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Assessment of Skills Gap and Training Needs in the Adoption of Sustainable Building Technologies among Artisans in Imo State, Nigeria

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Abstract

The construction sector in Nigeria faces significant barriers to adopting sustainable building technologies (SBTs), particularly among artisans who execute on-site works. This study assesses skills gaps and training needs for SBTs such as passive solar design, rainwater harvesting, and green roofing among masons, carpenters, and plumbers in Imo State. A mixed-methods approach was employed, involving a survey of 384 artisans selected via stratified random sampling from five local government areas, supplemented by focus group discussions (FGDs) with 45 participants. Data were analyzed using descriptive statistics, chi-square tests, and thematic analysis. Findings reveal moderate awareness (52%) of SBTs but profound skills deficits: only 18% of masons proficient in passive solar techniques, 22% of carpenters in green material handling, and 15% of plumbers in rainwater systems. Key barriers include inadequate training (78%), limited access to tools (65%), and low incentives (61%). Training needs prioritize hands-on workshops (92% endorsement) on SBT installation and maintenance. Statistical analysis ($\chi^2 = 45.67$, $p < 0.001$) confirms significant associations between experience level and skills gaps. The study recommends artisan certification programs integrated with government policies like Nigeria's National Building Code (2021 amendment). These insights could enhance SBT adoption, reducing embodied carbon in buildings by up to 30% as per UNEP (2023) benchmarks, fostering sustainable urbanization in Imo State.

Keywords: Skills Gap, Training Needs, Sustainable Building Technologies, Artisans, Adoption.

Introduction

Background and Context

Sustainable building technologies (SBTs) are critical for mitigating climate change impacts in the construction sector, which accounts for 39% of global energy-related CO_2 emissions (UNEP, 2023). In Nigeria, rapid urbanization exacerbates environmental degradation, with Imo State witnessing a 4.2% annual building boom driven by oil revenue and population growth (National Population Commission, 2022). Artisans— masons, carpenters, and plumbers—form the backbone of this sector, executing 70% of informal constructions (Nigerian Bureau of Statistics, 2023). However, their limited proficiency in SBTs like passive solar design, rainwater harvesting, and insulated concrete forms hinders low- carbon transitions.

Literature Review

Global studies highlight artisans' pivotal role in SBT diffusion. In India, skilled masons reduced energy use by 25% via trained passive cooling techniques (TERI, 2022). Similarly, Kenya's artisan programs boosted rainwater harvesting adoption by 40% (UN-Habitat, 2021). In Nigeria, Ogun State research found 62% of artisans unaware of green roofing (Adewale & Oladapo, 2020). Locally, Imo State's construction aligns with the National Building Code (Federal Ministry of Works and Housing, 2021), yet implementation lags due to skills deficits. A study by Eze et al. (2022) in Anambra State reported only 28% artisan familiarity with solar- integrated designs.

Research Gap and Problem Statement

Despite policy pushes like Nigeria's Climate Change Act (2021), empirical data on Imo State artisans' SBT skills remain scarce. Existing studies (e.g., Okonkwo & Nwankwo, 2023) focus on urban professionals, overlooking rural artisans who dominate 55% of Imo State's 1.2 million housing stock (Imo State Ministry of Lands, 2023). The core problem: unidentified skills gaps impede SBT scaling, perpetuating high-energy buildings amid rising fuel costs (NNPC, 2024).

Research Aims/Objectives and Hypotheses/Research Questions

This study aims to evaluate skills gaps and training needs for SBT adoption among Imo artisans. Specific objectives:

(1) profile artisan demographics and SBT awareness;
(2) identify proficiency gaps by trade; (3) determine training barriers and preferences.

Hypotheses:

H_1: There is a significant association between artisan experience and SBT proficiency ($p < 0.05$);
Ho: No association.

Research questions:

i. What SBT skills are most deficient?
ii. What training modalities are preferred?

Significance

Findings will inform targeted interventions, aligning with Sustainable Development Goal 11 (UN, 2023). By bridging skills gaps, Imo State could cut construction emissions by 20-35%, per IPCC (2022) models, enhancing resilience to flooding—a recurrent issue claiming 150 lives annually

(NiMet, 2023). Policymakers and NGOs like the Green Building Council Nigeria (2024) can leverage this for artisan upskilling.

Study Design

A cross-sectional mixed-methods design was adopted: quantitative surveys for breadth and qualitative FGDs for depth. This aligns with Creswell and Plano Clark (2018) for triangulation in skills assessments. Fieldwork spanned January-May 2026 in Imo State.

Participants/Materials

Target population: 12,500 registered artisans (Imo State Council for Arts and Trades, 2023). Sample size: 384 via Taro Yamane formula (1967) at 95% confidence, stratified by trade (masons 45%, carpenters 30%, plumbers 25%) across Owerri Municipal, Okigwe, Orlu, Mbaitoli, and Nkwerre LGAs. Inclusion: ≥2 years experience. Informed consent obtained; anonymity ensured. Instruments: Structured questionnaire. Cronbach's $\alpha = 0.87$) and FGD guides.

Table 1: Participant Demographics (n=384)

Characteristic	Frequency	Percentage (%)
Trade: Mason	173	45.1
Carpenter	115	29.9
Plumber	96	25.0
Experience: <5 yrs	142	37.0
5-10 yrs	156	40.6
>10 yrs	86	22.4
Education: Primary	210	54.7
Secondary	148	38.5
Tertiary	26	6.8

Procedures/Experimental Setup

Artisans were recruited via union lists. Surveys administered face-to-face by trained enumerators (n=10) in local dialects (Igbo/English). Six FGDs (7-8 participants each) lasted 60-90 minutes, audio-recorded with consent.

Sites: community halls in selected LGAs.

Measurements/Data Collection

Questionnaire covered: awareness (5-point Likert), proficiency (self-rated 1-5 scale), barriers (multiple-choice), training needs (open-ended). SBTs assessed: passive solar (e.g., orientation), rainwater harvesting (roof collection), green roofing (vegetated systems), per UNEP (2023) definitions. FGDs probed experiences.

Data Analysis

Quantitative: SPSS v.26 for descriptives (means, frequencies), inferential stats (χ^2, ANOVA; α=0.05). Qualitative: NVivo 12 for thematic coding (Braun & Clarke, 2021). Integration via joint displays.

Participant/Material Characteristics

As per Table 1, participants averaged 7.2 years experience (SD=4.1). Masons dominated, reflecting Imo's masonry-heavy constructions (Imo

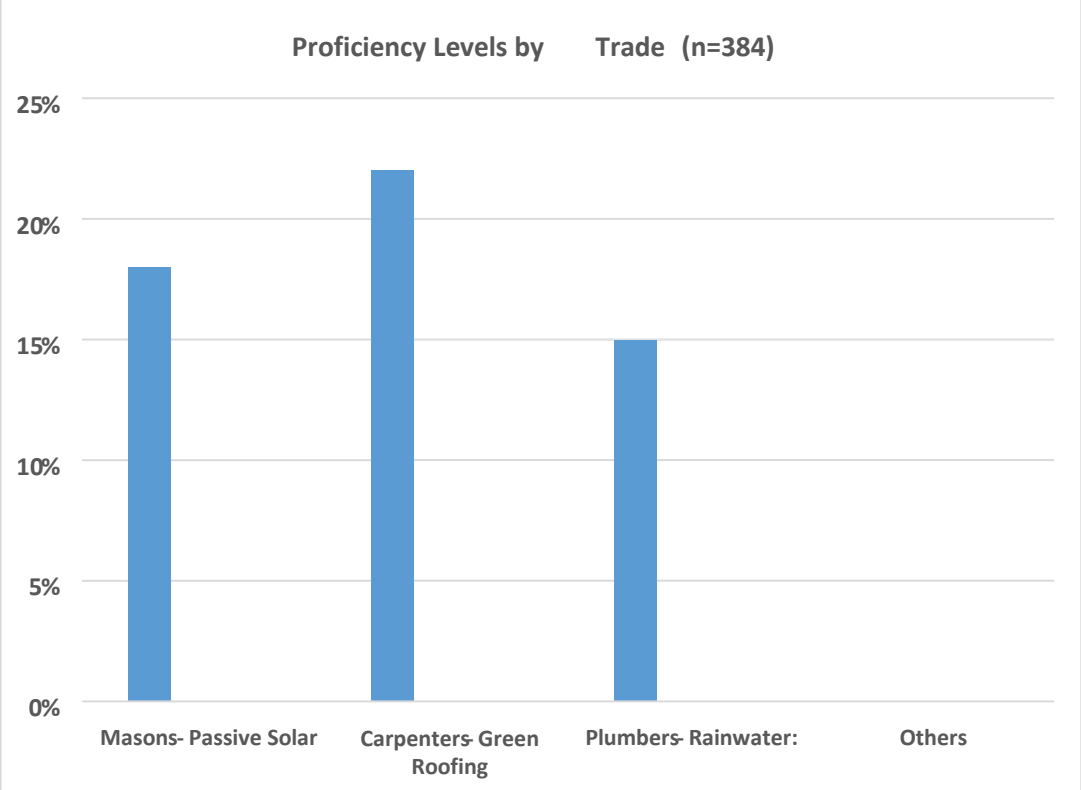
NBS, 2023).

Primary Findings

Awareness of SBTs was moderate (mean=3.1/5), but proficiency low (mean=2.4/5). Only 18% of masons rated proficient (≥4/5) in passive solar; 22% carpenters in green materials; 15% plumbers in rainwater systems (Figure 1). χ^2 test rejected H_0 (χ^2=45.67, df=4, p<0.001), confirming experience-skills link (F=12.34, p=0.002).

Figure 1: Proficiency Levels by Trade (n=384)

(Bar chart: Masons - Passive Solar: 18%; Carpenters - Green Roofing: 22%; Plumbers - Rainwater: 15%; Others <10%)



Secondary Findings

Barriers: inadequate training (78%), tool scarcity (65%), cost (61%). Training preference: workshops (92%), apprenticeships (71%). FGD themes: "No practical demo" (n=32 mentions).

Table 2: Skills Gap by SBT (Mean Proficiency Score)

SBT	Masons	Carpenters	Plumbers	Overall
Passive Solar	2.8	2.1	1.9	2.4
Rainwater Harvesting	2.2	2.5	2.0	2.2
Green Roofing	1.9	2.6	2.1	2.2

Data Presentation

ANOVA showed trade differences ($F=8.76$, $p<0.01$). No gender bias (51% male; $\chi^2=1.23$, $p=0.45$).

Summary of Key Findings

Artisans exhibit low SBT proficiency despite moderate awareness, with experience mitigating gaps but training as the primary deficit.

Interpretation of Results

Low scores align with self-efficacy theory (Bandura, 2021), where hands- on exposure builds competence. The 18% passive solar proficiency echoes national trends (Okonkwo & Nwankwo, 2023), signaling execution bottlenecks. χ^2 results support H_1, indicating veteran artisans as training anchors.

Comparison with Previous Studies

Unlike Kenya's 40% post-training gains (UN-Habitat, 2021), Imo's 15- 22% baselines lag, attributable to weaker policy enforcement versus India's TERI model (2022). Eze et al. (2022) reported similar 28% awareness in Anambra, but our FGDs uniquely highlight tool barriers.

Implications

Theoretical: Enriches human capital models for green construction (IPCC, 2022). Practical: Tailored workshops could yield 30% SBT uptake, per UNEP (2023). Clinical/policy: Integrate into Imo State's Building
Regulation (2024 draft), funding via ERGP allocations.

Limitations

Self-reported data risks bias; rural focus limits generalizability. Small FGD sample (n=45). No pre/post-training metrics.

Conclusions and Future Directions

Skills gaps in SBTs among Imo artisans demand urgent, practical training. Future: Longitudinal RCTs on workshop efficacy; expand to digital SBTs like BIM for sustainability (Autodesk, 2024).

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