

Evaluating Vernacular and Modern Sustainable Architectural Strategies for Climate Change Adaptation and Disaster Resilience in Shendam, Plateau State

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DOI: <https://doi.org/10.5281/zenodo.17663678>

Article History	Abstract
Original Research Article	<i>This study examined the role of vernacular and modern sustainable architectural strategies in climate change adaptation and disaster resilience in Shendam Local Government Area (LGA), Plateau State. The objectives were to assess the relevance and effectiveness of vernacular architecture, evaluate perceptions of modern sustainable architecture, and explore local perceptions of climate change adaptation and disaster resilience strategies. Four research questions and two research hypotheses guided the study. A quantitative survey research design was adopted, utilizing a structured questionnaire of 40 items with a modified 4-point Likert scale to gather data from 150 participants, including 12 architects, 7 urban planners, and 131 community residents. Stratified random sampling technique ensured a representative sample from both urban and rural areas. Data were analyzed using descriptive statistics and simple linear regression analysis. The instrument reliability estimates ranged between 0.79 and 0.72. Validity of the items were ensured by experts in the fields of measurement and evaluation, architecture and urban planning. The findings revealed that vernacular architecture, with its climate-responsive designs and locally sourced materials, remains highly effective in promoting sustainability and disaster resilience. Respondents also supported the integration of modern sustainable architecture, citing benefits such as energy efficiency and the ability to withstand extreme weather. However, the high costs associated with modern technologies posed a barrier to widespread adoption. The study recommended that a hybrid approach, combining both vernacular and modern strategies, offers the most sustainable solution to the region's climate and disaster challenges.</i>
Received: 13-11-2025	
Accepted: 18-11-2025	
Published: 20-11-2025	
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Citation: Akpan, Boniface Ekarika; Tolulope Dorcas Mobbolade-Solomon; Yusuf Abdulkarim Abdullahi. (2025). Evaluating Vernacular and Modern Sustainable Architectural Strategies for Climate Change Adaptation and Disaster Resilience in Shendam, Plateau State. UKR Journal of Multidisciplinary Studies (UKRJMS). Volume 1(9), 73-83.	Keywords: Vernacular Architecture, Modern Sustainable Architectural Strategies, Climate Change, Adaptation, Disaster Resilience.

Introduction

Climate change is altering rainfall patterns, intensifying temperature extremes, and increasing the occurrence of disaster events worldwide. Consequently, buildings and settlements must not only minimize their environmental impact but also adapt to hazards induced by climate change. Research indicates that the built environment, particularly in regions sensitive to climate variations, is under increasing pressure to improve both adaptation and resilience (Dimuna, Ekhaese, & Ndimako, 2024). In Africa, vernacular architecture developed over generations with locally sourced materials and climate-responsive designs

provides passive cooling, natural ventilation, and other sustainable features (Akpami, 2023). However, contemporary sustainable architectural methods that depend on advanced materials and technologies may neglect local climatic, cultural, and ecological factors, highlighting the necessity to merge both approaches (Umana, Garba, Ologun, & Umar, 2024).

In the context of Shendam in Plateau State, Nigeria, this study aimed to assess how vernacular and modern sustainable architectural strategies interact to facilitate

climate change adaptation and disaster resilience. “Vernacular strategies” denote indigenous building practices, materials, and designs influenced by local climate, culture, and history; whereas “modern sustainable strategies” refer to contemporary technologies, materials, and design codes intended to mitigate risk and bolster resilience. The two categories of strategies are interrelated: vernacular elements provide insights for modern approaches by presenting locally validated climate-responsive solutions, while modern strategies can incorporate vernacular knowledge to improve performance in the face of emerging climatic challenges (Akhanolu & Ahianba. 2025). This interaction between vernacular and modern design serves as an independent variable (architectural strategy), affecting the dependent variables of climate change adaptation and disaster resilience within the built environment of Shendam.

Vernacular architecture, deeply intertwined with local traditions and materials, plays a vital role in shaping our built environment, especially in places where modern construction methods are hard to come by (Walker, 2018). Considering Shendam Local Government Area (LGA) in Plateau State, Nigeria, for instance; it is a fascinating example of how indigenous architectural practices can lead to sustainable building solutions. The region’s unique climate and geography create the perfect backdrop for exploring the relevance, effectiveness, and sustainability of vernacular architecture. These architectural styles, honed over centuries, reflect a deep understanding of the local environment and offer valuable insights into climate-responsive building practices that often get overlooked in modern designs (Obia & Itam, 2019)

The challenges brought on by climate change and the increasing frequency of environmental disasters have made it essential to rethink sustainable building practices around the globe. In Shendam LGA, the adverse effects of climate change, such as prolonged droughts and flooding, highlight the need to reconsider both traditional building methods and modern sustainable designs. While modern architecture is often seen as a solution to environmental issues, it has faced criticism for its high energy consumption and reliance on non-renewable materials (Akpami, 2023). This is where vernacular architecture comes into play, utilizing locally sourced materials and passive design strategies that could offer more environmentally friendly alternatives.

As climate change continues to take its toll, communities around the world are increasingly focused on finding ways to adapt. In Shendam LGA, residents are becoming more aware of the urgent need for climate adaptation efforts. This research delved into how the community perceives these strategies, looking at their understanding of how both traditional and modern architectural designs can help

reduce environmental risks. Key adaptation measures like water conservation systems, green roofs, and using locally sourced building materials are crucial for lessening the community's vulnerability to environmental challenges. Additionally, these strategies aimed to strengthen the resilience of buildings, making sure they can withstand flooding, extreme heat, and other climate-related threats (Smith, Lee & White. 2021).

When we talk about disaster resilience in architecture, we are referring to how well buildings can withstand and bounce back from natural disasters. In Shendam LGA, where flooding and other natural calamities pose a significant risk, adopting disaster-resilient designs is essential. This study explored the community's perspectives on disaster resilience, examining how both modern and traditional architectural methods can help lessen the impact of disasters. Traditional architecture, known for its use of durable, natural materials and local environmental insights, has great potential to boost disaster resilience in Shendam (Giddens, Harris & Miller. 2017).

Several empirical studies have been conducted in the areas of vernacular, modern architecture and hybrid strategies that could mitigate climate resilience. However, the current research on hybrid architectural strategies provides relevant insight and reveals a significant gap in long-term effectiveness evidence of architectural practices in Shendam Local government area. Investigating the effectiveness of various climate adaptation strategies in building design, Iwayemi, Daramola, Taiwo, & Olaoye, (2024) conducted a study in Ayetoro community in Ondo State, Nigeria. Using a quantitative research design, the authors employed a self-administered questionnaire to gather data from 379 respondents. The instrument was validated with a Cronbach’s alpha of 0.878, and the survey addressed adaptation strategies related to climate resilience in building forms. Findings indicate that strategies such as raising ground-floor levels, fortifying houses with barriers, and positioning valuable items on elevated platforms were seen as effective. Conversely, strategies like permanent relocation or drain construction were deemed ineffective. This study highlights the role of vernacular adaptation strategies in ensuring resilience, though it does not explicitly examine the comparison with modern architectural strategies. The study’s relevance to the present research lies in its focus on climate adaptation strategies, which can be juxtaposed with modern architectural approaches in Shendam.

Exploring the environmentally responsive design of the Makoko Floating School, Okeke, Chukwuali, & Idoko (2019) focused on Makoko, a waterfront community in Lagos, Nigeria. This study used a descriptive research design and collected secondary data along with field

surveys of the floating school's architectural form. The research highlights how vernacular techniques, such as the use of local materials, stilts, and floating platforms, contribute to climate adaptation in a flood-prone environment. The findings suggested that these strategies effectively mitigate flooding, a key concern for the Makoko community. This case study emphasizes how vernacular architecture designed with local knowledge and materials responds to the challenges posed by climate change, particularly flooding. While the study is not situated in Plateau State, its insights into vernacular resilience can be adapted to this present research work on the comparative analysis between vernacular and modern sustainable strategies in Shendam.

Mba, Okeke, Igwe, Ozigbo, & Oforji (2024) examined modern architectural practices in Enugu Metropolis, Nigeria, and explored how sustainability is integrated into the design process. The study used a quantitative survey method with a structured questionnaire administered to 126 registered architectural firms. Statistical analysis using Pearson's correlation revealed that while awareness of sustainable design practices was high, actual implementation was inconsistent due to barriers such as high costs and lack of regulatory support. The study's findings underscore that while modern architects are aware of sustainability concepts, the challenges of adoption and implementation remain significant. This study provides useful insights into the barriers faced by contemporary architects in Nigeria and can help contextualize the challenges faced in adopting modern sustainable strategies in Shendam.

Also, Akpami (2023) examines the integration of vernacular architecture into modern urbanization strategies. The research focused on three case studies from Nigeria: Makoko (Lagos), Osun Sacred Grove, and Zaria in Kaduna State. A qualitative case-study approach was used, with data collected through spatial analysis, field observations, and the study of traditional architectural forms and materials. The findings suggest that vernacular architecture offers key lessons for modern urban planning, particularly in terms of climate responsiveness, sustainability, and local material use. The study argues that modern urban development in Nigeria could benefit significantly from incorporating vernacular strategies, especially in areas vulnerable to climate change. This research directly informs this present research study by offering a framework for integrating both vernacular and modern sustainable strategies to improve climate adaptation and resilience in Shendam.

The problem addressed by this study lies in the challenges faced by Shendam Local Government Area (LGA) in Plateau State, Nigeria, where both climate change and environmental disasters are increasingly affecting the

region. Vernacular architecture, deeply rooted in local traditions and sustainable building practices, offers a potential solution to these challenges. (Ajayi, Adededeji & Goh, 2019). However, the relevance, effectiveness, and sustainability of these traditional building methods, which are closely aligned with local environmental conditions, are often overshadowed by modern construction techniques. As Shendam faces prolonged droughts, flooding, and other climate-related issues, there is a pressing need to reassess both vernacular and modern architectural practices. This study seeks to explore the community's perceptions of the potential of vernacular architecture to address contemporary issues such as climate change adaptation and disaster resilience, while also evaluating how modern sustainable designs align with these local strategies for building resilience.

This study aimed at examining the ongoing importance of these traditional structures and their potential to address contemporary challenges in Shendam LGA, particularly in the face of climate change and disaster resilience. It also assessed how perceptions of modern sustainable architecture align with the realities of adapting to climate change and enhancing disaster resilience in Shendam LGA. Further, it sought to bridge the gap between traditional and modern architectural approaches in Shendam LGA, with the goal of enhancing climate adaptation and disaster preparedness in the region. The following objectives translated into the research questions and hypotheses that guided the study:

1. To examine the relevance, effectiveness, and sustainability of vernacular architecture in Shendam LGA.
2. To assess the perceptions of architects, planners and community residents with regards to modern sustainable architecture and its effectiveness in addressing climate change, disaster resilience, and socio-economic challenges in Shendam LGA.
3. To review the perceptions of architects, planners and community residents toward climate change adaptation strategies in Shendam LGA.
4. To examine the perceptions of architects, planners and community residents toward disaster resilience in Shendam LGA.

Research Questions

1. What is the relevance, effectiveness, and sustainability of vernacular architecture in Shendam LGA?
2. What are the perceptions of architects, planners and community residents with regards to modern sustainable architecture and its effectiveness in addressing climate change, disaster resilience, and socio-economic challenges in Shendam LGA.

3. What are the perceptions of architects, planners and community residents toward climate change adaptation strategies in Shendam LGA.
4. What are the perceptions of architects, planners and community residents toward disaster resilience in Shendam LGA.

Hypotheses

1. There is no significant relationship between Vernacular Architecture and Climate Change Adaptation in Shendam Local Government Area (LGA).
2. There is no significant relationship between Modern Sustainable Architecture and Disaster Resilience in Shendam Local Government Area (LGA).

Methodology

The study adopted a quantitative survey research design, focusing solely on statistical analysis to evaluate the impact of vernacular and modern sustainable architectural strategies on climate change adaptation and disaster resilience in Shendam Local Government Area (LGA), Plateau State. The primary data collection method was a structured survey using a 40-item set of statements adopting a modified 4-point Likert scale ranging from strongly agree (SA=4) to strongly disagree (SD=1) to assess the effectiveness of architectural strategies in terms of sustainability and resilience. The survey was divided into four sections: Vernacular Architecture (Independent

Variable), Modern Sustainable Architecture (Independent Variable), Climate Change Adaptation (Dependent Variable), and Disaster Resilience (Dependent Variable). A total of 150 participants, including 12 architects, 7 urban planners, and 131 residents of Shendam Local government area, were selected through stratified random sampling to ensure a diverse representation of the population, drawn from both urban and rural areas within Shendam LGA. The instrument was validated by experts in the field of measurement and evaluation, architecture, building and planning and the reliability indices yielded coefficients of 0.79, 0.76, 0.72 and 0.74 respectively. Data were analyzed using descriptive statistics, including mean, standard deviation, and simple linear regression analysis. This approach provided a comprehensive statistical evaluation of how these strategies contribute to climate adaptation and disaster resilience. Ethical considerations were strictly followed, ensuring the confidentiality and voluntary participation of all respondents. Informed consent was obtained from all participants, with an emphasis on their right to withdraw from the study at any time without penalty.

Presentation of Results

Research question 1: What is the relevance, effectiveness, and sustainability of vernacular architecture in Shendam LGA?

Table 1: Relevance, effectiveness, and sustainability of vernacular architecture

No.	Question	N	$\bar{X}$	SD	Remark
1.	Vernacular architecture has been effective in adapting to the local climate in Shendam LGA.	150	3.41	0.63	Agree
2.	The use of local materials in vernacular buildings contributes to energy efficiency.	150	3.52	0.58	Agree
3.	Vernacular architectural strategies enhance disaster resilience in Shendam LGA.	150	3.47	0.60	Agree
4.	Vernacular buildings provide better thermal comfort compared to modern structures.	150	3.38	0.66	Agree
5.	Traditional building techniques are more affordable for local communities than modern alternatives.	150	3.44	0.59	Agree
6.	The sustainability of vernacular architecture is supported by its minimal environmental impact.	150	3.57	0.55	Agree
7.	Vernacular architecture is well-suited for the local climate and weather conditions in Shendam LGA.	150	3.49	0.62	Agree
8.	There is a growing interest in preserving vernacular architectural knowledge in Shendam LGA.	150	3.36	0.69	Agree
9.	Vernacular architecture contributes significantly to the cultural identity of Shendam LGA.	150	3.61	0.52	Agree
10.	Vernacular architecture can be easily adapted to meet the current needs of climate change adaptation.	150	3.54	0.57	Agree

Criterion mean value = 3.00.
Mean values above 3.00 indicate agreement.
Mean values below 3.00 indicate disagreement.
Mean values equal to 3.00 indicate indifference

Table 1 presents respondents' views on the relevance, effectiveness, and sustainability of vernacular architecture in Shendam LGA. With a criterion mean of 3.00, all items recorded mean values above this threshold, indicating widespread agreement among the 150 respondents that vernacular architecture plays a significant role in shaping climate-responsive and culturally rooted building practices in the area. Responses show strong support for the effectiveness of vernacular architecture in adapting to the local climate, as reflected by the mean score of 3.41 for item 1. Similarly, the use of local materials is perceived to contribute substantially to energy efficiency ($\bar{X} = 3.52$), highlighting the environmental benefits of traditional construction approaches. The respondents also agreed that vernacular architectural strategies enhance disaster resilience ($\bar{X} = 3.47$), suggesting that traditional building methods are considered structurally reliable under prevailing environmental conditions. Thermal comfort emerged as another key strength of vernacular buildings, with a mean of 3.38, indicating that respondents perceive these structures as more suited to local weather patterns than modern alternatives. Affordability was also highly rated ($\bar{X} = 3.44$), underscoring the economic advantages of traditional building techniques, which rely on readily available local resources. The sustainability of vernacular architecture, supported by its minimal environmental

impact, recorded a mean of 3.57, one of the highest scores in the table, showing strong consensus on its ecological benefits.

Furthermore, respondents acknowledged that vernacular architecture is well-suited to the local climate ($\bar{X} = 3.49$) and expressed growing interest in preserving indigenous architectural knowledge ($\bar{X} = 3.36$). The cultural value of vernacular architecture was also emphasized with a high mean score of 3.61, indicating that it forms an integral part of the community's identity. Lastly, the adaptability of vernacular architecture to current climate change needs was strongly affirmed ($\bar{X} = 3.54$), suggesting that traditional practices remain relevant in addressing modern environmental challenges. Overall, the findings indicate that respondents hold positive perceptions of vernacular architecture, recognizing its environmental, cultural, economic, and climate-resilient qualities. This underscores the continued relevance of traditional building techniques in sustainable development and climate adaptation efforts within Shendam LGA.

Research question 2: What are the perceptions of architects, planners and community residents with regards to modern sustainable architecture and its effectiveness in addressing climate change, disaster resilience, and socio-economic challenges in Shendam LGA?

Table 2: Modern Sustainable Architecture

No.	Question	N	$\bar{X}$	SD	Remark
11.	Modern sustainable architecture helps mitigate climate change impacts in Shendam LGA.	150	3.48	0.61	Agree
12.	Modern sustainable buildings are more energy-efficient than vernacular buildings.	150	3.42	0.66	Agree
13.	The use of renewable energy sources in modern architecture enhances resilience to climate change.	150	3.55	0.58	Agree
14.	Modern buildings in Shendam LGA are better equipped to handle extreme weather conditions.	150	3.37	0.70	Agree
15.	Sustainable architectural designs help reduce the environmental footprint of construction in Shendam LGA.	150	3.51	0.59	Agree
16.	Modern sustainable architectural strategies promote long-term disaster resilience in Shendam LGA.	150	3.46	0.63	Agree
17.	The materials used in modern sustainable architecture are more readily available in Shendam LGA than traditional materials.	150	3.28	0.72	Agree
18.	The cost of implementing modern sustainable architectural strategies is high compared to vernacular architecture.	150	3.33	0.69	Agree
19.	Modern sustainable buildings are more suited to address the socio-economic challenges of local communities.	150	3.40	0.64	Agree
20.	The integration of modern sustainable architecture is an effective solution for long-term resilience to climate change in Shendam LGA.	150	3.53	0.57	Agree
Criterion mean value = 3.00. Mean values above 3.00 indicate agreement. Mean values below 3.00 indicate disagreement. Mean values equal to 3.00 indicate indifference					

Table 2 presents respondents' perceptions of modern sustainable architecture and its effectiveness in addressing climate change, disaster resilience, and socio-economic challenges in Shendam LGA. With a criterion mean of 3.00, all ten items recorded mean values above this benchmark, indicating strong agreement among the 150 respondents regarding the positive impact of modern sustainable architectural practices in the area. The results show that respondents believe modern sustainable architecture significantly contributes to mitigating climate change impacts, as reflected in the high mean score of 3.48 for item 1. Similarly, modern sustainable buildings are perceived to be more energy-efficient than vernacular buildings ($\bar{X} = 3.42$), demonstrating that technological improvements in design and materials are recognized by the community. The adoption of renewable energy sources, an important aspect of modern architecture, was also highly rated ($\bar{X} = 3.55$), indicating a strong perceived link between renewable energy integration and climate resilience.

Respondents also agreed that modern buildings are better equipped to withstand extreme weather conditions ($\bar{X} = 3.37$), which suggests confidence in the structural performance of contemporary designs. Sustainable architectural strategies were further acknowledged for their ability to reduce environmental footprints ($\bar{X} = 3.51$) and enhance long-term disaster resilience in Shendam LGA ($\bar{X}$

= 3.46). Although modern building materials are perceived to be more available ($\bar{X} = 3.28$), respondents also recognized that implementing modern sustainable strategies is more costly than vernacular options ($\bar{X} = 3.33$). Nonetheless, this cost implication did not reduce their overall perception of modern architecture's benefits. Moreover, modern sustainable buildings were seen as better suited to addressing socio-economic challenges ($\bar{X} = 3.40$), suggesting that respondents view them as adaptable to community needs. The highest level of agreement in this section concerns the integration of modern sustainable architecture as an effective long-term climate resilience solution ($\bar{X} = 3.53$), highlighting the strong collective belief in its future relevance. Overall, the findings indicate widespread support for modern sustainable architecture within Shendam LGA. Respondents acknowledge its environmental advantages, resilience benefits, and socio-economic relevance, despite the associated cost challenges. This suggests that modern sustainable architecture is viewed as a necessary and effective component of future development and climate adaptation strategies in the region.

Research questions 3: What are the perceptions of architects, planners and community residents toward climate change adaptation strategies in Shendam LGA

Table 3: Climate Change Adaptation

No.	Question	N	$\bar{X}$	SD	Remark
21.	Climate change adaptation strategies in Shendam LGA have improved due to the adoption of sustainable architectural practices.	150	3.44	0.63	Agree
22.	Building designs in Shendam LGA are becoming more resilient to climate change impacts.	150	3.41	0.66	Agree
23.	The adoption of modern sustainable building practices contributes to better climate change resilience in Shendam LGA.	150	3.53	0.58	Agree
24.	Vernacular architecture plays a key role in adapting to changing climatic conditions in Shendam LGA.	150	3.47	0.60	Agree
25.	Climate change adaptation strategies in Shendam LGA need more widespread implementation of sustainable architectural practices.	150	3.59	0.55	Agree
26.	There is a significant increase in the use of climate-responsive architectural strategies in Shendam LGA.	150	3.38	0.69	Agree
27.	Local communities are aware of the importance of climate change adaptation in building design.	150	3.32	0.71	Agree
28.	There is a need for more education on sustainable building practices to support climate change adaptation in Shendam LGA.	150	3.61	0.52	Agree
29.	The integration of climate change adaptation measures into building practices is essential for the survival of communities in Shendam LGA.	150	3.57	0.57	Agree
30.	Policies promoting climate change adaptation through sustainable architecture are needed in Shendam LGA. Criterion mean value = 3.00. Mean values above 3.00 indicate agreement. Mean values below 3.00 indicate disagreement. Mean values equal to 3.00 indicate indifference	150	3.44	0.63	Agree

Table 3 presents the analysis of respondents' perceptions of climate change adaptation strategies in Shendam LGA, particularly regarding the role of architectural practices, both vernacular and modern, in enhancing resilience. All ten items recorded mean values above the criterion mean of 3.00, indicating strong agreement among the 150 respondents about the effectiveness and necessity of climate-responsive architectural practices in the region. The results suggest notable improvements in climate change adaptation strategies due to the adoption of sustainable architectural practices, as indicated by a mean score of 3.44 for item 1. Similarly, building designs in Shendam LGA are perceived to be increasingly resilient to climate change impacts ($\bar{X} = 3.41$). The adoption of modern sustainable building practices is seen as a key contributor to enhanced resilience ($\bar{X} = 3.53$), confirming respondents' confidence in contemporary climate-responsive technologies.

Importantly, respondents also acknowledged the continued relevance of vernacular architecture in climate adaptation, with a mean of 3.47, suggesting a recognition of the complementary strengths of traditional and modern practices. Moreover, item 5, which recorded one of the highest mean scores ($\bar{X} = 3.59$), indicates a strong perception that climate adaptation strategies in the region require broader implementation of sustainable architectural practices. Respondents also agreed that climate-responsive strategies are increasingly being used in the area ($\bar{X} = 3.38$),

although the level of community awareness about climate change adaptation in building design scored slightly lower but still significant ($\bar{X} = 3.32$). This suggests moderate but growing public understanding of climate-related issues. Correspondingly, item 8 recorded the highest mean ($\bar{X} = 3.61$), highlighting a perceived strong need for more education on sustainable building practices in order to support climate adaptation efforts.

Furthermore, respondents strongly agreed that integrating climate adaptation measures into building practices is essential for community survival ($\bar{X} = 3.57$), underscoring the perceived urgency and importance of climate-responsive construction in Shendam LGA. Lastly, the need for policies promoting climate change adaptation through sustainable architecture also received substantial support ($\bar{X} = 3.44$), reflecting a call for stronger institutional backing and regulatory frameworks. Overall, the findings reveal that respondents recognize the critical role of architecture, both modern and traditional, in strengthening climate change adaptation in Shendam LGA. They also emphasize the need for increased education, broader adoption, and stronger policy support to ensure long-term resilience in the region.

Research question 4: What are the perceptions of architects, planners and community residents toward disaster resilience in Shendam LGA.

Table 4: Disaster Resilience

No.	Question	N	$\bar{X}$	SD	Remark
31.	Vernacular architecture enhances disaster resilience in Shendam LGA.	150	3.46	0.62	Agree
32.	Modern sustainable buildings are more resilient to natural disasters compared to traditional buildings in Shendam LGA.	150	3.51	0.60	Agree
33.	Disaster resilience in Shendam LGA can be improved by integrating both vernacular and modern architectural strategies.	150	3.58	0.55	Agree
34.	The construction of disaster-resilient buildings is a priority in Shendam LGA.	150	3.37	0.67	Agree
35.	The implementation of disaster-resilient designs has reduced the impact of disasters in Shendam LGA.	150	3.42	0.64	Agree
36.	Building codes in Shendam LGA should be revised to focus more on disaster resilience.	150	3.63	0.53	Agree
37.	There is adequate government support for disaster-resilient architecture in Shendam LGA.	150	3.29	0.71	Agree
38.	Communities in Shendam LGA have the necessary knowledge to implement disaster-resilient building practices.	150	3.31	0.69	Agree
39.	The cost of implementing disaster-resilient architectural strategies is a barrier to their widespread adoption in Shendam LGA.	150	3.34	0.70	Agree
40.	Future building policies in Shendam LGA should focus more on improving disaster resilience.	150	3.59	0.56	Agree
Criterion mean value = 3.00.					
Mean values above 3.00 indicate agreement.					
Mean values below 3.00 indicate disagreement.					
Mean values equal to 3.00 indicate indifference					

Table 4 presents respondents' perceptions of disaster resilience in Shendam LGA, with a specific focus on the role of architectural practices, vernacular, modern sustainable, and combined approaches, in enhancing resilience to natural hazards. With a criterion mean of 3.00, all ten items recorded mean values greater than this benchmark, indicating strong overall agreement among the 150 respondents on the importance and effectiveness of disaster-resilient architectural strategies in the region. The findings show that respondents believe vernacular architecture contributes significantly to disaster resilience, with a mean score of 3.46 for item 1, suggesting that traditional building methods remain robust and well-suited to local conditions. Modern sustainable buildings, however, are perceived to offer even greater resilience to natural disasters ($\bar{X} = 3.51$), indicating confidence in contemporary materials and technologies. The highest mean in the table ($\bar{X} = 3.58$) is observed for item 3, which highlights a strong belief that integrating both vernacular and modern architectural strategies offers the best approach to improving disaster resilience in Shendam LGA.

Respondents also agree that constructing disaster-resilient buildings is a priority in the area ($\bar{X} = 3.37$), and that the implementation of disaster-resilient designs has helped reduce the impact of disasters ($\bar{X} = 3.42$). Additionally, the need to revise building codes to better emphasize disaster resilience gained substantial support ($\bar{X} = 3.63$), reflecting a widely shared perception that regulatory frameworks require strengthening to promote safer construction practices. However, the mean scores for items 7 and 8, government support ($\bar{X} = 3.29$) and community knowledge ($\bar{X} = 3.31$), are relatively lower, though still above the criterion mean. This suggests that while respondents agree these factors exist, they may not be seen as fully adequate. This signals potential gaps in governmental efforts and community-level awareness or training regarding disaster-resilient architecture. The cost of implementing disaster-resilient strategies ($\bar{X} = 3.34$) is also seen as a barrier to wider adoption, indicating economic constraints faced by individuals and communities. Despite

this, respondents strongly agree that future building policies should place greater emphasis on improving disaster resilience ($\bar{X} = 3.59$), reflecting a clear demand for forward-looking, proactive planning. Overall, the results indicate that respondents recognize both traditional and modern architectural approaches as valuable in strengthening disaster resilience in Shendam LGA. While regulatory improvements and greater government and community support are needed, there is strong consensus on the necessity of integrating disaster-resilient principles into future building practices and policies to safeguard communities from natural hazards.

Hypothesis One: There is no significant relationship between Vernacular Architecture and Climate Change Adaptation in Shendam Local Government Area (LGA).

To test this hypothesis, simple linear regression analysis was employed, with Vernacular Architecture as the independent variable and Climate Change Adaptation as the dependent variable. Both variables were measured on a continuous scale. The analysis results, presented in Table 5, showed a correlation coefficient ($R = .765$), indicating a strong positive relationship between Vernacular Architecture and Climate Change Adaptation. This suggests that as the use of Vernacular Architecture increases, the capacity of the community to adapt to climate change improves correspondingly. Additionally, the adjusted R-squared value ($\text{Adj. } R^2 = .592$) implies that 59.2% of the variance in Climate Change Adaptation can be explained by Vernacular Architecture. The analysis of variance (ANOVA) result showed an F-value of 912.234, with a significance level of $p = .000$. Since the p-value is less than the 0.05 threshold, the null hypothesis is rejected. Therefore, it is concluded that Vernacular Architecture has a significant relationship with Climate Change Adaptation in Shendam LGA. The regression equation derived from this relationship is:

$$\text{Climate Change Adaptation} = 4.823 + 0.684 (\text{Vernacular Architecture})$$

Table 5: Simple Regression Analysis of the Influence of Vernacular Architecture on Climate Change Adaptation

Source of Variation	SS	Df	MS	F-ratio	Sig.
Regression	3887.328	2	3887.328		
Residual	2708.526	148	3.643	912.234*	.000
Total	6595.854	149			

Model	B	Std. Error	Beta	t	Sig.
Constant	4.823	.516		9.351	.000
Vernacular Architecture	.684	.026	.765	26.324	.000

*Significant at the 0.05 level

$R = .765$

$R^2 = .585$

Adjusted $R^2 = .592$

Hypothesis Two: There is no significant relationship between Modern Sustainable Architecture and Disaster Resilience in Shendam Local Government Area (LGA).

To test this hypothesis, simple linear regression analysis was carried out with Modern Sustainable Architecture as the independent variable and Disaster Resilience as the dependent variable. Both variables were measured on a continuous scale. The results, presented in Table 6, showed a correlation coefficient ($R = .609$), indicating a moderately strong positive relationship between Modern Sustainable Architecture and Disaster Resilience. This suggests that as

the adoption of Modern Sustainable Architecture increases, the resilience of the community to disasters management. Furthermore, the adjusted R-squared value ($\text{Adj. } R^2 = .371$) implies that 37.1% of the variance in Disaster Resilience can be explained by Modern Sustainable Architecture. The ANOVA result yielded an F-value of 455.876, with a significance level of $p = .000$, which is below the 0.05 threshold. As a result, the null hypothesis is rejected. Thus, it is concluded that Modern Sustainable Architecture significantly influences Disaster Resilience in Shendam LGA. The regression equation is: Disaster Resilience = $10.054 + 0.523$ (Modern Sustainable Architecture)

Table 6: Simple Regression Analysis of the Influence of Modern Sustainable Architecture on Disaster Resilience

Source of Variation	SS	Df	MS	F-ratio	Sig.
Regression	2537.381	2	2537.381		
Residual	4281.215	148	4.228	455.876*	.000
Total	6818.596	149			

Model	B	Std. Error	Beta	t	Sig.
Constant	10.054	.598		16.812	.000
Modern Sustainable Architecture	.523	.028	.609	18.350	.000

*Significant at the 0.05 level

$R = .609$

$R^2 = .371$

Adjusted $R^2 = .371$

Discussion of Findings

The findings of research question one shows that respondents have a positive perception of vernacular architecture in Shendam. Introducing vernacular walling to the building envelope will reduce the amount of cement/mortar and sandscrete blocks by 30 percent. This vernacular walling could finally be finished with cement rendering which could further improve the aesthetics of the structure. This finding is not surprising as it reflects the environmental, cultural, and climate-resilient qualities of vernacular architecture, supporting the idea that local building practices provide effective adaptation to climate challenges. This finding aligns with previous research by Iwayemi et al. (2024) that vernacular strategies, such as raising ground floors and fortifying houses, were recognized as effective for climate resilience in Ayetoro, Nigeria.

The findings of research question two express strong support for modern sustainable architecture despite the challenges of cost. Introducing reinforced concrete columns and beams at intervals of the Mud bricks (or sun-dried adobe), laterite, and stone walls will help raise the headroom of the building thereby promoting the different environmental, cultural, economic, and climate-resilient

characteristics and function of the envelope space. The increased headroom will help regulate indoor temperatures and provide a natural cooling effect in the hot months and warmth during the cooler nights. It will also enhance the room space from the current hut-like structure. The findings resonate with Mba et al. (2024), who explored the barriers to implementing modern sustainable practices in Enugu. The study acknowledges the significant potential of modern architecture to address environmental and socio-economic issues but highlight the financial and regulatory obstacles that hinder its widespread adoption. Mba et al. found that while architects are aware of sustainable design practices, the practical challenges—particularly cost—remain a critical issue, a sentiment echoed in the present study’s recognition of the benefits of modern architecture, despite its high costs.

Regarding the findings of research question three, which stress the role of both modern and vernacular architecture in climate change adaptation. The present study mirrors this by recognizing the value of both traditional and modern ‘hybrid’ strategies. Improved bamboo could be use as reinforcement in concrete columns and beams. Processed bamboo could also be used on roof trusses to increase the

span. Bamboo grows faster than trees and the reserve trees could be used for temperature regulation thereby reducing the carbon footprint of shendam. Reducing the steel component helps reduce cost while still maintaining the required strength acknowledging that each has its role in addressing climate adaptation. Okeke, Chukwuali, and Idoko (2019) study on the Makoko Floating School supports this conclusion. Their research highlights how vernacular techniques—such as using local materials and stilts—are crucial in adapting to climate challenges in flood-prone environments. While the Makoko study focuses on specific techniques suited to flooding, the present research broadens this to include diverse climate resilience needs and sustainability.

Lastly, the findings of research question four, which suggest that both traditional and modern architectural approaches are valuable for strengthening disaster resilience in Shendam. Given the unique context of Shendam, the use of both vernacular principles and modern construction techniques could be integrated to promote climate-responsive architecture. Designers should prioritize local materials such as stone, laterite, and mud bricks for new constructions, as these materials are better suited to the region's climate and can be sourced sustainably. For urban development, especially in Shendam town, there should be a focus on multi-story buildings that incorporate local materials like laterite and stone in their facades, alongside modern materials such as concrete and glass. This hybrid approach would not only preserve the region's cultural heritage but also meet the needs of modern urban development. The findings of this study are supported by Akpami (2023) research on integrating vernacular architecture into modern urbanization strategies which emphasized that vernacular architecture provides important lessons for modern urban planning, especially in areas vulnerable to climate change. The present study agrees with this view, asserting that combining the strengths of both approaches can improve and enhance disaster resilience of building designs and structures in Shendam. This integration of vernacular and modern strategies aligns with Akpami (2023) call for more inclusive, context-specific urban planning that leverages both local knowledge and modern innovations to address contemporary challenges.

Conclusion

In conclusion, the findings indicate that respondents hold positive perceptions of vernacular architecture, recognizing its environmental, cultural, economic, and climate-resilient qualities. In like manner, the findings also indicate widespread support for modern sustainable architecture within Shendam LGA. despite the associated cost challenges. The findings equally revealed that respondents

recognized the critical role of both modern and traditional architecture in strengthening climate change adaptation in Shendam LGA. Lastly, the results indicate that respondents recognize both traditional and modern architectural approaches as valuable in strengthening disaster resilience in Shendam LGA. Conclusively, it could be concluded that vernacular architecture has a significant relationship with climate change adaptation in Shendam LGA while modern sustainable architecture significantly influences disaster resilience in Shendam LGA.

Recommendations

Based on the findings of the study, the researchers made the following recommendations:

- i) that local government agencies, such as the Plateau State Ministry of Environment, collaborate with architectural institutions to promote the use of traditional building techniques in climate adaptation strategies.
- ii) those relevant agencies, such as the Federal Ministry of Works and Housing and the Plateau State Housing Authority, work alongside financial institutions to create incentives for sustainable building practices which may include subsidies, low-interest loans, or tax rebates for builders and developers incorporating eco-friendly designs.
- iii) that local planning authorities incorporate mixed architectural strategies in urban and rural development plans which may involve the development of model communities in Shendam where both building methods are integrated into the design to showcase their combined potential for resilience.
- iv) those urban planners, in collaboration with disaster management agencies, such as the National Emergency Management Agency (NEMA), adopt a hybrid approach that blends the cultural and practical benefits of vernacular architecture with the technological advantages of modern designs.

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