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Original Research Article

Social Vulnerability Indicators and Their Relationships with Flood Hazard Determinants in Jalingo Metropolis, Nigeria

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Abstract: Social vulnerability is how income, gender, age, education, housing type and other personal factors make some people more exposed to floods. In fast-growing Nigerian cities like Jalingo, we do not know which social factors are most linked to flood risk. This study tested 8 social factors against 8 flood risk determinants amongst 437 households in Jalingo's 10 DMAs. We used Pearson correlation in SPSS. Social factors tested were gender, location, age, education, house ownership, income, years in the area, and occupation. Flood risk determinants were flood hazard perception, climate change impact, urban change impact, institutional support, amenity value, self-protection, responsibility, and other risk concerns. The results revealed house ownership as the strongest factor. Owners knew more about floods and worked with the government more than tenants. r = .099 with flood perception and r = .243 with institutional support, both significant. Location and education are linked positively to climate change worries. Gender and occupation are linked negatively to the climate change impact. Age is linked negatively to amenity value. But no social factor is linked to self-protection or responsibility. In Jalingo, owning a house makes people more aware of floods and more likely to join government programmes. This shows that flood risk in Jalingo is not the same as in other cities. Flood plans here must target tenants and match local social patterns.

Keywords: Social Vulnerability, Flood Risk, Pearson Correlation, House Ownership, Jalingo Metropolis

Introduction

Floods do not hit everyone the same way. In Jalingo, a tenant with low income will suffer more than a house owner with savings. An elderly woman will find it harder to

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escape than a young man. This is called “social vulnerability”. The social dimensions of flood vulnerability, rooted in income deficits, gendered power dynamics, age-related mobility limitations, educational disparities, and tenure insecurity, have been extensively theorised in the hazard literature (Cutter, 1996; Wisner et al., 2004; and Samuel Rufat et al., 2015). Social Vulnerability Theory (SVT) posits that vulnerability to natural hazards is not simply a function of physical exposure but is mediated by the socioeconomic and demographic characteristics of affected populations (Pelling, 2013; Adger et al., 2004). In practice, this means that two households located equally within a flood zone may face profoundly different outcomes depending on their social capital, housing security, educational access, and income levels. For urban flood risk management, identifying these social differentials is critical to designing interventions that reach the most exposed populations.

Social vulnerability indicators are strongly related to flood hazard determinants in Jalingo Metropolis, and the broader literature shows that flood risk is shaped by the interaction of hazard, exposure, and unequal coping capacity rather than by hydrology alone. In flood research, the most consistently supported social vulnerability dimensions are poverty, socioeconomic status, demographic structure, health, housing quality, infrastructure access, and coping capacity, but their effects vary by place, disaster phase, and outcome (Rufat et al., 2015; Tascón-González et al., 2020). Reviews also show that many studies still reuse generic indicator sets without sufficient local adaptation, validation, or ground-truthing, which is a central limitation for a city like Jalingo, where rapid urban growth, flash flooding, and local drainage conditions likely matter as much as standard census variables (Painter et al., 2024; Hamidi et al., 2025). For Nigerian and comparable African settings, the evidence points to a recurring pattern: socially disadvantaged households often occupy flood-prone land, have weaker buildings and services, and possess fewer resources for preparedness and recovery (Salami et al., 2017; Amoako & Inkoom, 2018). In Jalingo specifically, extreme floods have already produced major mortality, displacement, housing destruction, and farm losses, underscoring that the city’s flood problem is both physical and social (Oruonye, 2012).

Flood hazard determinants in Nigerian and comparable studies are dominated by hydro-geomorphic and urban land-use variables. In the Hadejia basin, elevation, rainfall, slope, distance from rivers, soil, flow accumulation, and drainage density were used to model hazard extent (Shuaibu et al., 2022). Global floodplain analysis similarly found that topography and drainage area correlate with flood sensitivity and settlement patterns (Devitt et al., 2023). Nigerian case studies add human modifications such as blocked drainage, poor waste management, and unplanned growth as direct hazard amplifiers in cities (Douglas, 2017; Salami et al., 2017). The main implication for Jalingo is that hazard mapping should not stop at rainfall or river proximity. Urban drainage blockage, land-use change, and settlement concentration in flood-prone corridors are repeatedly identified as determinants that intensify local flood hazard (Douglas, 2017; Salami et al., 2017; Salhi et al., 2024).

Despite growing recognition of social vulnerability in the global hazard literature, empirical studies that statistically interrogate the correlations between social indicators and composite flood hazard determinants at the community scale in Nigerian metropolitan contexts are largely absent. Many studies talk about social vulnerability globally. Odunuga et al. (2012) studied Lagos and Akukwe (2014) studied other cities. But few studies in Nigeria tested which exact social factor links to which exact flood problem using numbers. In Jalingo, we still do not know: Does house ownership make people more aware of floods? Do women perceive risk differently from men? Does education change how people see climate change? These questions have no clear answer for Jalingo yet. Without these answers, government programs may help the wrong people.

The literature, therefore, supports analysing Jalingo through three linked lenses: which indicators best capture social vulnerability, which flood hazard determinants matter most, and how the two sets of variables interact spatially and institutionally (Lapietra et al., 2023; Shuaibu et al., 2022; Tate et al., 2021). The question of how indicators such as housing tenure, gender, occupation, and household income co-vary with residents' perceptions of urban change, institutional arrangements, amenity values, and attenuated risk remains unanswered in the Jalingo context. This evidence gap limits the precision and social equity of flood risk interventions.

This paper addresses this gap by investigating the statistical relationships between eight social vulnerability indicators and eight composite variables representing other determinants of residents' vulnerability to flood hazards in Jalingo Metropolis, Nigeria. Bivariate Pearson's r correlation analysis was conducted on 437 complete household observations from a stratified systematic survey across ten demarcation areas (DMAs) of Jalingo Metropolis. Social vulnerability indicators (gender, location, age, education, housing tenure, household income, years of residency, and occupation) were correlated with composite Likert-scale variables representing Flood Hazard Perception (FHP), Climate Change Impact (CCI), Urban Change Impact (UCI), Institutional Arrangement (IA), Amenity Values (AV), Self-Protection (SP), Attribution of Responsibility (AR), and Attenuation of Risk to Other Concerns (AROC). The analysis tests whether and how social characteristics shape residents' engagement with and perceptions of flood hazard in a northeastern Nigerian city. The findings are intended to inform the design of socially differentiated flood risk mitigation programmes, particularly targeting the most socially exposed groups, tenants, low-income households, women, and the youngest cohorts.

2. METHODS

2.1 Population and Setting

The study population consisted of 39,427 registered households in Jalingo Metropolis distributed across ten DMAs. The metropolitan area is characterised by significant socioeconomic heterogeneity, with a majority of residents (57.2%) earning between ₦30,001 and ₦80,000 per month, and 14% earning below the national minimum wage of ₦30,000. The area is located on the alluvial fans of Rivers Mayo-Gwoi and Lamurde and has experienced multiple severe flood events since 2005.

2.2 Sampling and Participants

A stratified systematic sampling approach was employed. The study area was divided into Zone A and Zone B based on expert flood risk assessment and further clustered into ten DMAs aligned with TAWASCO water demarcation boundaries (see Table 1 and Fig. 1). Questionnaires were distributed systematically every 14th household across each DMA. Of 700 questionnaires distributed, 437 complete observations, cases with non-missing values for all variables, were included in the correlation analysis. The sample was 64.3% male and 35.7% female, with the majority (65.2%) between 18 and 34 years old and 69.4% holding tertiary education qualifications.

Table 1*:* Sample Population

Zone	Demarcation areas (DMAs)	Residential Count	(%)	Sample Distributed	(%)	Sample Used	(%)
	Abuja	2469	6.3	44	6.3	34	8
	Jalingo North	2683	6.8	48	6.8	36	8
Zone A	Kofia	3783	9.6	67	9.6	41	9
	Kona	644	1.6	11	1.6	10	2
	Mile six	5695	14.4	101	14.4	67	15
	Lamurde	4077	10.3	72	10.3	47	11
	Magami	3612	9.2	64	9.2	39	9
Zone B	Central	3613	9.2	64	9.2	35	8
	Sabon Gari	6221	15.8	111	15.8	60	14
	Sintali	6630	16.8	118	16.8	68	16
	Total	**39427**	**100**	**700**	**100**	**437**	**100**

Source: *Researcher computation, 2022.*

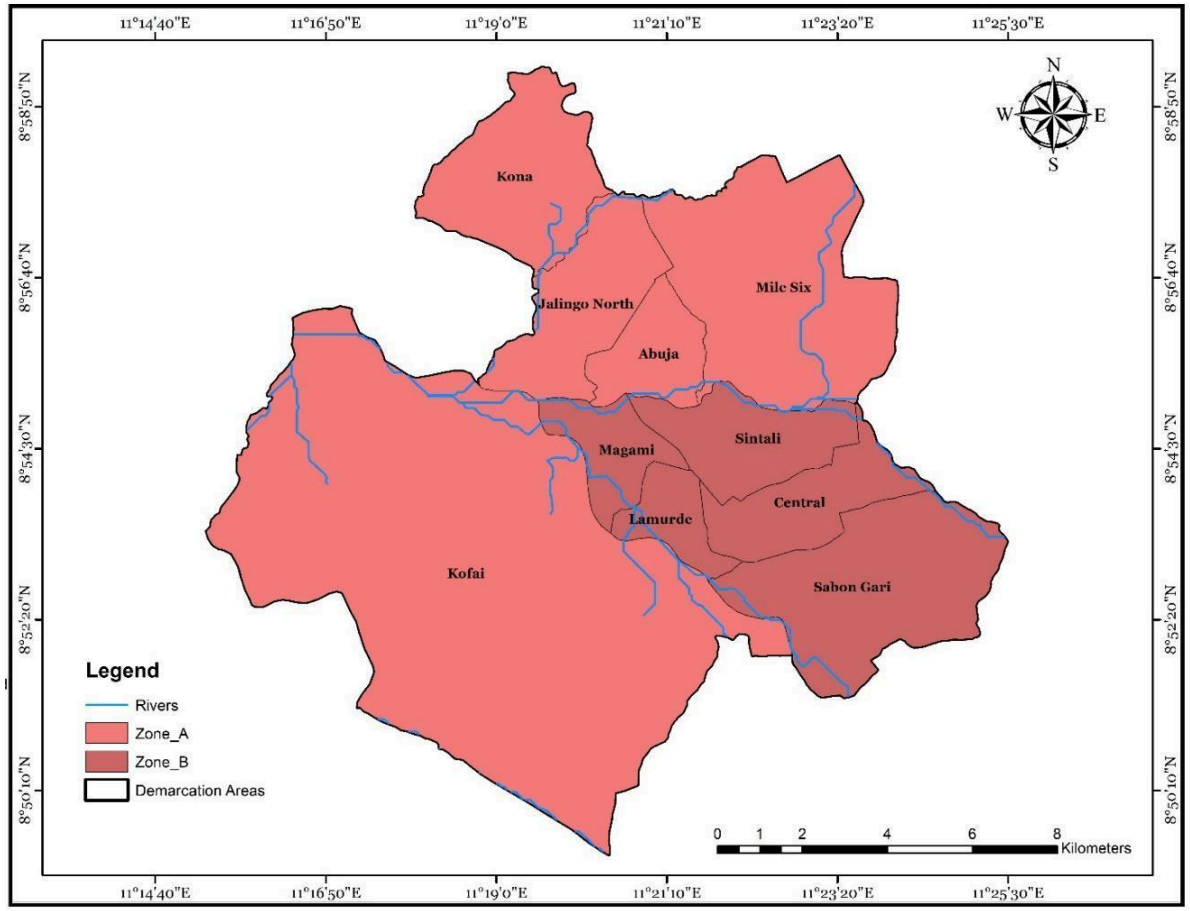

Figure 1: Map of the study area, stratified into Zone A and B. Source: Researchers' computations, 2026

2.3 Research Design

This paper employs a correlational cross-sectional design. Social vulnerability indicators were treated as independent variables, while composite scale scores representing each of the eight vulnerability determinants were treated as dependent variables. This design follows Oulahen's (2015) analytical framework, operationalising social vulnerability as a set of measurable demographic and socioeconomic characteristics that can be statistically associated with residents' positions on other vulnerability dimensions.

2.4 Procedure

Social vulnerability indicators were operationalised as follows: Location (Zone A = 1, Zone B = 2); Gender (Male = 1, Female = 2); Age (categorical: 18–24, 25–34, 35–44, 45–54, 55+); Education (Basic = 1, Secondary = 2, Tertiary = 3, Other = 4); Housing Tenure (Owner = 1, Tenant = 2); Household Monthly Income (₦<30,000 = 1, ₦30,001–80,000 = 2, ₦80,001–130,000 = 3, >₦130,000 = 4); Years at Current Address (continuous, later binned); Occupation (categorical). Composite variable scores for each of the eight determinants were created by summing and averaging Likert responses to all items within that determinant category. All data were entered in Microsoft Excel and imported into IBM SPSS v.20 for analysis.

2.5 Data Analysis

Pearson's r bivariate correlation coefficients were computed between each social vulnerability indicator and each composite determinant score. Significance was tested at $\alpha = 0.01$ (two-tailed) and $\alpha = 0.05$ (two-tailed). The 437 complete observations were selected to ensure all variables were available for the full correlation matrix. Given that Likert scale items were treated as interval-level data following Boone and Boone (2012), Pearson's r was deemed the appropriate parametric statistic.

3. RESULTS

3.1 Housing ownership is the strongest social factor.

Table 2 shows that housing tenure emerged as the most consistently significant social vulnerability indicator across the correlation matrix. Tenure showed a statistically significant positive correlation with Flood Hazard Perception (FHP: $r = .099$, $p < .05$) and a moderate positive correlation with Institutional Arrangement (IA: $r = .243$, $p < .01$), representing the strongest single correlation in the entire matrix. No other social indicator approached this magnitude of association with IA.

Table 2: Pearson's r correlation matrix showing social vulnerability indicators and composite mean of variables representing other determinants of vulnerability.

Social Factor	FHP	CCI	UCI	IA	AV	SP	AR	AROC
Location	-.040	.205**	-.079	-.037	-.043	.021	-.051	-.104*
Gender	.091	-.138**	-.054	.087	.024	.021	.012	.098*
Age Category	.062	.032	-.049	-.055	-.123**	.037	.088	-.037
Education	-.024	.117*	-.098*	-.055	.041	.034	-.012	-.096*
Housing Tenure	.099*	.009	.020	.243**	-.059	.062	.084	.097*
Household Income	.058	.038	-.018	-.104*	.064	-.001	-.068	-.042
Old New Resident	.047	.002	.066	-.032	.104*	-.088	.060	-.006
Occupation	.032	-.141**	.105*	-.063	.100*	.061	.025	.070

Note**. *Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).* ***Source:*** *Fieldwork, 2022*

3.2 Location and Education as Predictors of Climate Change Impact Perception

Location (zone membership) showed a statistically significant positive correlation with climate change impact (CCI: $r = .205$, $p < .01$), the second-strongest association in the matrix. Education also positively correlated with CCI ($r = .117$, $p < .05$). Conversely, Gender ($r = -.138$, $p < .01$) and Occupation ($r = -.141$, $p < .01$) showed significant negative correlations with the CCI.

3.3 Age, Years of Residency, and Occupation as Predictors of Amenity Values

Age category showed a significant negative correlation with amenity values ($r = -.123$, $p < .01$), while years of Residency ($r = .104$, $p < .05$) and Occupation ($r = .100$, $p < .05$) showed weak positive correlations with AV.

3.4 Non-Significant Determinants: Self-Protection and Attribution of Responsibility

Notably, no social vulnerability indicator showed a statistically significant correlation with either Self-Protection (SP) or Attribution of Responsibility (AR).

4. DISCUSSION

4.1 Housing Tenure as the Dominant Social Predictor

The positive association between owner-occupancy and FHP indicates that homeowners, who have greater financial stakes in their properties, are more likely to perceive flood hazards as a serious risk. The even stronger association with IA suggests that homeowners are significantly more likely to have engaged with institutional processes: obtaining building permits, receiving advice from development control officials, and being aware of mitigation plans. Tenants, by contrast, face structural barriers to institutional engagement, as one respondent in Magami DMA observed:

'As a tenant, I cannot do any retrofitting on the property I am renting to mitigate floodwater, because the owner of the property would not allow me.'

The positive tenure-FHP association is consistent with Grothmann and Reusswig (2006), who found that homeowners exhibit relatively higher risk perception because they bear greater property-related losses. The tenure-IA correlation aligns with Aderogba KKamel (2012) and Adeola (2009), who showed that government programmes and institutional support disproportionately favour homeowners in post-disaster contexts. Brouwer et al. (2007) found that renters experience elevated negative health effects and economic losses but receive less institutional support, a pattern replicated in Jalingo. Flood risk interventions must explicitly target tenants, who represent 31.6% of the survey population. Tenant-specific engagement pathways, including direct information campaigns and landlord-tenant flood resilience agreements, are needed to close the institutional access gap.

4.2 Location and Education as Predictors of Climate Change Impact Perception

The positive location-CCI association suggests that residents of Zone B, the lower-lying zone with 56% of its land in the flood zone, are more attuned to climate-related flood signals, likely because they experience more frequent inundation events. The education-CCI correlation indicates that higher educational attainment facilitates greater understanding and acceptance of climate change concepts. The negative gender-CCI correlation suggests that female respondents report lower climate change concern, which may reflect constrained access to climate information channels given patriarchal structures in Jalingo's social fabric. The negative occupation-CCI association may reflect that certain

occupational groups (particularly farmers and blue-collar workers) are less exposed to formal climate information dissemination.

The location-CCI correlation is consistent with Susan et al. (2022), who found that residents of more severely flood-exposed areas in Lagos were more aware of flood risk. The education-CCI relationship aligns with Samuel Rufat et al.'s (2015) meta-analysis, identifying education as a significant driver of social vulnerability. The gender finding resonates with Olatundun I. Oluwatoyin's (2018) observation that women's invisibility in African policy-making limits their access to risk-reduction information. Climate risk communication in Jalingo must be gender-sensitive and delivered through accessible community channels rather than formal institutional platforms. Targeting women's groups, religious organisations, and occupational associations for climate awareness campaigns would help close the information equity gap.

4.3 Age, Years of Residency, and Occupation as Predictors of Amenity Values

The negative age-AV relationship suggests that older residents place less weight on proximity-based amenity factors (access to water, affordability, and nearness to schools) as reasons for their current location. This likely reflects the reality that older, established residents made location choices earlier in life under different economic conditions and are less likely to relocate based on amenity reassessment. The positive years-of-residency association with AV indicates that longer-term residents have developed greater attachment to location-specific amenities, reinforcing their tendency to remain in flood-prone areas. The occupation correlation may reflect that certain occupational group (particularly farmers and market traders) value proximity to water and agricultural land, amenities that coincide with flood-prone riparian zones.

The amenity-location nexus aligns with Collins (2005) and Terpstra et al. (2006), who demonstrated that environmental amenity values in flood-prone zones increase vulnerability by reinforcing place attachment. The age-AV negative relationship contrasts with Adeola, F. O.'s (2009) finding that longer residence duration leads to increased attachment, though the direction of the relationship in Jalingo may be contextually mediated by economic constraints and the scarcity of affordable housing options elsewhere in the metropolis. Location decisions in Jalingo are primarily driven by affordability and access to water, not safety. This suggests that flood vulnerability reduction cannot be achieved through information provision alone; it requires affordable housing development outside flood-prone zones as a structural intervention.

4.4 Non-Significant Determinants: Self-Protection and Attribution of Responsibility

Notably, no social vulnerability indicator showed a statistically significant correlation with either Self-Protection (SP) or Attribution of Responsibility (AR). The uniform non-significance across all social categories for SP and AR is itself analytically meaningful. It suggests that the tendency to attribute flood mitigation responsibility to government (particularly local, state, and federal authorities) and the modest uptake of self-protective measures (primarily sandbagging) are not differentiated by income, gender,

age, education, or tenure. Rather, these patterns appear to be culturally generalised across all social strata of Jalingo's population.

The universal attribution of responsibility to government aligns with Urenna and Happiness's (2018) observation that public perception of flood protection as primarily a governmental responsibility is widespread. The non-differentiation by income is particularly notable: Sandink (2007) found that fewer than 15% of exposed residents take self-protective actions regardless of income level, a pattern replicated in Jalingo, where sandbag use (51%) and other low-cost measures dominate across income groups. Since SP and AR are not socially differentiated, education and empowerment campaigns for self-protective behaviour must target the entire Jalingo population rather than specific social subgroups. However, structural measures, including improved drainage, green infrastructure, and enforced setback regulations, will be more effective than behavioural appeals given the generalised government-dependency orientation.

5. CONCLUSION

This paper empirically examined the correlational structure between social vulnerability indicators and composite flood hazard determinants among 437 households in Jalingo Metropolis. Housing tenure emerged as the most important social predictor, significantly associated with both flood hazard perception and institutional arrangement engagement. Location and education predicted climate change impact perception, while age, years of residency, and occupation shaped amenity value perceptions. Critically, neither self-protection nor attribution of responsibility was differentiated by any social indicator, pointing to culturally generalised patterns of government dependency and low-cost coping behaviour.

In conclusion, flood risk in Jalingo Metropolis is as much a social crisis as it is a hydrological one. The physical forces of extreme rainstorms and low-lying topography only transform into disasters because structural poverty, weak institutional planning, and low risk awareness push vulnerable human populations directly into the path of destruction. True resilience will only be achieved when environmental management is seamlessly integrated with socio-economic empowerment and proactive urban planning. Moreso, Jalingo is not like Lagos or Abuja. As such her flood plans must be different from Lagos or Abuja. One flood plan for all cities would not work. To mitigate the compounding impacts of social vulnerability and flood hazards in Jalingo Metropolis, the following interventions are urgently required:

1. Enforce Strict Spatial Zoning and Buffer Zones: Establish and legally protect strict buffer zones along the Mayogwoi and Lamurde stream channels. Residential and institutional building developments on active floodplains must be halted, and alternative, safer tracts of land must be provisioned for urban expansion. Build cheap houses outside flood zones so people stop living in risky areas and fix drainage and enforce building rules, because sandbags alone would not help.
2. Drainage Modernization and Waste Infrastructure: Investment must be directed into constructing a comprehensive, interconnected concrete drainage system across the

metropolis. Simultaneously, municipal solid waste management systems must be revolutionized to prevent residents from using drainage channels as dump sites (Oruonye, 2012).

3. Socio-Economic Safety Nets: Given that poverty drives floodplain encroachment, the state government should implement targeted social safety nets, micro-credit facilities, and climate-smart agricultural training for those whose livelihoods depend on floodplain irrigation (Musa & Shabu, 2019).
4. Community-Based Early Warning Systems (CBEWS): Bridge the risk perception gap by designing localized, multi-lingual early warning networks. Utilizing mobile text alerts to send climate messages through women's groups and market unions. Community leaders should ensure that vulnerable groups receive actionable, real-time weather information prior to peak flood stages.

These findings advance understanding of the social architecture of flood vulnerability in northeastern Nigeria and provide a foundation for the design of socially differentiated, equity-oriented flood risk governance frameworks. This study gives Jalingo real data to design fair flood programmes that reach the most exposed people first.

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