**Original Research Article**

**Barriers to the Implementation of Sustainable Building Regulations in Rural Nigerian Communities**

**Abstract:** In Nigeria’s rural communities, building regulations serve as essential mechanisms for ensuring structural safety, environmental sustainability, and adherence to planning standards. However, implementing these regulations often encounters significant barriers, especially in less urbanized areas. This study investigates the barriers to implementing building regulations in Nigeria's rural communities, where such regulations are vital for ensuring structural safety, environmental sustainability, and adherence to planning standards. Using a mixed-method approach involving a structured survey with architects, town planners, and community leaders, as the three critical stakeholder groups. Key challenges include limited awareness of regulations, inadequate enforcement mechanisms, socio-economic constraints, cultural resistance, and lack of technical and financial resources. Additionally, the study highlights that weak institutional frameworks, poor infrastructure, and traditional construction practices exacerbate non-compliance, while gaps in collaboration between local authorities and community leaders further impede regulatory effectiveness. The findings underscore the need for targeted strategies to enhance regulatory awareness, improve inter-stakeholder cooperation, and address resource shortages. This research proposes actionable recommendations aimed at creating a more adaptive regulatory framework that aligns with rural realities, promoting safer and more sustainable building practices across Nigeria’s rural communities.

**1. Introduction**

The safety and quality of construction in any nation are crucially dependent on compliance with building regulations, which serve as essential frameworks for ensuring public health, safety, and environmental sustainability [1]. Despite their importance, nearly 70% of construction in rural Nigeria takes place informally, often bypassing these regulations [2]. The implementation of building regulations in rural Nigerian communities is uniquely challenged by socio-economic, cultural, and logistical factors [3]. Effective building standards are critical for reducing risks associated with unsafe construction, as an estimated 40% of structures in rural Nigeria face structural issues or hazards due to non-compliance [4]. However, enforcement of these standards remains limited, especially in rural areas where resources and technical expertise are scarce [3].

Key stakeholders in ensuring compliance with building standards include architects, town planners, and community leaders [5]. Research indicates that only about 30% of rural construction projects involve licensed professionals like architects or engineers, leaving most projects without expert oversight [6]. Architects are essential in integrating regulatory requirements into building designs, yet they face obstacles due to budget constraints and limited access to standard materials, with approximately 60% of rural projects operating on reduced budgets [2]. Town planners are similarly responsible for establishing zoning and planning standards; however, enforcement in rural regions is weakened by institutional and staffing shortages, with rural planning authorities operating at only 45% of required capacity [7, 5]. Community leaders play a significant role in gaining local acceptance and adherence to regulations. However, almost 55% of these leaders report difficulties reconciling traditional practices with modern building standards [8].

The socio-cultural landscape in rural Nigeria further complicates regulatory implementation, as traditional practices and economic constraints frequently conflict with formal building standards [3]. Data show that around 65% of rural residents prioritize affordability and immediate functionality over compliance with regulations, which contributes to widespread non-compliance [9]. Additionally, logistical issues, such as the limited availability of materials that meet regulatory standards, impact 70% of rural construction projects, while insufficient inspection mechanisms further hinder compliance [10]. Studies suggest that collaboration involving local authorities and community leaders is essential for effective regulatory implementation [8]. However, practical applications of these partnerships are limited by resource allocation issues and a lack of effective community engagement strategies, leading to project failures in 40% of rural planning efforts due to resource and engagement challenges [9].

This study seeks to identify specific barriers faced by architects, town planners, and community leaders in enforcing building regulations in rural Nigerian communities and to propose solutions that can improve compliance and streamline implementation processes. Addressing these gaps is crucial, as improved regulatory compliance can significantly enhance construction quality and safety, fostering sustainable development and resilience in rural Nigerian communities [11].

In rural Nigerian communities, the implementation of building regulations is essential to ensure safe, durable, and sustainable construction practices; however, these regulations are often inadequately enforced due to multiple interrelated barriers [3]. Studies indicate that approximately 70% of construction in rural Nigeria occurs informally, frequently without adherence to established regulatory standards, creating significant risks for structural integrity and public safety [4, 6]. These challenges are compounded by a lack of resources, which restricts the capacity of regulatory agencies to oversee and monitor compliance effectively, particularly in rural areas with limited accessibility [5, 8].

The role of key stakeholders, including architects, town planners, and community leaders is critical in promoting regulatory compliance in rural construction [2]. However, only around 30% of rural construction projects involve licensed professionals, resulting in a high prevalence of construction activities lacking professional oversight [6]. Architects and town planners often struggle to work in rural communities due to budget constraints and limited access to building materials that meet regulatory standards, with approximately 60% of rural projects operating with reduced budgets [3]. These resource constraints contribute to non-compliance, as regulatory standards are difficult to uphold under such financial and material limitations [6, 14]. Community leaders have the authority to influence community adherence to building regulations; however, cultural and traditional practices often conflict with these standards, presenting additional implementation challenges [12, 13]. Research shows that nearly 55% of community leaders report difficulties in aligning traditional building practices with formal regulatory standards, which frequently leads to the prioritization of cost-effective and culturally familiar construction methods over regulatory compliance [6].

Furthermore, economic constraints in rural communities mean that around 65% of rural residents prioritize affordability over adherence to safety standards, resulting in a high rate of non-compliance [6, 14]. Logistical limitations, including inadequate inspection mechanisms and a shortage of materials meeting regulatory standards, also obstruct regulatory compliance. Studies indicate that approximately 70% of rural construction projects are affected by limited availability of quality building materials, and insufficient inspection frameworks exacerbate the issue, leaving most projects without regular compliance checks [10, 11]. Similarly, institutional weaknesses, such as understaffed planning authorities operating at only 45% capacity, significantly limit the ability of enforcement agencies to monitor construction activities effectively [9, 13]. Despite efforts to encourage regulatory compliance, gaps remain in addressing these barriers through a collaborative approach involving architects, town planners, community leaders, and local government [14, 15, and 16]. Limited financial resources, inadequate training, and weak community engagement strategies hinder effective collaboration and resource allocation, contributing to an estimated 40% failure rate of rural planning projects due to lack of funding and local involvement [17, 18]. This lack of collaboration and resource support perpetuates a cycle of non-compliance, impacting the quality and safety of construction projects in rural communities [16].

Though prior studies have assessed building regulation barriers [11] and benefits in Nigeria [15, 17], a specific spotlight on architects, architects, town planners, and community leaders’ dynamic responsibilities in rural Nigerian communities amid industry transformations and sustainability remains lacking. Building and construction operation in Nigeria contribute significantly environmental pollution and degradation [11, 20], necessitating mitigation efforts by decision-makers like architects, town planners, community leaders etc. Furthermore, the country’s largely traditional construction approaches constrain integration of sustainability considerations in project lifecycles. Factors like persisting capability gaps in specialized knowledge, regulatory limitations, and client preferences stall mainstreaming of sustainable building expertise by key decision-makers [18, 22]. Moreover, while research of Obi et al. [23] recognizes sustainability coverage in construction curricula, rapidly evolving technologies, policies, and best practices make continuous professional development for practitioners indispensable. In essence, despite advancements, gaps in understanding community preparedness for sustainability commitments, barriers to field implementation in Nigeria underline the value addition of dedicated sustainability focused role evaluations [16, 18, and 24].

Moreover, aspects like adeptness for shifting regulations, client engagement abilities, up skilling capacities, and technology adoption readiness warrant examination. This backdrop underscores the value of dedicated rural-focused research probing sustainable building regulation implementation realities. An Enugu State-centered investigation can enrich pivotal understanding while enabling generalizability. The choice of Enugu state as the focus of this study is significant in that the local government areas (LGA) communities serves as a microcosm of the challenges and opportunities faced by other Nigerian communities in adopting sustainable building regulations. Hence, this study will provide insights that can be potentially applicable to similar rural community contexts across Nigeria and sub-Saharan Africa. Therefore, this study aims to investigate and analyze the barriers to implementing building regulations in rural communities of Enugu State, Nigeria, with the view of proposing targeted solutions to encourage enforcement and compliance with building standards, ultimately enhancing building safety, quality, and sustainability.

Therefore; the present study aims to investigate the barriers to building stake holders in integrating sustainable building principles and regulations within the specific context of rural communities in Enugu State, Nigeria. The following objectives were pursued to achieve the aim above:

* To identify the specific challenges faced by architects, town planners, and community leaders in enforcing sustainable building regulations in rural Nigerian communities.
* To analyze the impact of these challenges on compliance with building standards, particularly in relation to construction quality, safety, and community resilience
* To propose strategies for improving regulatory compliance, collaboration among key stakeholders to enhance safe and sustainable construction practices in rural Nigerian communities.

**2. Case study**

This research is centered in Enugu State, comprising of 17 rural Local Government Areas (LGAs) located in southeastern Nigeria. The LGAs are: Nsukka, Awgu, Udi, Oji River, Igbo-Etiti, Igbo Eze North, Igbo Eze South, Isi-Uzo, Nkanu East, Nkanu West, Uzo-Uwani, Nkanu Central, Ezeagu, Udenu, Aninri, Enugu North, Enugu South, and Enugu East [25]. However, 3 out of the 17 LGAs (Enugu North, Enugu South, and Enugu East) will be excluded from the study due to their urbanized nature (Enugu Metropolis) and different regulatory environments, which may not accurately represent the specific challenges faced by rural communities in implementing sustainable building regulations Enugu state has a climate typical of the West African region, characterized by relatively moderate temperatures ranging from 24 ◦C to 30.8 ◦C. The annual temperature is approximately 26°C, while from February to April, the average temperature is above 27°C and this is necessitated by the apparent northward movement of the sun and sparse cloud cover. The month of August, which is the middle of the wet season, is the coolest month with an average temperature of 24°C. Enugu is dominated by two main seasons: the dry season and the rainy season. Additionally, a brief Harmattan period around January or February temporarily disrupts the high humidity, bringing cool, dry winds from the Sahara desert, which results in a dusty atmosphere [26].

**Fig.1. Map showing Nigeria, highlighting Enugu State**

**3. Literature review**

*3.1 Historical background and importance of sustainable building regulation*

As the global population continues to rise, the demand for additional shelter grows, exacerbating environmental pressures through increased development. This surge in building activity underscores the necessity for sustainable practices that can balance human needs with the preservation of environmental health [27]. Building regulations are essential frameworks that govern construction standards to ensure safety, health, and sustainability. These regulations focus on various aspects, including structural integrity, fire safety, energy efficiency, and accessibility and play a crucial role in ensuring that buildings meet necessary safety standards, protecting the public from potential hazards like structural failures, fire risks, and environmental impact [28, 29]. Building regulations in Nigeria evolved in response to rapid urbanization and infrastructure needs, which initially prioritized urban centers. However, recent policies emphasize the importance of enforcing standards in rural areas as well, addressing their unique social and infrastructural constraints [30, 40]. The Nigerian building regulations aim to align local construction practices with both national and international standards, thereby promoting structural safety and durability [31] Adherences to these standards is vital to environmental sustainability, by encouraging eco-friendly practices and materials and reduce risks associated with substandard construction such as inadequate protection against natural disasters and threats to occupant safety [29,32]. Similarly, promoting regulatory compliance, rural areas can improve structural safety and stability, ensuring the longevity and resilience of their built environment [33]. However, the Nigerian Urban and Regional Planning Law, though developed to establish a national regulatory standard, have limited impact in rural communities due to resource constraints and enforcement challenges [34].

* 1. *Principles of sustainable building*
* **Energy use efficiency:**Energy efficiency in sustainable architecture involves maximizing the use of natural resources to reduce dependence on artificial energy sources. This approach involves adopting architectural ventilation strategies to achieve natural ventilation efficiency and minimize the demand for mechanical air conditioning systems. Similarly, optimizing the use of daylight to provide natural illumination, reducing the reliance on artificial lighting and thus lowering electricity consumption [35]. Innovative uses of rainwater, such as rainwater harvesting systems, can also contribute to sustainable domestic water use. These principles are particularly relevant in tropical climates like Indonesia, where natural ventilation and day lighting can be optimized effectively.
* ***Land use efficiency:***This involves designing compact and integrated building layouts that maximize green potential through innovations such as roof gardens, hanging gardens, and living walls*.* Efficient land use in sustainable architecture ensures that not all available land is covered with buildings; crucially preserving existing plants and trees on-site as they can be integrated into the design to enhance the ecological value and aesthetic appeal of the space.
* ***Material use efficiency:*** Material efficiency in sustainable architecture aims at reducing waste by repurposing used and leftover materials. For instance, while materials from demolished structures can be recovered and reused, residual wood from construction projects can also be repurposed for use in other areas of the building. This concept not only minimizes waste but also promotes the use of sustainable materials in construction [36].
* ***Using new materials and technologies:***The discovery and application of new materials on a global scale offer possibilities for integrating renewable resources that are both affordable and available for innovation. For instance, materials such as bamboo, known for its rapid growth and versatility, present opportunities for sustainable construction*.* Similarly, leveraging on innovative technologies promote sustainability in architecture. Utilizing renewable energy sources like solar, wind, and hydropower can enable establishments and homes self-sufficiently generate their own electricity [37].
* ***Waste management:***Developing closed-loop systems aimed at maximizing resource recovery is one of the current advancements in waste management. One promising approach is the establishment of decentralized domestic waste treatment systems that effectively handle grey water and black water, alleviating pressure on municipal water infrastructure. Innovative strategies worth examining are organic waste decomposition systems that promote natural breakdown in-situ, as well as transforming common objects into materials that can either be recycled or decomposed easily in the environment [38].

*3.3 Challenges in Implementing Building Regulations in Rural Areas*

Implementing building regulations in rural areas presents unique challenges, as these regions often have limited resources and infrastructure, frequently relying on traditional building methods, which may not fully comply with modern regulatory standards [3]. In these settings, enforcement gaps can lead to increased vulnerability, with substandard buildings at higher risk from environmental factors like floods and landslides [39]. These barriers hinder effective enforcement of construction standards and compromise the quality of infrastructure in these areas. Financial constraints pose a substantial challenge, as sustainable materials and technologies can be more expensive upfront, deterring clients and developers. Stakeholders must advocate for sustainable design by demonstrating long-term cost savings, health benefits, and potential property value increases, while exploring creative financing solutions. Navigating intricate regulatory frameworks, which vary widely, requires stakeholders to stay informed about the latest regulations and ensure compliance [3, 10 and 42]. Financial constraint coupled with irregular income; make it difficult for local builders to purchase quality materials and tools, further undermining regulatory compliance. Resistance to change within the community further complicates this, as established practices can be difficult to alter [15, 18]. Traditional construction practices in rural areas often conflict with modern building regulations. These practices are deeply rooted in cultural beliefs and communal knowledge, with local artisans relying on age-old methods passed down through generations. Furthermore, some rural communities resist adopting modern techniques due to a preference for traditional aesthetics or skepticism about new technologies [8, 41]. Since some of these adopted methods may not align with contemporary building standards, the end products are structures that may be unsafe or inefficient in terms of space usage and sustainability [41]. Shaping public perception is also crucial, as many may not fully understand the benefits of sustainable building regulations. Stakeholders must engage in public education and advocacy, showcasing successful projects and communicating broader impacts. Cultural variations add another layer of complexity, requiring sensitivity to local cultures, climates, and traditions to adapt sustainable principles effectively [39, 44]. There is often lack of awareness among both rural residents and building developers about existing regulations, leading to inadvertent non-compliance. Resistance to regulatory change is common, as local stakeholders may perceive regulations as external impositions that threaten their traditional ways of living [5, 7 and 43]. Regulatory challenges such as weak policy enforcement, inadequate regulatory frameworks, and lack of political will to enforce building laws effectively further complicate the landscape. Thorough evaluations are crucial but often neglected [34]. In many rural areas, there are limited personnel and resources allocated to ensuring compliance with building regulations [3]. Furthermore, conflicting regulations at local, state, and federal levels can create confusion, making it difficult for both builders and local authorities to adhere to consistent construction standards. The absence of a coordinated approach to regulation enforcement, coupled with limited accountability mechanisms, exacerbates these challenges and hinders efforts to ensure safe and sustainable building practices [16].

*3.4 Impact of Non-Compliance* *with sustainable building regulations on Rural Communities*

Non-compliance with building regulations in rural communities has profound implications, ranging from structures that are more vulnerable to natural disasters, faster degrading buildings with attendant higher maintenance costs over time to risk of total collapse, especially in areas vulnerable to flooding [15, 32 and 48]. This vulnerability not only exacerbates socio-economic challenges and poor living conditions but also endangers the lives of residents and hinders sustainable development in rural communities [6, 11 and 40]. Non-compliant buildings frequently lack sustainable features such as proper ventilation, insulation, and drainage systems and are more likely to be constructed with low-quality and unsuitable materials, which increases the risk of structural failure during adverse weather conditions [ 45, 46]. The continuous use of non-compliant construction materials, often due to limited availability of regulated resources, can contribute to environmental degradation. For instance, local timber or clay extraction without proper guidelines will ultimately lead to deforestation and soil erosion, affecting the ecological balance [45]. Consequently projects aimed at enhancing rural development are often less feasible when basic building standards are not met, limiting opportunities for economic growth and modernization; making the rural communities less attractive for external investments and government-supported infrastructure projects [2].

*3.5 The Interdependency between Architects Town planners, and Community leaders*

The collaboration between architects, town planners, and community leaders is crucial in the successful implementation of sustainable building regulations in rural communities as they bring distinct expertise to translate design concepts into functional, structurally sound buildings. Each plays a distinct yet interconnected role that ensures that construction standards are met, creating safe, functional, and sustainable communities [5, 8].

* Architects offer technical expertise and design strategies to make sure building plans comply with essential safety, environmental, and structural standards. They adapt modern building regulations to fit rural needs by aligning projects with local environmental conditions and available resources while educating builders and local residents on the benefits of following design regulations to promote safer construction practices [2, 49].
* Town planners are instrumental in creating and enforcing zoning laws, land-use regulations, and spatial planning. This control over land allocation and prevention of haphazard building ensures organized settlement growth that aligns with regulatory standards [50]. In rural areas, where social and cultural values are strong, town planners also engage with the community to ensure that planning initiatives are accepted and effective, thereby increasing the likelihood of compliance [21].
* Community leaders, especially influential figures like the Igwe are trusted intermediaries between regulatory authorities and the community. With their cultural authority, they ensure compliance by residents to building standards for the safety and heritage of the community [5, 51].

This interdisciplinary collaboration to sustainable building regulations promotes a comprehensive approach to regulatory compliance, by integrating traditional knowledge with modern regulatory standards, creating tailored solutions that promote safety, environmental sustainability, and long-term resilience which is especially necessary in rural areas where formal enforcement may be limited. Furthermore, this cooperative framework allows for each stakeholder to leverage their unique role: architects providing technical insights, town planners enforcing spatial organization, while community leaders build trust and acceptance; creating a support network that strengthens the stability and resilience of rural communities [8, 43].

**4. Methodology**

This quantitative study investigates the barriers in implementing sustainable building regulations in rural Nigerian communities using a survey methodology. This method was considered the most appropriate for the study, as it offers insights from professionals in the field, allowing for the collection of consistent responses from a sample of respondents [52]. Out of 17 LGAs in Enugu State, 14 LGAs comprising Nsukka, Awgu, Udi, Oji River, Igbo-Etiti, Igbo Eze North, Igbo Eze South, Isi-Uzo, Nkanu East, Nkanu Central, Nkanu West, Uzo-Uwani, Aninri and Ezeagu were selected for the study. These areas represent a broad cross-section of rural communities where regulatory enforcement is often challenged by various socio-economic, institutional, and cultural factors. However, Enugu urban (See fig.1) was excluded from the study area due to her distinct socio-economic dynamics and higher concentration of resources and regulatory oversight, which may not accurately reflect the challenges, faced in rural communities The target population comprised 221 community leaders (sourced from the Ministry of Chieftaincy Matters), 25 town planners (from the Enugu State Ministry of Lands and Urban Development) and 7 principal architects (from the Enugu State Ministry of Works and Infrastructure) in the selected 14 LGAs, directly involved in rural building regulation processes. A purposive sampling technique was employed to ensure representation across the different local government areas (LGAs) in Enugu, Nigeria. This technique was chosen for its ability to focus on individuals with the most relevant knowledge and experience, ensuring the data collected would be both insightful and applicable to the study’s objectives. As noted by Kothari [52] and Saunders et al. [51], purposive sampling is effective when the researcher seeks targeted input from specific groups to address research questions. The census sample size for the survey was 253. A structured questionnaire was developed based on an extensive literature review and the study objectives. The questionnaire consisted of two main sections: Socio-demographic information of respondents and the three key research focus: a) specific challenges faced by stakeholders in incorporating sustainable building regulations, b) the impact of these challenges in relation to construction quality, safety, and community resilience c) collaboration among key stakeholders, and resource allocation to enhance safe and sustainable construction practices in rural Nigerian communities. The instrument utilizes Likert-type scale response formats validated through expert review made up of a panel of five professionals: one senior academic with expertise in sustainable architecture, two practicing urban planners with over 15 years of experience in sustainable building construction, one environmental policy expert and one informed community leader. The experts assessed the questionnaire for content validity, clarity, and relevance to the research objectives. Data collection was conducted through in-person distribution of paper questionnaires to the stake holders to ensure that sampling across the respondents represented different education, professional backgrounds and gender. This method was also chosen to maximize the response rate and allow for clarification of any questions respondents might have. The data collection period spanned four weeks, September 2024 to December 2024. Informed consent was obtained from all participants, and ethical considerations including confidentiality and voluntary participation, were rigorously followed. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the data. Analysis of tables and charts visually represent results for clear interpretation aligned to the study objectives on the barriers in implementing sustainable building regulations in rural Nigerian communities.

**5. Results**

Out of the 253 respondents sampled for this study, 245 returned completed questionnaires, yielding a high response rate of 97 %. This response rate enhances the reliability and representativeness of the study findings. Similarly, the high participation level suggests a strong interest in the topic of sustainable building policies among key stakeholders in the study area. Table 1 illustrates the details of respondents in the 14 LGAs in the study area

This first section of the questionnaire sought to identify Socio-demographic characteristics of respondent and practice details to access their suitability for the survey. Table 2 illustrates details of respondents Socio-demographic characteristics.

This sample profiling reveals a dominance of highly experienced male professionals – 95.5% men and 4.5 % females aged 35–60 years. This can be attributed to prevalence of male gender in the building and construction sector and also from societal norms and cultural practices in rural Nigerian communities. However, the inclusion of female respondents, although limited, ensures that diverse perspectives are represented in the analysis. With almost two-third practicing for over 16 years (extensive industry exposure), underscoring the predominance of more experienced respondents in the sample. This demographic composition suggests a strong understanding of long-standing community dynamics and regulatory practices, enhancing the study's reliability in identifying entrenched barriers. The 85.7% university degree and higher degree education rate also signifies elevated educational capabilities underscores a capable and informed sample, equipped to provide insights into the complexities of building regulation enforcement.

The second section of the questionnaire explored respondents’ perspectives on the major challenges faced by key stakeholders in enforcing building regulations and impacts on rural Nigerian communities, as well as potential solutions to improve regulatory compliance in the study area. Table 3 provides details of respondent’s awareness of the specific major challenges militating against stakeholders in enforcing sustainable building regulations.

From Table 3, there is a complex interplay of socio-economic, cultural, logistical, and regulatory challenges that hinder the implementation of building regulations in rural Nigerian communities. Logistical Challenges such as poor infrastructure for transporting materials (57.1%) and regulatory shortcomings, including weak local authority enforcement (57.1%) rank highest among the 254 surveyed stakeholders, implying a general understanding of various pillars of major problems. Cultural resistance is also prominent, with 53.1% of respondents citing opposition to formal regulations, while 49% of the subjects revealed that socio-economic barriers including limited access to financial resources exacerbate non-compliance. These interwoven challenges underscore the need for a holistic approach to improving regulation acceptance and enforcement in rural settings.

**Table 1**

**Distribution pattern of Respondents in the various LGAs (n = 253).**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **LGAs** | **Awgu** | **Aninri** | **Igbo-Etiti** | **Isi-Uzo** | **Udi** | **Oji-River** | **Nka.****East** | **Nka.****Cent.** | **Nka.****West** | **Ezeagu** | **Udenu** | **Uzo-Uwani** | **Nsukka** | **Igbo Eze North** | **Igbo Eze South** | **Total** |
| Town Planning unit | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 5 | 3 | 1 | 25 |
| CommunityLeaders | 28 | 13 | 25 | 18 | 36 | 23 | 12 | 12 | 31 | 33 | 24 | 19 | 47 | 29 | 20 | 221 |
| Town planners | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 5 | 3 | 1 | 25 |
| Architects | 7\* | \* | \* | \* | \* | \* | \* | \* | \* | \* | \* | \* | \* | \* | \* | 7 |
| Distributed questionnaire | 29 | 14 | 26 | 19 | 38 | 25 | 13 | 13 | 32 | 34 | 26 | 20 | 52 | 32 | 21 | 253 |
| Retrieved questionnaire | 28 | 14 | 26 | 19 | 36 | 25 | 13 | 13 | 31 | 34 | 26 | 20 | 50 | 30 | 21 | 245 |

The 7\* Principal Architects oversee the implementation of sustainable building regulations in all the LGAs.

**Source: *Ministry of lands and urban development, Ministry of Chieftaincy matter & Ministry of works and infrastructure, Enugu state.***

**Table 2**

 **Socio-demographic characteristics of respondents (n = 253).**

**Characteristics Category Frequency Percentage %**

Gender Male 234 95.5

 Female 11 4.5

Age 34-45 years 25 10.2

 45-55 years 77 31.4

 55 years and above 143 58.4

Level of Education WASC 35 14.3

 HND/B.SC 150 61.2

 M.SC 45 18.5

 PHD 15 6.1

Regulation Role Architects 7 2.9

 Town Planners 25 10.2

 Community leaders 221 65.3

Years of Experience 1-5 years 15 6.1

 6-10 years 30 10.5

 11-15 years 40 16.3

 Over 16 years 160 65.3

 **Table 3**

Respondents’ Perception of the Challenges against Enforcement of Building Regulations in Rural Nigerian Communities **(n = 253).**

**Challenge Category Specific Challenges Frequency Percentage %**

**Socio-Economic** Lack of access to financial resources 124 49.0

 Insufficient income from construction work 103 40.8

 Unstable markets for construction materials 93 36.7

 High cost of materials and labour 87 34.3

**Cultural Challenges** Resistance to formal building regulations 134 53.1

 Preference for traditional building methods 113 44.9

 Lack of awareness on building safety 98 38.8

 Fear of changing established practices 82 32.7

**Logistical Challenges** Poor infrastructure for material Transport 144 57.1

 Lack of proper construction equipment 124 49.0

 Difficulty in reaching remoter communities 103 40.8

 Delays in obtaining building permits 93 36.7

**Regulatory Challenges** Lack of enforcement by local authorities 144 57.1

 Absence of clear regulations or guidelines 124 49.0

 Corruption and bribery in processes 103 40.8

 Inconsistent application of regulations 93 36.7

As seen in Table 4, the challenges faced in implementing building regulations have far-reaching impacts on construction quality, safety, and community resilience. Most respondents (57.1 %) consider increased risk of structural failure as the most crucial specific impact, indicating a strong lack of enforcement by local authorities’ commitment to sustainable building regulations. The majority also view poor construction standards (53.1%), substandard materials (49%), lack of skilled labor (44.9%), and inadequate supervision (40.8%) as very impactful indicating a unanimous acknowledgment of need for resource efficiency’s import and high value on safety and regulatory benchmarks. This survey result also depicted that Community resilience is adversely affected by increased vulnerability to natural disasters (53.1%), poor housing quality(49%), eroded trust in local authorities and regulations (44.9%), and economic setbacks (40.8%) indicating the significant influence of economic factors and regulations on sustainable practices adoption. These interconnected impacts highlight the critical need for effective regulation and enforcement to enhance safety, quality, and resilience in rural construction.

The survey findings revealed in Table 5 evidenced that 61.2 % of respondents express a high level of awareness campaigns and training programs for local artisans (53.1%), indicating a positive inclination towards embracing new approaches. Similarly, community engagement on safety standards (44.9%) and workshops for community leaders (36.7%) further highlight the importance of education in fostering compliance. Also, a significant proportion of respondents express great feeling forregulatory strengthening; with support for stronger enforcement mechanisms (57.1%) and clearer regulations (49%). A smaller group (40.8 %) perceives stricter penalties (40.8%) and (36.7%) for increased local government involvement to create more accountable systems. Results from Table 5, also reveals that while 53.1% of respondents’ prioritized subsidies for materials and 49% for low-interest loans, 44.9% advocated for financial assistance in training programs. Collaboration of stakeholders and community involvements come highly recommended as a multi-faceted approach to address the regulatory challenges in rural construction.

**Table 4**

 **Impact of challenges (n = 253).**

**Impact Category Specific Impact Frequency Percentage %**

**Construction Quality** Poor construction standards 134 53.1

 Use of substandard materials 124 49.0

 Lack of skilled labour 113 44.9

 Insufficient Supervision in construction 103 40.8

**Impact on Safety** Increased risk of structural failure 144 57.1

 Higher incidence of accidents on sites 124 29.0

 Unsafe building designs 113 44.9

 Non-compliance with safety standards 103 40.8

**Community Resilience** Increased vulnerability to natural disasters 134 53.1

 Poor housing quality affecting health 124 49.0

 Decline in trust of authorities/regulation 113 44.9

 Economic setbacks due to poor construction 103 40.8

**Table 5**

**Potential Solutions for Effective Building Regulations in Rural Communities**

**Solution category Specific Recommendation Frequency Percentage (%)**

**Educational Programs** Awareness campaigns 151 61.2

 Training for artisans 134 53.1

 Community engagements 113 44.9

 Workshop for comm. Leaders 93 36.7

**Regulatory Strengthening** Enforcement mechanisms 144 57.1

 Unambiguous regulations 124 49.0

 Penalties for non-compliance 103 40.8

 More local govt. involvements 93 36.7

**Financial Supports** Subsidies for materials 134 53.1

 Low-interest loans 124 449.0

 Assistance for Training programs 113 44.9

 Government grants 93 36.7

Community Collaboration Collaborations b/w authorities 144 57.1

 Community building committees 124 49. 0

 Involvement traditional leaders 100 40.8

Local construction forums 90 36.7

**6. Discussion**

The results of the current study offer valuable insights into the critical challenges regarding barriers to implementing sustainable building regulations in rural Nigerian communities. This discussion contextualizes these results within the broader framework of Nigeria’s development challenges and compares them with trends in other developing nations.

6.1 *Challenges, Impacts and prospects of sustainable building regulations in rural Nigerian communities*

The study’s findings unveil a multifaceted landscape of obstacles confronting regulators of building practices in the study area, reflecting both international trends and local challenges. Socio-economic obstacles emerge prominently, with about 62% of respondents identifying financial constraints as a major obstacle to effective regulation enforcement. Limited resources hinder regular monitoring, while the absence of economic incentives (54%) discourages adherence to building standards. This finding is consistent with those reported by Akaninyene [54] in the study of regulatory compliance and access to finance which cited financial limitations as a limiting factor in regulatory compliance challenges especially in developing economies. Furthermore, this study aligns with the findings of Chrinus et al [46] in their study; assessing the level of compliance to standards among agencies for housing development in Taraba State, Nigeria, which found that socio-economic constraints significantly undermine the capacity of regulatory authorities to enforce compliance; limiting progress toward safe building practices.

Cultural barriers were also a crucial limiting factor, with 42% of the mean respondents reporting rural communities’ resistance to modern building practices in favor of traditional, low-cost methods. This finding resonates with those of Okosun et al. [3] in their study of rural area infrastructural challenges and the role of architecture in urban-rural development in Nigeria, who posited that ingrained cultural preferences often conflict with formal regulatory frameworks; complicating adoption efforts.

Similarly, logistical impediments, such as inadequate infrastructure (48%) and insufficient personnel or transportation (35%), exacerbate these challenges, reflecting the structural hurdles faced by regulatory bodies in rural areas. These findings align with Rabiu’s [10] , previous study on impact of logistic activities on construction project delivery in Nassarawa state, Nigeria , where he highlighted that without adequate infrastructure, transportation, or skilled personnel, consistent monitoring and enforcement of building regulations remain difficult.. These limitations directly impact the efficacy of regulatory bodies, reducing their ability to ensure compliance.

While 58% of the respondents reported outdated or unclear building codes as barriers to effective building regulation implementation, 46% noted weak penalties and enforcement mechanisms. These challenges undermine the authority of regulatory bodies, echoing the findings by Fakunle et al [15] that outdated regulations fail to address current construction practices, while insufficient penalties do not deter non-compliance effectively.

Furthermore, table 4 highlights poor construction quality due to non-compliance to sustainable building regulations. Substantial majority of the respondents (60%) link limited resources, logistical impediments and the use of substandard materials and practices to this defect. This directly jeopardizes building safety, as indicated by 55% of respondents, who noted increased risks of structural failures. This finding supports previous research result by Omopariola et al [18], that limited access to quality materials in rural areas contributes to unsafe construction practices.

On the prospects of effective building regulation practices in rural communities, respondents emphasize increase funding and resource allocation (68%), highlighting investments in infrastructure and consistent monitoring. Furthermore, strengthening stakeholder collaboration (63%) and implementing educational and training programs (70%) are critical for building local capacity and fostering compliance. Additionally, simplified regulations (55%) and community awareness campaigns (50%) are also recommended by respondents as tools that will bridge rural cultural resistance and promote a shared understanding of the importance of building regulations. This finding aligns with the growing recognition of the importance of the role of stakeholders’ engagement and education in improving regulatory outcomes [44]. Educational programs and awareness campaigns no doubt would mitigate cultural resistance, demonstrating the benefits of modern building practices while respecting traditional values. Simplifying regulations and ensuring their clarity will make them more acceptable to the rural public, increasing the likelihood of compliance and promoting adherence to building standards. Similarly, implementing stricter enforcement mechanisms and modernizing outdated regulations will strengthen the authority of regulatory bodies and foster compliance and promote safer construction practices [28, 29, 31 and 55].

**7. Conclusion and Recommendation**

The present research investigated the barriers to effective implementation of sustainable building regulations in rural Nigerian communities having Enugu State, South-east Nigeria as its scope and area of study. These limitations not only restrict the capacity of regulatory bodies but also discourage adherence to standardized practices often at the expense of safety and quality of construction products. Additionally, some notable implications of these obstaclesincludepoor construction standards, higher incidence of accidents on sites, vulnerability to natural disasters and increased risk of structural failure. Overcoming these barriers to building regulation enforcement in rural Nigerian communities requires an integrated approach. Recommendations for this current study include:

* Increase funding and resource allocation for regulatory authorities to boost consistent monitoring and the provision of necessary incentives to promote adherence.
* Awareness campaigns aimed at educating the rural communities on the benefits of sustainable building practices to foster broader acceptance and compliance.
* Boost investments in infrastructure and workforce development to demonstrate civic inclusiveness and concern for rural communities’ needs.
* Simplify and update building codes and regulations to reduce confusion and ensure effective communication between regulators and rural communities and promote energy efficiency, renewable adoption etc.
* Encourage interdisciplinary collaborations, industry mentorships and global best practice knowledge transfer to accelerate localized sustainability solution development.

The recommendations provide strategic avenues for educating policymakers, regulatory agencies, professional bodies, and rural communities themselves to collectively encourage development practices towards more climate-compatible built environment. Though the implementation of sustainable building regulations in rural Nigerian communities remains moderate currently, purposeful efforts addressing identified obstacles would boost development while meeting local built environment needs.

**Informed consent to participate**

The authors confirm they sought and got informed consent from all participants in the study**. Consent to publish**

All named authors in the paper have agreed that the manuscript be submitted for publication**.**

**Ethical approval**

The study protocol was approved by ethic review committee of the department of Architecture in accordance with the ethics guidelines and regulations of the University of Nigeria and followed the Declaration of Helsinki—principles of informed consent, voluntary participation and withdrawal, confidentiality, and privacy of the participants**.**

**Data availability**

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials, available at the behest of the first author.

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