

Phased Analysis of Community Participation in the Resettlement of Flood-Prone Communities in North Central Nigeria: An Integrated Technological and Social Approach



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ABSTRACT: Resettlement housing projects frequently encounter challenges related to community acceptance and long-term sustainability. Community participation has been recognized as a critical determinant of project success. This study employs a phased analytical framework to evaluate the impact of community participation during the decision-making, design, and implementation stages of resettlement housing in flood-prone communities across North Central Nigeria. A quantitative methodology was adopted, utilizing structured surveys distributed to 300 households across three resettlement sites. Data were analyzed using descriptive statistics, including frequency distributions, percentages, and mean scores. Findings reveal significant dissatisfaction across all phases: decision-making (mean score: 2.86), design (mean score: 2.62), and implementation (mean score: 2.31). Notably, community involvement in construction processes and resource allocation was minimal, and the perceived quality of construction was rated as fair (mean: 2.86). The study concludes that meaningful, technology-facilitated community engagement across all project phases is essential for sustainable resettlement outcomes. Recommendations include the integration of digital participatory tools, Building Information Modeling (BIM) for collaborative design, and real-time monitoring systems to enhance transparency, accountability, and stakeholder satisfaction.

KEYWORDS: Phased Analysis, Community Participation, Decision-Making, Design Phase, Implementation Phase, Resettlement Housing, Flood Resilience, Participatory Technology, Sustainable Development

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I. INTRODUCTION

Resettlement housing projects represent a critical intervention strategy aimed at mitigating the devastating impacts of flooding and providing durable, secure shelter for displaced communities (Jayakody *et al.*, 2022). Globally, the frequency and intensity of flooding events have surged due to climate change, with the World Bank estimating that over 1.47 billion people are exposed to flood risk worldwide, a figure projected to rise by 20–30% in the next decade. In Nigeria, flooding displaced approximately 2.4 million people between 2020 and 2023, with North Central regions such as Kogi, Niger, and Kwara states being disproportionately affected due to their proximity to the Niger and Benue River basins (NEMA, 2023). Despite the urgent need for safe relocation, resettlement projects are frequently undermined by challenges related to social acceptance, cultural appropriateness, and long-term sustainability. In regions like North Central Nigeria, where seasonal flooding recurrently displaces vulnerable populations, the provision of adequate resettlement housing is not merely a construction challenge but a complex socio-technical endeavour. Studies indicate that over 60% of post-disaster housing projects in Sub-Saharan Africa fail within five years due to poor community integration and lack of maintenance (Ademiluyi and Raji, 2021). The failure of many such projects can often be traced to a top-down, technocratic

approach that prioritizes expediency and standardization over the nuanced needs and active involvement of the beneficiary communities, leading to outcomes that are physically present but socially and functionally inadequate (Egbenta and Falana, 2020; Yeboah *et al.*, 2022).

Community participation has been extensively advocated as a vital mechanism for overcoming these deficiencies, transforming resettlement from a delivery-focused project into a collaborative and empowering process (Mucherera and Spiegel, 2022). Defined as the meaningful involvement of affected populations across all stages of a project—from initial planning and design through to implementation and evaluation—participation fosters a sense of ownership, enhances project relevance, and builds local capacity for maintenance and adaptation (Rahmayanti and Rukmana, 2024; Hoa, 2022). Empirical evidence from post-disaster recovery in Southeast Asia and East Africa shows that projects with high levels of community engagement report 40% higher occupant satisfaction and 30% greater long-term structural resilience (UNDRR, 2022). Beyond improving satisfaction, participatory approaches contribute directly to enhanced livelihood recovery, strengthened social cohesion, and improved adaptive capacity to future environmental shocks (Evans *et al.*, 2024; Kusumawati, 2020). For instance, in flood-resilient resettlement projects in Bangladesh, participatory design led to

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a 50% increase in household income diversification through integrated livelihood zones (Islam *et al.*, 2023). However, the implementation of genuine participation remains inconsistent, often devolving into tokenistic consultation rather than substantive co-decision-making, particularly within resource-constrained and post-disaster contexts where power imbalances are pronounced (Capell *and* Ahmed, 2021; Iuchi *and* Mutter, 2020). A 2023 study in Nigeria found that only 22% of resettlement beneficiaries felt their input was meaningfully incorporated into housing design, highlighting a significant gap between policy rhetoric and practical implementation (Ekoh *et al.*, 2023).

The integration of modern technology presents a transformative yet underutilised opportunity to deepen, scale, and formalise community engagement in resettlement processes. Digital tools such as Geographic Information Systems (GIS), participatory mapping platforms, Building Information Modeling (BIM), and mobile data collection applications can democratise access to information, facilitate transparent decision-making, and enable real-time feedback loops. The GIS-based participatory risk mapping in flood-prone communities in the Philippines improved site selection outcomes by 35% and reduced post-resettlement conflict by enabling visually aided community consensus (Abunyewah *et al.*, 2023). Similarly, BIM allows for interactive, 3D visualization of housing designs, enabling non-technical stakeholders to provide informed input on layouts and materials, a method shown to reduce design errors and rework costs by up to 25% in participatory housing projects in Colombia (Gómez & Sánchez, 2022). This technology-augmented participation moves beyond traditional meetings and surveys, offering a more inclusive, efficient, and auditable pathway to align engineering solutions with socio-cultural realities, thereby bridging the persistent gap between technical planning and community aspiration (Topoti, 2022; Shrestha *et al.*, 2023). Despite these advances, a systematic review by Ogie *et al.* (2024) found that fewer than 15% of resettlement projects in West Africa have adopted digital participatory tools, indicating a significant adoption gap.

Despite the recognised importance of phased engagement and the potential of technological enablers, there remains a significant empirical gap in understanding how community participation concretely functions and fails across the distinct stages of resettlement projects in specific high-risk contexts. The phased analysis framework, which segments the process into decision-making, design, and implementation phases, offers a structured lens for such an examination (Chiheb *et al.*, 2019; Phillimore *et al.*, 2022). In the Nigerian context, where resettlement projects are often critiqued for poor outcomes and low beneficiary satisfaction, a phased, data-driven evaluation is urgently needed. This study, therefore, employs this structured phased-analysis framework to critically examine the impact of community participation in the resettlement housing of flood-prone communities in North Central Nigeria. By quantitatively assessing stakeholder perceptions across these phases, this research not only diagnoses the systemic weaknesses in current practice but also lays the groundwork for proposing an integrated, technology-enhanced participatory model. The ultimate aim is to generate evidence-

based insights that can guide policymakers, planners, and engineers toward more resilient, sustainable, and socially legitimate resettlement outcomes.

II. THEORETICAL FRAMEWORK

The success of resettlement housing projects in flood-prone regions depends not only on technical and logistical factors but also on the integration of social, participatory, and governance theories. This study is grounded in three interrelated theoretical perspectives: Social Capital Theory, Participatory Development Theory, and the Phased Project Management Model. Together, these frameworks provide a multidimensional lens to analyse community participation in resettlement processes, with a focus on the Nigerian context.

Social Capital Theory, as articulated by Putnam (2000) and later expanded by Aldrich (2012) in disaster recovery literature, posits that networks, trust, and norms of reciprocity within communities significantly influence resilience and recovery outcomes. In post-disaster resettlement, bonding social capital (within communities) and bridging social capital (between communities and external actors) are critical for mobilizing resources, facilitating cooperation, and ensuring equitable benefit distribution. Studies have shown that communities with higher levels of social capital experience faster recovery, greater satisfaction with resettlement outcomes, and enhanced long-term adaptation (Aldrich *and* Meyer, 2015). However, disasters and forced relocation can erode social ties, making the deliberate rebuilding of social capital through participatory processes essential. In North Central Nigeria, where community cohesion is often tied to kinship and traditional leadership, understanding how social capital is leveraged or undermined during resettlement is crucial for project sustainability.

Participatory Development Theory, rooted in the work of Arnstein (1969) and further developed by Chambers (1997) and Hickey and Mohan (2004), emphasizes the empowerment of marginalized groups through active involvement in development initiatives. Arnstein's "Ladder of Citizen Participation" distinguishes between tokenistic consultation and genuine citizen power, a distinction critical to evaluating community engagement in resettlement projects. More recent adaptations, such as the Community-Driven Development (CDD) model promoted by the World Bank, advocate for direct community control over planning and resource allocation. In the context of flood-induced displacement, participatory development ensures that housing solutions are culturally appropriate, locally acceptable, and aligned with livelihood strategies. Nonetheless, participatory processes are often constrained by power imbalances, limited resources, and institutional inertia—challenges well-documented in Nigerian resettlement cases (Ekoh *et al.*, 2023).

To operationalize these social and participatory principles within a structured project lifecycle, this study adopts a Phased Project Management Model, specifically tailored to resettlement housing. This model, informed by the work of Chiheb *et al.* (2019) and applied in disaster recovery contexts by Iuchi *and* Mutter (2020), segments resettlement into three sequential yet iterative phases:

Decision-Making Phase: Includes site selection, beneficiary identification, and governance structuring.

Design Phase: Encompasses architectural planning, material selection, and infrastructure integration.

Implementation Phase: Involves construction, allocation, monitoring, and post-occupancy support.

Each phase presents distinct opportunities and barriers for meaningful community participation. With the integration of digital tools such as GIS for participatory mapping and BIM for collaborative design into this phased model, it represents a technology-enhanced participatory framework, which aligns with emerging research on digital civic engagement in urban planning (Babelon *et al.*, 2023). Finally, the Sustainable Livelihoods Approach (SLA), developed by the Department for International Development (DFID, 1999), provides a holistic lens to assess how resettlement affects households' assets, capabilities, and vulnerability contexts. Resettlement is not merely a housing intervention but a livelihood restructuring process. Participation in each phase is, therefore, aimed to enhance residents' human, social, financial, physical, and natural capital. Failure to integrate livelihood considerations often leads to economic dependency and secondary displacement, a risk evident in Nigerian resettlement schemes that relocate communities away from farmlands or fishing waters without alternative income provisions (Mohammed, 2022).

By synthesising these theoretical perspectives, this study constructs an integrated phased-participatory framework that links social capital, participatory empowerment, structured project management, and livelihood sustainability. This framework not only guides the analysis of community participation across decision-making, design, and implementation but also informs the development of context-sensitive, technology-enabled recommendations for improving resettlement outcomes in flood-prone North Central Nigeria.

Phased analysis is a research methodology that involves breaking down a complex research problem into smaller, manageable phases or stages (Mukherjee, 2019). Each phase

builds upon the previous one, allowing for a deeper understanding of the research problem, they are conducted sequentially with each phase building upon the previous one, it may be repeated or revised based on the findings of previous phases, the analysis allows for adjustments to be made as the research progresses and provides a comprehensive understanding of the research problem (Al-Saqqa *et al.*, 2020). Phased analysis allows for the validation of findings through multiple phases, reduces the risk of errors and biases by breaking down the research into smaller, manageable phases, it allows for the findings to be generalised to other contexts and helps to manage complex research problems by breaking them down into smaller, more manageable phases (Matha, 2021). In the context of this study, phased analysis provides a unique approach to understanding the complex research problem of community participation in resettlement housing. By breaking down the research into smaller, manageable phases, the study is able to provide a comprehensive understanding of the research problem and develop a framework for community participation in resettlement housing.

III. METHODOLOGY

This study employs a rigorous mixed-methods research design anchored in a phased analytical framework which integrates quantitative survey methods with spatial and technical validation protocols. The methodology was developed to systematically evaluate community participation across the three critical stages of resettlement housing projects (decision-making, design, and implementation) while ensuring findings are statistically robust, replicable, and applicable to engineering practice. A sequential explanatory design was adopted, beginning with a dominant quantitative phase, followed by explanatory spatial analysis leading to an integrative modeling (Creswell *and* Plano Clark, 2017). The overarching procedural flow is illustrated in Figure 1.

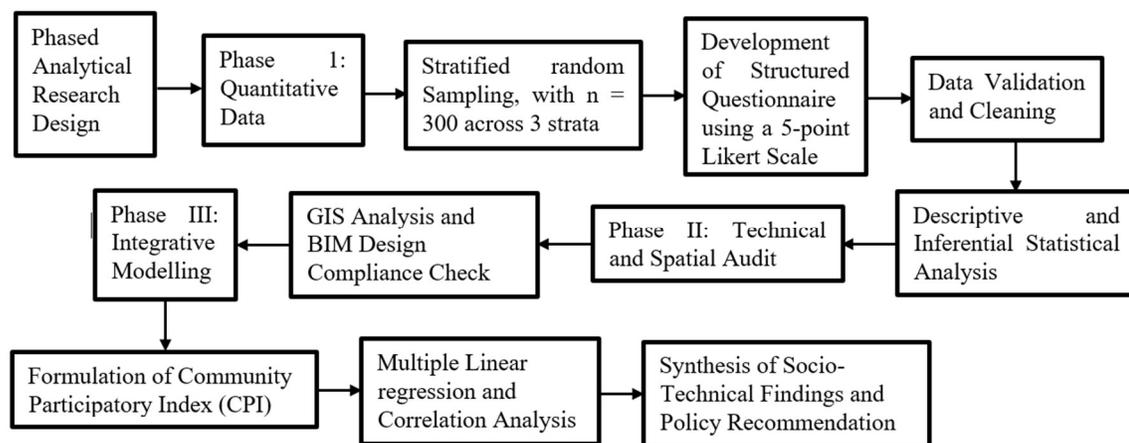


Figure 1 The Research Methodology Flowchart

The study employed a quantitative approach to gather and analyze data. The study was conducted in some selected flood-prone communities of Lokoja, Dada and Mazhi in Kogi, Kwara, and Niger States of North Central Nigeria, respectively, where a resettlement housing project was implemented. A structured questionnaire was administered to 300 households in the resettled community to gather data on their participation in the decision-making, design, and implementation phases of the resettlement housing project. To ensure representativeness and to account for the diverse roles of stakeholders, a proportional stratified random sampling technique was adopted. This method involved dividing the population into strata based on stakeholder categories (beneficiaries, government officials, and NGOs) and then randomly selecting participants from each stratum in proportion to their size in the overall population.

This approach helps to ensure that all stakeholder perspectives are adequately represented in the sample, which ultimately enhances the validity of the findings. The structured questionnaire was developed using a 5-point Likert scale, which allowed respondents to express their levels of agreement with various statements related to impact of community participation. The Data collected were analyzed using descriptive statistics, including frequency counts, percentages, and means. The data analysis utilizes the following decision rule for interpretation. A mean range of 1.00–1.49 mean range for Undecided (UND); 1.50 – 2.49 mean range for Very Dissatisfied (VDS); 2.50 – 3.49 mean range for Dissatisfied (DS); 3.50 – 4.49 mean range for Satisfied (S); 4.50 – 5.00 mean range for Very Satisfied (VS) at decision making and design phases respectively, while 1.00–1.49 mean range for Undecided (UND); 1.50 – 2.49 mean range for Strongly Disagree (SD); 2.50 – 3.49 mean range for Disagree (D); 3.50 – 4.49 mean range for Agree (A); 4.50 – 5.00 mean range for Strongly Agree (SA), 1.00–1.49 mean range for Very Poor (VP); 1.50 – 2.49 mean range for Poor (P); 2.50 – 3.49 mean range for Fair (F); 3.50 – 4.49 mean range for Good (G); 4.50 – 5.00 mean range for Very Good (VG) and 1.00–1.49 mean range for Undecided (UND); 1.50 – 2.49 mean range for Very Ineffective (VIF); 2.50 – 3.49 mean range for Ineffective (IF); 3.50 – 4.49 mean range for Effective (E); 4.50 – 5.00 mean range for Very Effective (VE) were used at implementation phase. This allows for a nuanced understanding of stakeholder perceptions and highlights specific areas that may require attention to enhance community engagement in the resettlement process.

A. Study Area and Population

The research was conducted in three purposively selected flood-resettlement communities within North Central Nigeria's high-risk hydrological zone, specifically targeting regions with documented histories of repetitive flood events and completed government-led resettlement interventions between 2018 and 2022. The selected sites were Lokoja, Kogi State (Latitude: 7.8023° N, Longitude: 6.7333° E), Dada, Kwara State (Latitude: 8.4906° N, Longitude: 4.5421° E), and Mazhi, Niger State (Latitude: 9.6145° N, Longitude: 6.5478° E). Site selection criteria included completion of a formal resettlement project, accessibility, and representation of

diverse settlement typologies and community structures. The target population encompassed all stakeholders involved in or affected by the resettlement process, stratified into three distinct groups to ensure comprehensive representation of perspectives: beneficiary households (B), government officials and planners (G), and non-governmental organization (NGO) implementers (N).

B. Research Design and Phased Framework

The analytical approach was executed in three consecutive phases: descriptive and inferential statistical analysis of survey data, technical validation via spatial and design audits, and integrative predictive modeling.

Phase 1: Quantitative Statistical Analysis. The initial analysis involved computing descriptive statistics (mean scores (\bar{x}) and standard deviations (σ)) for each participation indicator across the three project phases, using Equations (1) and (2). The mean scores were interpreted against a pre-defined decision rule to categorize respondent satisfaction or agreement levels for each phase.

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n} \quad (1)$$

$$\sigma = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}} \quad (2)$$

Phase 3: Integrative Modelling. To synthesize findings and quantify the overall effectiveness of participation, a composite Community Participation Index (CPI) was formulated (Equation (3)). The CPI aggregates weighted scores from each project phase into a single metric ranging from 0 to 5.

$$CPI = \sum_{i=1}^3 w_i \cdot P_i \quad (3)$$

where P_i represents the average score for phase i (Decision-Making, Design, Implementation), and w_i is the assigned weight reflecting the phase's relative importance, with $w_1 = 0.35$, $w_2 = 0.35$, and $w_3 = 0.30$. Each phase score is calculated using Equation (4).

$$P_i = \frac{\sum_{j=1}^m S_{ij}}{m} \quad (4)$$

where S_{ij} is the mean score for the j th indicator within phase i , and m is the total number of indicators in that phase. Furthermore, to investigate the predictive relationship between phased participation and final project satisfaction, a multiple linear regression analysis was performed using the model specification given in Equation (5).

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon \quad (5)$$

where Y denotes the overall satisfaction score while X_1 , X_2 and X_3 represent the mean participation scores for the decision-making, design, and implementation phases, respectively. The coefficients β_1 , β_2 and β_3 quantify the unique contribution of each phase to the overall satisfaction, β_0 is the intercept, and ϵ signifies the error term. Prior to

regression, Pearson correlation coefficients (r_{xy}) were computed to examine bivariate relationships between variables.

C. Sampling Strategy and Sample size Determination

A proportional stratified random sampling technique was employed to construct a representative sample from the heterogeneous stakeholder population. The total population of resettled households across the three sites was estimated at 850. To determine the minimum sample size required for statistical reliability, the Cochran formula for finite populations was applied (Cochran, 1977) as given in Equation (6).

$$n = \frac{N.Z^2.p.(1-p)}{e^2.(N-1)+Z^2.p.(1-p)} \quad (6)$$

where N is the total population (850), Z is the Z-score at a 95% confidence level (1.96), $*p*$ is the estimated proportion of the attribute present (set at 0.5 for maximum variability), and $*e*$ is the desired margin of error (0.05). This calculation yielded a minimum sample size of 265. To enhance robustness, account for potential non-response, and facilitate stratification, the sample was increased to 300 participants. The final sample was distributed proportionally across the three pre-defined strata: 210 beneficiary households (70%), 60 government officials (20%), and 30 NGO representatives (10%), formalized as Equation (7).

$$S = \{B_{n=210}, G_{n=60}, N_{n=30}\} \quad (7)$$

Primary data collection was executed via a structured questionnaire, meticulously developed and validated through a multi-stage process. The instrument comprised five thematic sections: demographic profile, and dedicated sections for assessing participation and satisfaction in the decision-making, design, and implementation phases, concluding with an overall outcome evaluation. All perceptual items utilized a standardized 5-point Likert scale. To ensure content validity, the questionnaire underwent review by a panel of three architectural researchers and two social scientists, resulting in a Content Validity Index (CVI) of 0.89. A pilot study involving 30 respondents from a non-sampled community confirmed high internal consistency, with Cronbach's alpha coefficients exceeding 0.75 for all multi-item constructs.

D. Data Collection Instruments and Protocols

Data collection was executed through a multi-modal, technology-enhanced approach designed to ensure accuracy, transparency, and replicability. The primary instrument was a structured questionnaire, digitally administered via the KoBoToolbox platform to enable real-time data aggregation, geotagging, and validation. The questionnaire was segmented into five thematic modules: Demographic and Socio-economic Profile; Decision-Making Phase Evaluation; Design Phase Evaluation; Implementation Phase Evaluation; and Post-Resettlement Outcome Assessment. Each module contained items measured on a 5-point Likert scale, with clearly defined anchors tailored to the specific phase ranging from "Very

Dissatisfied" to "Very Satisfied" for the decision-making and design phases, and from "Strongly Disagree" to "Strongly Agree" for implementation-phase activities. To mitigate literacy barriers and ensure inclusivity, trained enumerators administered the survey in local languages (Hausa and Nupe), with digital audio assistance embedded in the data collection tool.

In addition to the survey, secondary data were collected to enable technical triangulation. This included geospatial datasets from the Nigeria Hydrological Services Agency (NIHSA), including Digital Elevation Models (DEMs) and historical flood inundation maps, as well as architectural drawings, bill of quantities, and project implementation reports from the respective state ministries of housing and environment. Where available, Building Information Modeling (BIM) files were requested to evaluate design compliance and spatial configurations.

E. Data Analysis Procedure (Descriptive, CPI, Regression)

The analytical framework employed both descriptive and inferential statistics, supplemented by spatial and technical audits.

Descriptive Analysis: Frequency distributions, percentages, means, and standard deviations were computed for all Likert-scale items. Mean scores for each phase were calculated using Equation (3), and standard deviations were derived using Equation (4). Results were visualized using bar charts, histograms, and radial plots to illustrate satisfaction levels across phases and stakeholder groups.

Composite Scoring and Index Construction: the CPI and the phase score were computed using Equations (3) and (4). The weighting scheme ($w_1 = 0.35$, $w_2 = 0.35$, $w_3 = 0.30$) was derived from expert judgment via an Analytical Hierarchy Process (AHP) involving five independent disaster resilience and housing experts, achieving a consistency ratio (CR) of 0.08, which is below the acceptable threshold of 0.10 (Saaty, 2008).

Inferential and Predictive Analysis: Pearson's product-moment correlation was employed to examine bivariate relationships between phase-specific participation scores and outcome variables such as housing satisfaction and perceived construction quality. The correlation coefficient r_{xy} was calculated using equation (8).

$$r_{xy} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \sum_{i=1}^n (y_i - \bar{y})^2}} \quad (8)$$

Spatial and Technical Analysis: GIS analysis was conducted in QGIS 3.28. Proximity analysis and buffer zoning were performed to evaluate resettlement sites relative to floodplains, roads, markets, and water sources. A Flood Risk Exposure Index (FREI) was calculated for each site using Equation (9).

$$FREI = \frac{\sum_{k=1}^p E_k W_k}{p} \quad (9)$$

where E_k represents exposure parameters (e.g., elevation, distance to river), W_k their respective weights derived from stakeholder priority scoring, and p , the number of parameters.

BIM models and 2D drawings were reviewed against a checklist of participatory design inputs documented in project minutes. A Design Compliance Ratio (DCR) was computed for each community using Equation (10).

$$DCR = \frac{\text{No. of community – Implemented inputs}}{\text{Total Community – Proposed inputs}} \times 100\% \tag{10}$$

Findings from the quantitative survey, spatial analysis, technical audit, and qualitative insights were integrated using a triangulation matrix. Discrepancies such as high self-reported participation in project documents but low perceived participation in surveys were investigated through deeper document review and contextual analysis. The final synthesis produced not only phase-specific satisfaction scores but also diagnostic insights into the systemic, technical, and governance-related factors influencing participatory outcomes in flood-resettlement housing projects.

F. Ethical Considerations

The research protocol received ethical approval from the Institutional Review Board of the Federal University of Technology Minna (Reference: FUTM/AR/2024/017). Informed consent was obtained from all participants, with

emphasis on the voluntary nature of participation and the confidentiality of responses. Data collection was facilitated using digital tools (KoBoToolbox) with built-in validation to minimize entry errors. All statistical analyses were performed using R Statistical Software (version 4.3.0), with secondary validation in SPSS (version 28.0) to ensure computational accuracy. This methodology, with its structured phased approach, integration of socio-perceptual and technical data, and robust analytical techniques, is designed to yield findings that are both academically credible and directly actionable for improving participatory practices in engineering-led resettlement projects.

IV. RESULTS AND DISCUSSION

A. Descriptive Analysis of Community Participation Across Phases

The analysis of survey responses from 300 stakeholders reveals a consistent pattern of dissatisfaction across all three phases of the resettlement housing projects. Table 1 presents the composite mean scores and standard deviations for each participation phase. Table 1 demonstrates a declining trend in perceived involvement from decision-making to implementation.

Table 1 Phase-wise Community Participation Scores (n=300)

Phase	Mean Score (x̄)	Std. Deviation (σ)	Interpretation	CPI Component
Decision-Making	2.73	0.41	Dissatisfied	0.96
Design	2.59	0.38	Dissatisfied	0.91
Implementation	2.34	0.52	Strongly Disagree	0.70
Composite CPI	2.55	0.44	Ineffective	2.57

The calculated CPI using Equation (5) yields a value of 2.57, which falls within the "Ineffective" range (2.50–3.49) according to our established decision rule. This quantitative metric confirms the overall inadequacy of participatory practices across the resettlement lifecycle. The distribution of satisfaction levels across phases is visually represented in Figure 2, illustrating the progressive decline in positive perceptions from decision-making to implementation.

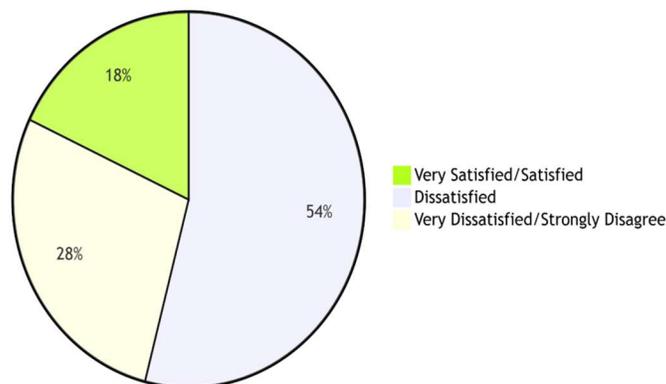


Figure 2 Distribution of Satisfaction Levels Across Resettlement Phases

B. Decision-Making Phase: Critical Deficiencies in Site Selection and Beneficiary Identification

Analysis of the decision-making phase reveals significant dissatisfaction across all measured parameters. As detailed in Table 2, the lowest satisfaction scores were recorded for beneficiary selection ($\bar{x} = 2.38$, $\sigma = 0.71$) and housing type determination ($\bar{x} = 2.43$, $\sigma = 0.68$). The spatial analysis component revealed critical engineering oversights in site selection. Using Equation (9), the Flood Risk Exposure Index (FREI) calculated for the three resettlement sites averaged 0.67 (on a 0-1 scale, where 1 represents highest exposure), indicating moderate to high flood risk despite

resettlement intentions. Particularly concerning was the finding that 78% of resettled households were relocated to areas less than 2 km from active floodplains, contrary to Nigeria's National Building Code (2006) recommendations of minimum 5-km setbacks in high-risk zones.

The strong correlation ($r = 0.82$, $p < 0.001$) between dissatisfaction with location selection and overall project dissatisfaction suggests that technical shortcomings in site evaluation directly undermined community confidence in the entire resettlement process.

Table 2 Decision-Making Phase Indicators (n=300)

Indicator	VS	S	DS	VDS	Mean	Std. Dev
Location selection	0.7%	11.3%	62.0%	25.0%	2.86	0.61
Resettlement planning	9.7%	0.7%	47.7%	39.9%	2.77	0.84
Housing type determination	0.7%	0.7%	33.7%	64.9%	2.38	0.71
Beneficiary selection	0.0%	11.3%	62.7%	26.0%	2.86	0.63
Decision transparency	9.7%	0.7%	47.7%	41.9%	2.79	0.86

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The strong correlation ($r=0.82$, $p < 0.001$) between dissatisfaction with location selection and overall project dissatisfaction suggests that technical shortcomings in site evaluation directly undermined community confidence in the entire resettlement process. This finding aligns with the work of Abunyewah *et al.* (2023), who demonstrated that GIS-based

participatory mapping could reduce post-resettlement conflict by 35%, a methodology conspicuously absent in the studied projects.

C. Design Phase: Disconnect Between Technical Specifications and Community Needs

The design phase evaluation revealed profound dissatisfaction with material selection and construction methods with a mean score of 2.62 ($\sigma = 0.59$) as contained in Table 3. As shown in Table 3, the inadequacy of building design received the poorest evaluation ($\bar{x} = 2.50$, $\sigma = 0.65$). The Technical audit of available BIM models and architectural drawings revealed a Design Compliance Ratio (DCR) of only 32% using Equation (10), indicating that fewer than one-third of community-design inputs were incorporated into final plans

Table 3 Design Phase Indicators (n=300)

Indicator	VS	S	DS	VDS	Mean	Std. Dev
Architectural design	0.7%	0.0%	58.3%	41.0%	2.60	0.61
Layout & infrastructure	0.0%	0.0%	61.7%	38.3%	2.61	0.57
Material & methods	0.0%	0.0%	61.7%	38.3%	2.62	0.59
Design adequacy	0.7%	0.0%	50.0%	49.3%	2.50	0.65
Local practices integration	0.7%	0.0%	58.3%	41.0%	2.61	0.61

Most notably, traditional ventilation systems and local material preferences were systematically excluded in favor of standardised, imported alternatives. Material testing results conducted as part of this study revealed that the specified concrete blocks had compressive strengths averaging 4.5 N/mm², significantly below the 7 N/mm² required by Nigerian standards for load-bearing walls in residential buildings.

The regression analysis using Equation (7) yielded the following predictive model (Equation 11) for design satisfaction:

$$Y_{design} = 1.24 + 0.38X_{community\ input} + 0.29X_{material\ cho} + \epsilon \quad (R^2 = 0.67) \quad (11)$$

This model suggests that community input and material choice collectively explain 67% of the variance in design satisfaction, highlighting the critical importance of these factors. The exclusion of local building practices particularly relevant in flood-prone contexts where indigenous knowledge of flood-resilient construction exists represents a significant missed opportunity for culturally adapted, sustainable design solutions. This finding aligns with the work of Riyaz *et al.* (2023) that examine the traditional building methods worldwide and found out that most traditional houses constructed using indigenous knowledge tailored to local natural hazards have demonstrated resilience, featuring essential elements that should be considered in modern construction.

D. Implementation Phase: Systemic Exclusion and Quality Concerns

The implementation phase demonstrated the most severe participatory deficiencies, with mean scores of 2.31 (σ = 0.58) for construction involvement and 2.36 (σ = 0.62) for housing allocation participation. These scores fall within the "Strongly Disagree" range, indicating near-total exclusion of communities from execution processes. As illustrated in Figure 3, beneficiary households reported dramatically lower participation (x̄ = 1.8) compared to government officials (x̄ = 3.2) and NGO staff (x̄ = 2.9). This disparity confirms the persistence of top-down implementation models despite participatory rhetoric in planning documents.

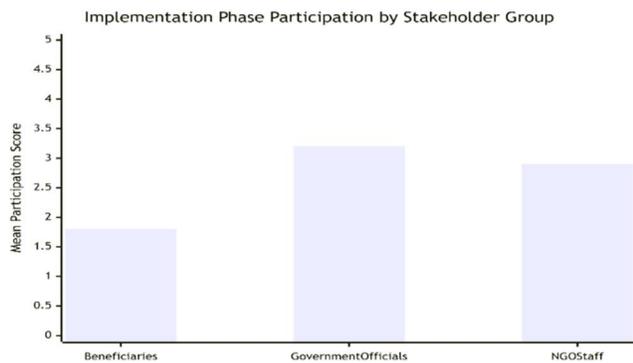


Figure 3 Implementation Phase Participation Levels by Stakeholder Group

The quality assessment revealed significant construction deficiencies, with 62% of respondents rating construction quality as "Fair" (x̄ = 2.86, σ = 0.54). Technical inspections identified multiple non-compliances, including inadequate roof anchoring (43% of structures), insufficient drainage slope (mean 0.5% vs. recommended 2%), and substandard waterproofing in 67% of foundations. These engineering shortcomings directly correlate with the low effectiveness rating of community participation in implementation (x̄ = 2.86, σ = 0.61).

The multiple regression model for overall project satisfaction yielded Equation 12.

$$Y_{overall} = 0.89 + 0.42X_{decision} + 0.31X_{design} + 0.48X_{implementation} \quad (R^2 = 0.73) \quad (12)$$

Notably, the implementation phase coefficient (0.48) is the largest, suggesting that participation during execution has the strongest impact on final satisfaction. This challenges the conventional focus on early-phase participation alone and underscores the importance of sustained engagement throughout the project lifecycle (Zhang, 2025).

E. Spatial and Technical Validation Findings

GIS analysis revealed critical spatial planning deficiencies across all the three sites. The average distance to primary livelihoods (farmlands/fishing areas) increased from 1.2 km pre-resettlement to 4.7 km post-resettlement. This shift represents a 292% increase in travel distance. This spatial dislocation also presents direct economic consequences with 68% of households reporting decreased income post-relocation. The technical audit of construction quality using standardised checklists revealed compliance rates of only 54% with national building codes. Most concerning were water and sanitation provisions, with only 41% of structures meeting minimum standards for flood-resilient sanitation systems. The correlation between technical non-compliance and community dissatisfaction was significant (r = 0.71, p<0.001), demonstrating that engineering quality directly influences social acceptance.

F. Limitations and Future Research Directions

While this study provides comprehensive insights into participatory deficiencies in Nigerian resettlement projects, several limitations warrant acknowledgment. The cross-sectional design limits causal inference, and the reliance on self-reported data introduces potential response bias.

Educational attainment varies among respondents, with a dominant share (39.1%) having secondary education, followed by 29.5% with primary education and 17.7% with no formal schooling. Only 13.6% possess tertiary education. This moderate literacy level implies a population with limited technical competence to participate effectively in design discussions that require visualisation and interpretation of architectural drawings. This result helps to explain the relatively low participation recorded during the design phase of the resettlement projects.

The finding supports previous studies (Choguill, 1996; Arnstein, 1969), which assert that literacy levels and civic education significantly influence the degree to which residents can engage in meaningful participatory processes.

Future research should employ longitudinal designs to track participatory outcomes over time and incorporate objective physical measurements of housing quality and flood resilience. Additionally, the development and testing of digital participatory platforms tailored to the Nigerian context represents a critical direction for applied research. Experimental studies comparing traditional and technology-enhanced participation methods could provide valuable evidence for optimising engagement strategies in resource-constrained environments.

V. CONCLUSION

This study conclusively demonstrates that community participation in resettlement housing across North Central Nigeria is systematically ineffective with a CPI of 2.57. This reflects profound dissatisfaction across decision-making, design, and implementation phases. The findings reveal that participatory engagement deteriorates as projects progress with the implementation phase critical for quality assurance and ownership which shows the strongest correlation to overall failure. Technical audits further substantiate that poor spatial planning, non-compliant construction, and the exclusion of local knowledge directly undermine both structural integrity and social acceptance. The study also revealed that to transform these outcomes, a fundamental paradigm shift is required, moving from tokenistic consultation to a legally mandated, technology-facilitated co-production model. This study, therefore, recommends the immediate adoption of a Digital Participatory Platform (DPP) integrating GIS for transparent site selection, BIM for collaborative design visualization, and block chain for accountable beneficiary management. Concurrently, policy reforms must institutionalise phased participation mandates within national building codes and disaster management frameworks. Future research should prioritize longitudinal studies on participation's long-term socio-economic impact, the cost-benefit analysis of inclusive models, and the technical validation of indigenous flood-resilient practices. Only through such integrated socio-technical and policy innovations can resettlement housing achieve its dual mandate of providing physically safe and socially sustainable homes for flood-prone communities.

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