by conceptualizing it across multiple dimensions thermal, structural, environmental, and socio-economic and demonstrating how ISSB buildings perform across these dimensions. This multi-dimensional framework can be applied to assess other building materials and technologies.

Empirical Contribution: The study provides empirical evidence from 365 occupants and 20 key informants on ISSB performance in Southwestern Nigeria, contributing to the limited body of field-based research on ISSB buildings in tropical Africa.

Policy Contribution: The study's evidence-based recommendations provide a foundation for policy development to promote sustainable, climate-resilient housing in Nigeria and other tropical developing countries.

Limitations and Future Research

The study acknowledges several limitations. The cross-sectional design captures perceptions at a single point in time, and findings may not be fully generalizable to other tropical regions. Reliance on self-reported data, though triangulated with key informant interviews, may introduce response bias. Future research should incorporate physical measurements of thermal performance and material testing to complement occupant perceptions. Longitudinal studies tracking building performance over extended periods would provide valuable insights into long-term durability and climate resilience.

Final Remarks

This study has demonstrated that Interlocking Stabilized Soil Block buildings offer significant resilience to climate change impacts in tropical regions, providing thermal comfort, structural durability, and socio-economic benefits that address pressing housing and climate challenges in Nigeria. However, the full potential of this technology remains unrealized due to perceptual and institutional barriers. Addressing these barriers through coordinated policy interventions, public awareness, and technical capacity building is essential to scale up ISSB adoption and unlock its contribution to sustainable, climate-resilient housing. As climate change intensifies and housing demand grows, ISSB technology offers a timely and practical solution that deserves the attention of policymakers, practitioners, and researchers alike.

REFERENCES

1. Abad, E. I. B., Guaricela, R. I. E., & Catá, J. B. A. (2019). *Bloque de suelo estabilizado en pequeño formato y tecnología de colocación en obra en vivienda de interés social*. Universidad del Norte.
2. Adam, E. A., & Agib, A. R. A. (2001). *Compressed stabilised earth block manufacture in Sudan*. UNESCO.
3. Adegun, O. B., & Adedeji, Y. M. (2017). Review of economic and environmental benefits of earthen materials for housing in Africa. *Frontiers of Architectural Research*, *6*(4), 519-528. https://doi.org/10.1016/j.foar.2017.08.003
4. Afolami, A., & Oyebamiji, I. (2017). Users' perception and thermal comfort of residents in an estate built with laterite interlocking blocks, Ekiti State, Nigeria. In T. M. Obamuyi, S. O. Fadare, A. D. Dada, T. O. Fakokunde, & M. A. Abayomi (Eds.), *Proceedings of the 1st International Conference of the School of Management Technology* (p. 193). Federal University of Technology, Akure.
5. Anosike, N. M., & Oyebade, A. A. (2012). Sandcrete blocks and quality management in Nigeria building industry. *Journal of Engineering Project and Production Management*, *2*(1), 37-46.
6. Bales, C., Donahue, C., Fisher, M., Mellbom, A., & Pearson, A. (2009). *Interlocking compressed earth blocks: From soil to structure* [Senior project]. California Polytechnic State University.
7. Bosher, L., & Dainty, A. (2019). *Building resilience: A systems approach to disaster risk reduction*. Routledge.
8. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101. https://doi.org/10.1191/1478088706qp063oa
9. Bredenoord, J., Kokkamhaeng, W., Janbunjong, P., et al. (2019). Interlocking block masonry (ISSB) for sustainable housing purposes in Thailand, with additional examples from Cambodia and Nepal. *Engineering Management Research*, *8*(2), 42. https://doi.org/10.5539/emr.v8n2p42
10. Bredenoord, J., Park, J., & Kim, K. (2020). The significance of community training centers in building affordable housing and developing settlements. *Sustainability*, *12*(7), 2952. https://doi.org/10.3390/su12072952
11. Commonwealth of Learning. (2015). *Producing interlocking stabilised soil blocks*. [Course material]. COL.
12. Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.
13. Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE Publications.
14. Daniel, A. A., Benjamin, G. K., & Tali, J. O. (2018). Adopting stabilized earth construction to address urban low-cost housing crisis in Jos, Nigeria. *Journal of Ergonomics Studies and Research*, *1*(1), 1-10.

15. Federal Ministry of Works and Housing. (2021). *National Housing Policy*. Federal Government of Nigeria.
16. Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockström, J. (2010). Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society*, *15*(4), 20. https://doi.org/10.5751/ES-03610-150420
17. Ganou Koungang, B. M., et al. (2023). Biosourced earth blocks in Cameroon: Energy savings and comfort performance. *Cogent Engineering (2023), 10: 2159159*. https://doi.org/10.1080/23311916.2022.2159159
18. Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics*, *4*, 1-23. https://doi.org/10.1146/annurev.es.04.110173.000245
19. Ibitoye, O. A. (2021). Knowledge and potentials of recycled paper as affordable building material in Ikorodu, Lagos State. *FUDMA Journal of Sciences*, *5*(3), 419-422.
20. Ibitoye, O. A., Alagbe, O., & Dare-Abel, O. (2022). Comparative cost advantages of interlocking stabilized soil block and sandcrete block for building construction in South-West Nigeria. *International Journal of Scientific Research and Engineering Development*, *5*(5). https://doi.org/10.5281/ZENODO.7213970
21. Ibitoye, O. A., Solomon, B. A., Afolabi, T. A., & Oyewole, A. (2022). Documentation of local architectural vocabularies for residential building components in Yoruba cultures. *FUDMA Journal of Sciences*, *6*(1), 404-414. https://doi.org/10.33003/fjs-2021-0601-2037
22. Ibitoye, O. A., Abiola, O. A., & Babamboni, A. S. (2023). Demographic characteristics of housing estates developed with ISSB technology in selected Southwestern Nigerian (SWN) cities. *FUDMA Journal of Sciences*, *7*(2), 275-283. https://doi.org/10.33003/fjs-2023-0702-2038
23. Ibitoye, O. A., & Tolu-Alalade, J. O. (2026). Thermal performance of interlocking stabilised soil blocks (ISSB) for passive and sustainable building design. *Asian Journal of Geographical Research*, *9*(2), 54-63. https://doi.org/10.9734/ajgr/2026/v9i2384
24. Ibitoye, O. A. (2025). The role of resident perception in mainstreaming green facades in Nigerian high-rise architecture. *Timbou African Academic Publications*.
25. Intergovernmental Panel on Climate Change. (2022). *Climate change 2022: Impacts, adaptation and vulnerability*. Cambridge University Press.
26. International Organization for Standardization. (2005). *Ergonomics of the thermal environment: Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria* (ISO 7730:2005). ISO.
27. Jagadish, K. (2007). *Building with stabilized mud*. I.K. International Publishing House.
28. Laibi, A. B., et al. (2025). Experimental Assessment of the Dynamic Hygrothermal and Mechanical Behavior of Compressed Earth Block Walls in a Tropical Humid Climate. *Buildings* ***2025****, 15(19), 3484;* https://doi.org/10.3390/buildings15193484
29. Meerow, S., Newell, J. P., & Stults, M. (2016). Defining urban resilience: A review. *Landscape and Urban Planning*, *147*, 38-49. https://doi.org/10.1016/j.landurbplan.2015.11.011
30. Neya, I., et al. (2024). Thermal comfort in compressed earth block buildings in hot arid climates. *Journal of Minerals and Materials Characterization and Engineering* 12(01):1-16 10.4236/jmmce.2024.121001
31. Nigerian Meteorological Agency. (2021). *Climate data report: Nigeria 1961-2020*. NIMET.
32. Olaleye, A. A., & Ibitoye, O. A. (2022). Architect's response on utilisation of interlocking stabilised soil blocks as an alternative building material for housing projects in Southwest Nigeria. *FUDMA Journal of Sciences*, *6*(5), 198-202. https://doi.org/10.33003/fjs-2022-0605-1191
33. Olgyay, V. (1963). *Design with climate: Bioclimatic approach to architectural regionalism*. Princeton University Press.
34. Oyelami, C. A., & Van Roy, J. L. (2016). A review of the use of lateritic soils in the construction/development of sustainable housing in Africa: A geological perspective. *Journal of African Earth Sciences*, *119*, 226-237. https://doi.org/10.1016/j.jafrearsci.2016.04.005
35. Pérez-Peña, A. M. (2009). *Interlocking stabilised soil blocks: Appropriate earth technologies in Uganda*. UN HABITAT.
36. UN-Habitat. (2020). *Building resilience in urban settlements*. United Nations Human Settlements Programme.
37. United Nations Environment Programme. (2023). *Global status report for buildings and construction*. UNEP.

38. Venkatarama Reddy, B. (2015). Design of a manual press for the production of compacted stabilized soil blocks. *Current Science,* *109*(9), 1653-1660.
39. World Bank. (2023). *Nigeria urbanization review*. World Bank Group.
40. Yamane, T. (1967). *Statistics: An introductory analysis* (2nd ed.). Harper & Row.