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Flood Hazard Vulnerability and Resilience Strategies among Women in Odukpani's Coastal Communities, Cross River State, Nigeria

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Abstract

This study examined women's vulnerability to flood hazards and their resilience strategies in Odukpani's coastal communities, Cross River State, Nigeria. It aimed to assess the extent of vulnerability, identify adopted coping strategies, and determine socio-economic factors influencing resilience. The hypothesis tested was that women's socio-economic characteristics significantly affect their resilience to flooding. Using a descriptive survey design, 384 women were selected through stratified random sampling. Data were gathered with a structured questionnaire and analyzed using descriptive statistics and multiple linear regression in SPSS. Findings revealed that women in Odukpani experience high flood vulnerability, with 41.9 percent reporting that flooding occurs very often and 25.8 percent stating it happens frequently. Housing was the most affected sector (36.2 percent), followed by farming and fishing (28.9 percent). In response, 30.5 percent of women temporarily relocated to safer areas, while 27.9 percent stored food and water. Only 2.5 percent relied on government or NGO aid, indicating weak institutional support. Regression results showed that socio-economic characteristics significantly influenced resilience, explaining 92.8 percent of its variance ($R^2 = 0.928$, $F = 1637.0$, $p < 0.001$). Household income ($B = 0.520$, $p < 0.001$) and social support networks ($B = 0.330$, $p < 0.001$) had strong positive effects, while education ($B = 0.024$, $p = 0.410$) was positive but not significant. The study concluded that financial and institutional constraints heighten vulnerability. It recommended economic empowerment, better infrastructure, effective early warning systems, and stronger institutional support, while urging future studies to explore how cultural and gender dynamics shape long-term adaptation.

Key words: Flood vulnerability, Gender vulnerability, Climate resilience, Coastal communities, Disaster management

Introduction

Flood hazard vulnerability and resilience strategies have become central themes in disaster risk management, especially as climate change continues to increase the frequency and severity of extreme weather events. Vulnerability reflects the extent to which individuals and communities are exposed to and affected by flood risks, often determined by socio-economic conditions, geographical settings, and infrastructural inadequacies, while resilience captures their ability to anticipate, withstand, and recover from

integrated resilience frameworks that blend structural, social, institutional, and ecological strategies to support long-term adaptation (Wang et al., 2022). In rural and flood-prone regions, exposure remains high due to resource constraints, but community-based actions and local adaptive knowledge have proven vital in reducing risk and strengthening collective resilience (Fahad et al., 2023). These insights stress the need to link vulnerability reduction with proactive resilience-building for sustainable flood management.

Globally, there is increasing recognition that vulnerability and resilience to floods are not experienced equally across populations. Women, in particular,

often face disproportionate risks due to gendered social roles, limited access to financial and informational resources, and exclusion from decision-making structures. Studies in South and Southeast Asia have shown that women bear distinct burdens during floods such as disruptions to livelihood, health challenges, and caregiving responsibilities, yet they also play key roles in resilience through informal social networks, household food management, and local disaster preparedness (Naz & Saqib, 2021; Azad & Pritchard, 2023; Chisty et al., 2021). International frameworks like the Sendai Framework for Disaster Risk Reduction now emphasize the importance of gender-responsive strategies, acknowledging that empowering women enhances community resilience (Wang et al., 2022). However, a conceptual gap remains in understanding gender-specific coping mechanisms within small, resource-constrained coastal communities, particularly in Nigeria, where studies often generalize vulnerability and resilience without distinguishing how women's social roles, livelihood patterns, and indigenous knowledge influence their adaptive responses to recurring floods. Addressing this gap is essential for developing inclusive and context-based flood resilience strategies.

Flood resilience strategies often integrate advanced technologies, robust infrastructure, and gender-inclusive disaster planning. For instance, in the Netherlands, a global leader in flood resilience, dike reinforcement projects are coupled with community engagement to ensure diverse household needs, including those of women, are addressed. In the United States, women in vulnerable areas like New Orleans' Lower Ninth Ward were disproportionately affected by Hurricane Katrina, highlighting structural inequalities in access to recovery resources. However, recent resilience frameworks in developed countries have focused on enhancing inclusivity through women-centered programs, such as flood preparedness training for women-led households and gender-sensitive evacuation planning. These examples underscore that while advanced economies possess resources for large-scale flood management, gender disparities persist, and addressing women's vulnerabilities remains critical to achieving true resilience (Gaisie et al., 2022).

Across Africa, the intersection of poverty, informal settlement patterns, and weak institutional support intensifies flood vulnerabilities, especially for women. In Accra, Ghana, women in informal settlements have been shown to suffer greater economic and health-related consequences from flooding, largely due to their reliance on informal livelihoods and caregiving responsibilities (Gaisie et al., 2022). Similarly, in Lagos, Nigeria, coastal communities struggle with recurrent flooding exacerbated by urbanization, inadequate drainage, and sea-level rise. Women are among the most affected, facing disruptions in trading, household food insecurity, and heightened exposure to waterborne diseases (Ndimele et al., 2024). Despite these challenges, women's resilience strategies in African coastal settings include informal savings groups, community-based early warning systems, and reliance on indigenous ecological knowledge that enhances adaptive capacity (Fahad et al., 2023). These findings reflect the necessity of incorporating gender-responsive policies in African flood management frameworks, which are often dominated by structural interventions with limited social integration.

In Nigeria, and specifically in Odukpani's coastal communities of Cross River State, women's vulnerability to flood hazards is shaped by socio-economic, cultural, and environmental factors. Odukpani, situated along the Cross River estuary, experiences recurrent flooding that disrupts fishing, farming, and trading activities, which are primary livelihoods for women in the area (Abraham et al., 2025). Limited access to financial resources and exclusion from community-level decision-making further exacerbate their vulnerability. However, resilience strategies are emerging, often grounded in local practices and community solidarity. Women contribute significantly through adaptive agricultural practices, such as cultivating flood-resistant crops, and through the use of community-based natural resources for sustenance during flood

periods (Akpan et al., 2024). Additionally, indigenous religious practices and sacred ecological sites play a role in environmental stewardship, indirectly supporting resilience by promoting sustainable land and water management (Ogar, 2023). These examples highlight the dual role of women as both highly vulnerable to flood hazards and as key agents of resilience, emphasizing the need for policies and interventions in Cross River State that prioritize women's voices, strengthen their adaptive capacities, and integrate local ecological knowledge with broader resilience frameworks.

Flood hazard vulnerability and resilience are grounded in well-established theoretical frameworks that explain how social and environmental systems interact during disasters. Cutter's Hazards of Place Model, proposed by Susan L. Cutter in 1996, links vulnerability to the intersection of biophysical exposure and social conditions. It assumes, first, that vulnerability is spatially determined by a community's physical location and environmental exposure, and second, that social characteristics such as income, gender, and access to resources influence the capacity to prepare for and recover from hazards. Similarly, the Social-Ecological Resilience Theory, developed by C. S. Holling in 1973, views resilience as the ability of systems, both ecological and social, to absorb shocks, adapt to change, and reorganize without losing their core identity or functionality. Its two basic assumptions are that human and ecological systems are interconnected and that adaptive capacity, rather than resistance alone, determines long-term resilience. Together, these frameworks highlight that reducing flood vulnerability requires an integrated approach that combines physical protection with social empowerment and adaptive learning.

Flood vulnerability in Odukpani's coastal communities remains a critical concern, especially for women whose livelihoods depend largely on farming, fishing, and small-scale trading. Frequent flooding damages farmlands, destroys fishing areas, and interrupts local markets, pushing women into deeper economic insecurity. Findings indicate that women in Odukpani experience high flood frequency, with many reporting severe livelihood disruptions. Unlike men who may seek alternative income through wage labor or migration, women's socio-economic responsibilities often tie them to the community, limiting their adaptive capacity. This situation reflects wider patterns across southern Nigeria, where poor infrastructure, limited flood control, and weak institutional support worsen the effects of flooding in coastal and rural areas (Anam, Unimna & Ironbar, 2024). According to a 2025 statement by the Governor of Cross River State, flooding has already affected about 150 communities, destroying homes, farmlands, and public infrastructure (Daily Post, 2025).

The scale of damage across Cross River State underscores the magnitude of women's vulnerability in Odukpani. A 2023 national report noted that floods destroyed roughly 4,370 houses and displaced more than 51,000 people (National Daily Newspaper, 2023). Such widespread destruction disrupts local economies where women dominate informal trade and subsistence farming. As income sources collapse, women are forced to depend on short-term survival strategies like borrowing or selling household assets. Nchor (2023) highlights that informal households in Calabar rely heavily on adaptive livelihood strategies shaped by resource access and gender roles, yet women consistently face greater barriers in diversifying their income. In Odukpani, these structural inequalities deepen the cycle of poverty, further heightening women's exposure to the socio-economic effects of recurring floods.

Weak infrastructure, limited access to finance, and poor institutional coordination amplify the flood-related risks women face. Inadequate drainage systems, lack of flood shelters, and non-resilient housing expose women and children to greater danger during heavy rains. Despite several government efforts in infrastructure development, many coastal and riverine settlements remain outside the reach of effective flood management programs (Anam, Unimna & Ironbar, 2024). On a regional scale, the National Emergency Management Agency (NEMA) reported that the South-South region, including Cross River State, suffered total losses estimated at ₦2.51 trillion from the 2012 flood disaster, with ₦1.1 trillion attributed to lost economic activities (NEMA, 2012). These figures reveal the economic and human cost of repeated floods and highlight the urgent need for gender-sensitive flood management policies that strengthen women's resilience and promote inclusive community recovery. This research fills a critical gap as no prior study has statistically examined how factors such as income, education, and social support interact to influence women's flood resilience in Cross River State.

Global Perspectives on Women and Flood Vulnerability

Globally, studies have shown that women's vulnerability to flood hazards is influenced by deeply rooted social, economic, and cultural inequalities that determine exposure, coping capacity, and recovery potential. In South Asia, for example, research by Jerin, Azad, and Khan (2023) found that women in flood-prone areas of Bangladesh face greater livelihood insecurity, mobility restrictions, and caregiving burdens during disasters. Naz and Saqib (2021) similarly observed that women in char farming households are disproportionately affected by floods due to their dependence on natural resources, low asset ownership, and limited decision-making power. These findings highlight that women's vulnerability extends beyond physical exposure to the flood hazard itself; it is shaped by gendered divisions of labor, social marginalization, and unequal access to recovery resources. As climate change continues to intensify flood events, global evidence underscores the need to integrate gender equity into disaster management frameworks.

African Experiences and Institutional Challenges

Across Africa, women in coastal and low-lying settlements face compounded risks due to weak infrastructure, rapid urbanization, and limited institutional support. Ndimele et al. (2024) reported that in Lagos coastal communities, recurrent flooding disrupts women's livelihoods, trading activities, and access to clean water, heightening their exposure to health hazards. Bari et al. (2024) further argue from an intersectionality perspective that poverty, education level, and marital status often intersect to intensify women's vulnerability to flood disasters. Institutional weaknesses, such as the absence of inclusive planning and gender-sensitive policies, worsen these challenges, leaving women with minimal access to disaster relief, credit facilities, or recovery aid. These findings point to the urgent need for African governments to mainstream gender perspectives into disaster risk reduction and urban planning policies, ensuring that women's unique vulnerabilities and capacities are explicitly addressed in adaptation efforts.

Resilience Strategies and Gender Roles in Nigeria

In Nigeria, studies indicate that women in flood-prone communities are disproportionately affected due to their socio-economic roles in farming, petty trading, and caregiving. Ndimele et al. (2024) and Nchor (2023) highlight that floods often destroy farmlands, damage homes, and interrupt income-generating activities, leaving women with fewer recovery options than men. Despite these challenges, women continue to demonstrate resilience through informal coping strategies such as communal savings, food preservation, and mutual aid networks. However, these adaptive efforts are often undermined by limited access to institutional support, insurance, and early warning systems. The lack of targeted policies addressing women's roles in flood management reinforces structural inequalities and perpetuates their vulnerability. Strengthening women's resilience, therefore, requires recognizing and supporting their contributions as active agents in community-based adaptation and disaster recovery processes.

Empirical Gaps and Conceptual Implications

While existing studies across global and African contexts have documented the gendered dimensions of flood vulnerability, few have explored how socio-economic variables such as income, education, and social support interact to shape women's flood resilience in small coastal communities. Most Nigerian research focuses on urban flooding and infrastructure challenges, leaving limited empirical attention to gender-specific coping mechanisms in rural and coastal contexts like Odukpani. This study addresses that gap by statistically examining how women's socio-economic status influences their vulnerability and resilience to floods in these communities. Conceptually, it draws on frameworks such as Cutter's Hazards of Place Model (1996) and the Social-Ecological Resilience Theory (Berkes & Folke, 1998), which together emphasize that vulnerability and resilience are products of the interaction between social systems and environmental processes. By applying these theories, the study aims to provide a nuanced understanding of women's adaptive capacity and the socio-ecological dynamics shaping their responses to flood hazards in Cross River State.

Resilience strategies women adopt against floods

Women in coastal and flood-prone communities have developed diverse resilience strategies that enable them to adapt, cope, and recover from recurrent flooding despite their heightened vulnerabilities. A growing body of research emphasizes women's pivotal role in sustaining household and community resilience through both formal and informal mechanisms. In rural Bangladesh, Azad and Pritchard (2023) highlight how women contribute to adaptive capacity by diversifying household livelihoods, cultivating flood-resistant crops, and preserving food stocks to sustain families during prolonged flood events. Their role in maintaining social networks and organizing mutual aid systems also strengthens community resilience, demonstrating that resilience is not only about physical protection from hazards but also about sustaining social and economic systems under stress. Haque, Azad, and Choudhury (2022) add that women actively participate in social learning and innovative adaptation, such as adopting raised housing structures and collective farming, which enhance community resilience to flash floods.

Women's resilience strategies against flooding are often embedded in informal networks and community practices. Gaisie, Adu-Gyamfi, and Owusu-Ansah (2022) found that in Accra, Ghana, women in informal settlements employ strategies such as petty trading diversification, rotating savings groups, and shared childcare arrangements that allow families to better withstand economic shocks during flood events. These strategies are often shaped by women's resourcefulness in navigating poverty and limited access to institutional support, reflecting how gendered practices become central to resilience. Similarly, Saad (2021) observes that in urban slums, women engage in grassroots development initiatives such as organizing sanitation drives, small-scale infrastructure improvements, and advocacy for better drainage systems that indirectly build resilience to recurring floods. These examples illustrate that women's resilience is not confined to household survival but extends to broader community-based initiatives that reduce collective risk exposure.

Indigenous and marginalized women have also played a vital role in advancing resilience strategies through cultural knowledge and community leadership. In an Indigenous Fijian community, Singh, Tabe, and Martin (2022) document how women draw on traditional ecological knowledge to guide community adaptation to climate-related floods, including mangrove restoration and sustainable resource management. Such practices demonstrate the fusion of cultural heritage with modern resilience-building strategies. Cvetković and Ivković (2022) further argue that women's resilience is influenced by demographic, socio-economic, and psychological factors, as women often display higher levels of collective coping and emotional resilience, which contribute to stronger recovery outcomes after disasters. Taken together, these studies reveal that women's resilience strategies are multidimensional, encompassing livelihood diversification, social learning, community-based initiatives, and cultural knowledge, all of which are crucial to building sustainable resilience to flood hazards.

Factors influencing women's flood resilience

Women's resilience to flooding in coastal and riverine communities is shaped by an interplay of socio-economic, cultural, institutional, and environmental factors. Socio-economic status is one of the most critical determinants, as women with limited access to income, credit, and savings are less able to invest in adaptation measures or recover quickly after flood events. Xu, Xie, Yu, and Proverbs (2023), in their study of flood-affected communities in China, found that income levels, education, and employment directly influence resilience by determining the capacity to adopt preventive measures and sustain recovery. Similarly, in rural Bangladesh, Azad and Pritchard (2023) demonstrated that women's resilience is significantly enhanced when they have access to land, agricultural resources, and social networks that support diversification of livelihoods. These findings underscore that economic empowerment and resource access are central to strengthening women's adaptive capacity in flood-prone environments.

Institutional and governance-related factors also play a major role in shaping women's resilience. In Ghana, Gaisie, Adu-Gyamfi, and Owusu-Ansah (2022) noted that inadequate institutional support and limited involvement of women in decision-making processes undermine household resilience, particularly in informal settlements. Women's resilience is often weakened by exclusion from local disaster risk management structures, where male-dominated leadership overlooks gender-specific vulnerabilities and

coping needs. Akhir et al. (2021), in their research on flood victims in Malaysia, similarly highlighted the importance of government assistance, disaster relief programs, and community-based organizations in enhancing resilience, particularly when these initiatives integrate women's voices and prioritize their specific challenges. Policies that fail to address gender inequalities not only limit women's recovery capacity but also reinforce cycles of vulnerability during successive flood events.

Social and cultural dynamics further influence women's resilience, often in ways that intersect with structural inequalities. Chisty et al. (2021) emphasize that women's ability to withstand floods in Bangladesh is mediated by gender norms that restrict mobility, decision-making autonomy, and access to formal institutions. At the same time, women draw on social capital through community networks, religious groups, and informal associations to build resilience in contexts where formal support is weak. Polcarová and Pupíková (2022) argue that socially vulnerable groups, including women, face compounded risks because of their dependency on fragile support systems, yet these same social ties can become resilience assets when mobilized effectively. In this way, cultural practices, gender roles, and social networks act as both barriers and enablers of resilience, suggesting that effective flood resilience strategies must not only address economic and institutional gaps but also transform social norms to fully empower women in disaster-prone communities (Nwankwo, & Uchegbu, 2019).

Materials and methods

This research was carried out in Odukpani Local Government Area (LGA) of Cross River State, Nigeria, an area known for its cultural heritage and environmental diversity. Based on the 2006 National Population Census, Odukpani had a population of 242,649, which, projected to 2024 using an annual growth rate of 2.5 percent, gives an estimated population of 351,132. The study concentrated on women in flood-prone coastal communities, who are often the most exposed to flood hazards and livelihood disruptions (Efe, 2011). The sample size of 384 respondents was determined using the Cochran formula: $n = (Z^2 \times p \times q) / e^2$, where $Z = 1.96$ at 95 percent confidence level, $p = 0.5$ (estimated proportion of the population), $q = 1 - p$, and $e = 0.05$ (margin of error). This produced $n = (1.96^2 \times 0.5 \times 0.5) / 0.05^2 = 384$, ensuring statistical representativeness and adequate precision for generalizing findings to the wider population. A multi-stage sampling procedure was adopted, starting with purposive selection of flood-affected communities, followed by stratified random sampling of households and systematic selection of women respondents within each stratum.

Data collection involved a combination of structured questionnaires, key informant interviews (KIIs), and focus group discussions (FGDs). The questionnaire captured socio-economic characteristics, flood experiences, and resilience strategies and was distributed across Creek Town, Eniong Abatim, Okurikang, Eki, Ito, Idere, and Inuakpa communities. To ensure reliability, the instrument underwent a pilot test and was validated using Cronbach's alpha, which yielded a coefficient of 0.83, indicating strong internal consistency. Quantitative data were analyzed using descriptive statistics such as frequencies, percentages, and means, while inferential statistics including Chi-square tests and logistic regression were employed to examine associations between vulnerability factors and resilience strategies.

Qualitative data obtained from KIIs and FGDs were analyzed thematically to identify recurring patterns, coping mechanisms, and gender-specific challenges. The coding process was carried out manually to preserve contextual depth and cultural nuances in respondents' narratives. Ethical approval for the study was granted by the Postgraduate Research Ethics Committee of the University of Calabar, Nigeria. All participants were briefed on the purpose of the study and gave informed consent, with assurances of confidentiality and voluntary participation. This rigorous methodological design ensured that both the quantitative and qualitative components complemented each other, providing a comprehensive understanding of women's vulnerability and resilience to flood hazards in Odukpani's coastal communities.

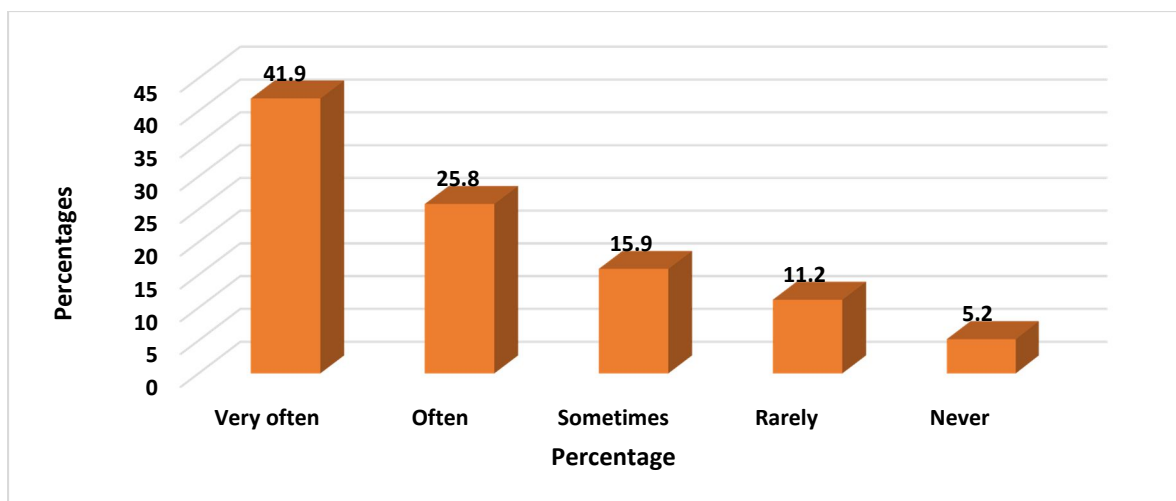


FIG. 2: Frequency of experiencing flooding in the community
Source: Authors' field survey, 2025.

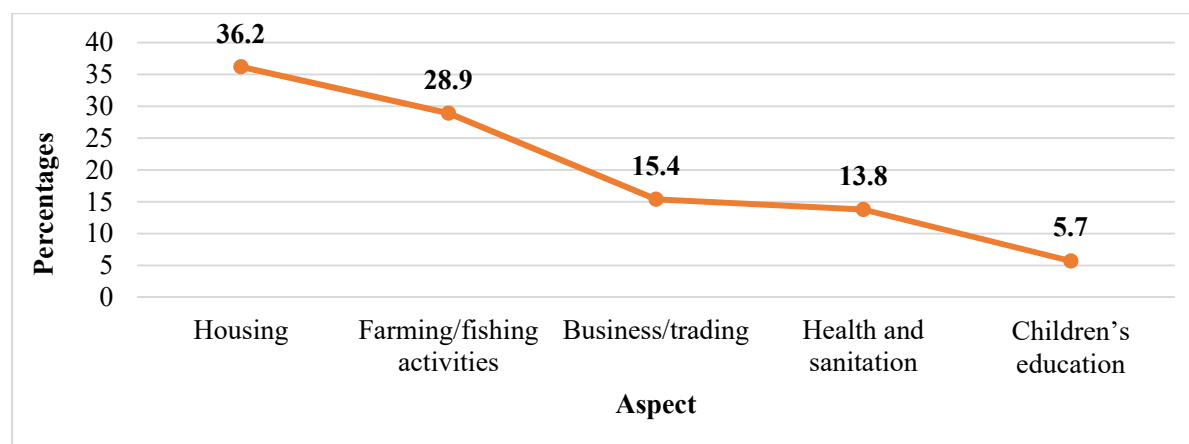


FIG. 3: Aspect of life most affected during flood events
Source: Authors' field survey, 2025.

Resilience strategies adopted by women against floods

Table 1 shows that livelihood diversification had the highest adoption rate at 17.4 percent. This indicates that most women engage in multiple income-generating activities to cushion the economic impact of floods. Strategies with moderate adoption levels include savings and microcredit participation (14.3 percent) and community networking and information sharing (13.3 percent). These reflect women's reliance on both financial and social support systems for recovery. The least adopted strategies were the use of indigenous knowledge and collective action or mutual support, each at 10.2 percent. This suggests that while traditional and cooperative approaches are still relevant, they are less frequently practiced compared to other coping strategies.

Table 1: Resilience strategies adopted by women against floods

Resilience Strategy	Frequency	Percentage
Livelihood diversification	67	17.4
Savings and microcredit participation	55	14.3
Food storage and preservation	49	12.8
Temporary relocation to safer areas	43	11.2
Reinforcement of houses and structures	41	10.7
Community networking and information sharing	51	13.3
Use of indigenous knowledge	39	10.2
Collective action and mutual support	39	10.2
Total	384	100.0

Source: Authors' field survey, 2025.

Tables 2 presents that women in Odukpani mainly depend on self-help and community-based approaches to cope with floods. The most common coping measures include temporary relocation to safer areas (30.5 percent), food and water storage (27.9 percent), and the use of local knowledge to anticipate floods (21.1 percent). Support from relatives or neighbours (18.0 percent) also contributes to their resilience, whereas aid from government or NGOs remains very limited (2.5 percent).

Table 2 : Coping strategies commonly adopted during floods

Strategy	Frequency	Percentage
Relocating temporarily to safer areas	117	30.5
Storing food and water ahead of floods	107	27.9
Using local knowledge to predict and prepare	81	21.1
Relying on help from relatives or neighbors	69	18.0
Seeking government or NGO support	10	2.5
Total	384	100.0

Source: Authors' field survey, 2025.

For recovery, Table 3 show that community support stands out as the main strategy (31.5 percent), followed by loans or credit (24.2 percent) and personal savings (18.5 percent). Institutional assistance (14.3 percent) and the sale of assets (11.5 percent) are less frequently used. Overall, women's resilience in Odukpani is driven more by social networks, indigenous knowledge, and informal financial mechanisms than by formal institutional aid. This pattern aligns with findings by Jerin et al. (2023) and Kantamaneni et al. (2022), who observed similar trends among women in other flood-prone communities.

Table 3: Methods of recovery after a flood event

Recovery Method	Frequency	Percentage
Using personal savings	71	18.5
Taking loans or credit	93	24.2
Relying on community support	121	31.5
Receiving government/NGO assistance	55	14.3
Selling assets (e.g., livestock, property)	44	11.5
Total	384	100.0

Source: Authors' field survey, 2025.

Factors influencing women's flood resilience

Figure 4 indicates that women's resilience to flooding in Odukpani is strongly influenced by economic strength and social support systems. Household income is the most significant factor enhancing resilience, accounting for 32.6 percent, followed by social support networks at 26.3 percent. Education contributes 17.4 percent, while access to early warning systems accounts for 12.8 percent, and government or NGO interventions represent the least at 10.9 percent. These findings show that women's ability to adapt and recover from floods is largely built on their financial stability, educational level, and community connections, with institutional contributions remaining limited. This observation aligns with Cvetković and Ivković (2022), who found that socio-economic status, knowledge, and social cohesion are key drivers of flood resilience.

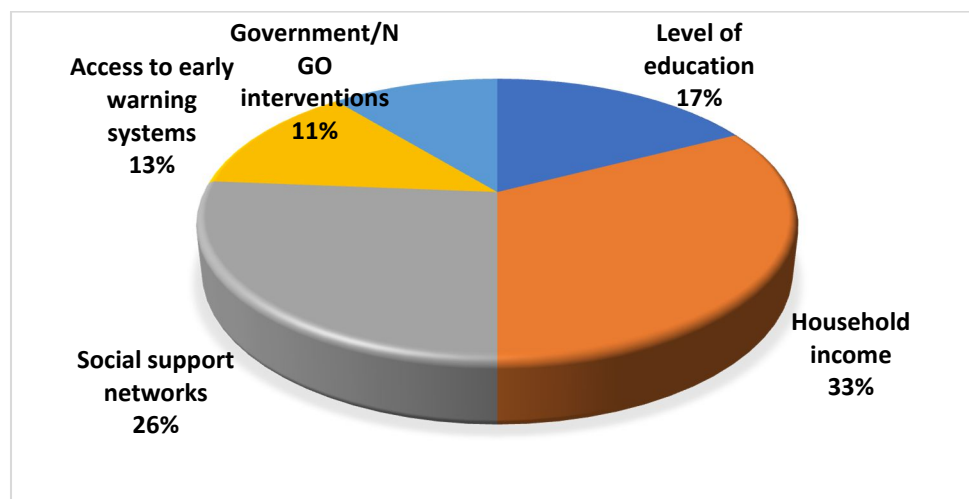


FIG. 4: Factors strengthening women's flood resilience

Source: Authors' field survey, 2025.

Figure 5 highlights the major barriers limiting women’s resilience to flooding. The most critical challenge is the lack of financial resources, recorded at 37.2 percent, followed by poor housing conditions (23.2 percent) and limited access to information (21.6 percent). Weak community cooperation (10.7 percent) and inadequate government support (7.3 percent) were also identified as significant obstacles. These results suggest that while women’s resilience depends largely on economic and social capacity, structural and institutional shortcomings continue to hinder recovery efforts. Similar to the findings of Fahad et al. (2023), this underscores that in rural flood-prone areas, resilience is primarily built through household-level economic strength and social capital rather than formal disaster management structures.

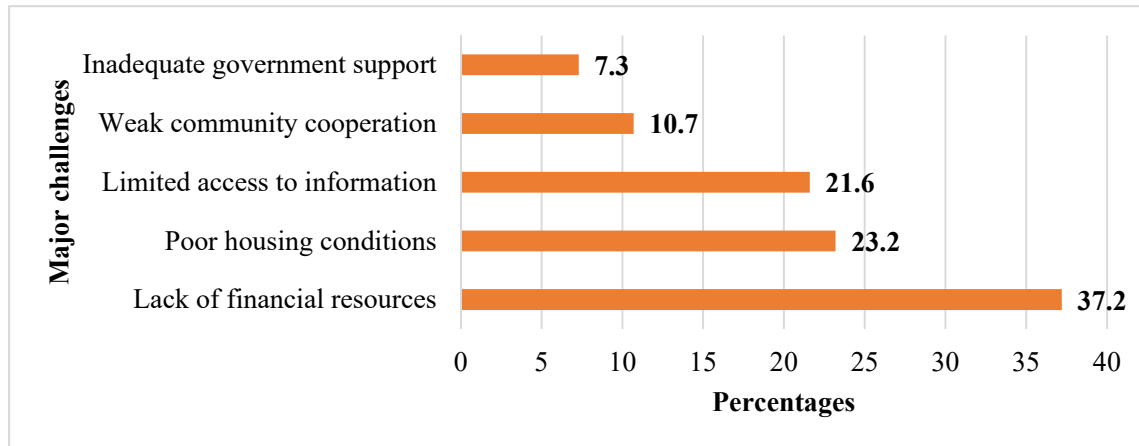


FIG. 5: Major challenges limiting women’s flood resilience
Source: Authors’ field survey, 2025.

Hypothesis testing

H_0 : Women’s socio-economic characteristics does not significantly influence their level of resilience to flooding in Odukpani Local Government Area.

H_1 : Women’s socio-economic characteristics significantly influence their level of resilience to flooding in Odukpani Local Government Area.

The regression results in Table 4 indicate a strong model fit, with $R = 0.963$ and $R\text{ Square} = 0.928$, showing that 92.8% of the variation in women’s flood resilience is explained by socio-economic characteristics. The F-statistic of 1637.0 with a significance level of $p = 0.000$ confirms the overall model is highly significant. The standard error of estimate = 0.340 further suggests that the predicted resilience values closely match the observed values, making the model reliable and robust.

From Table 5, the regression sum of squares (410.73) is much larger than the residual sum of squares (32.11), further emphasizing the strong explanatory power of the model. Table 6 shows that income ($B = 0.520$, $t = 10.66$, $p = 0.000$) and social support ($B = 0.330$, $t = 6.63$, $p = 0.000$) significantly influence women’s flood resilience. In contrast, education ($B = 0.024$, $t = 0.82$, $p = 0.410$), though positive, is not statistically significant. This demonstrates that income and social support are the key determinants of women’s resilience, while education contributes little within this dataset.

Table 4: Model Summary (Overall Fit of the Regression Model)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F-statistic	Sig. (F)
1	0.963	0.928	0.928	0.340	1637.0	0.000

Table 5: ANOVA (Significance of Regression Model)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	410.73	3	136.91	1637.0	0.000
Residual	32.11	380	0.084		
Total	442.84	383			

Table 6: Coefficients of Socio-Economic Factors

Predictor	B (Coef.)	Std. Error	t	Sig. (p)	95% Confidence Interval
Constant	0.050	0.046	1.09	0.276	-0.040 – 0.140
Education	0.024	0.029	0.82	0.410	-0.033 – 0.082
Income	0.520	0.049	10.66	0.000	0.424 – 0.616
SocialSupport	0.330	0.050	6.63	0.000	0.232 – 0.428

Conclusion

The study found that women in Odukpani's coastal communities face high vulnerability to recurrent flooding, which continually disrupts their homes, livelihoods, health, and overall well-being. Flooding in the area goes beyond an environmental concern it is a socio-economic challenge that affects women disproportionately due to their dependence on farming, fishing, and small-scale trading. Despite these difficulties, women display strong resilience through informal and community-based coping strategies such as temporary relocation, food and water storage, and mutual support networks. These responses reflect women's ability to adapt, collaborate, and sustain their families in the face of environmental stress, even though limited institutional assistance from government or NGOs highlights major gaps in formal disaster support systems. Resilience in these communities, therefore, is largely self-driven and built on cooperation, resourcefulness, and survival instincts rather than structured protection.

The findings also show that socio-economic factors play a critical role in shaping women's flood resilience. Household income and strong social networks emerged as the most significant enablers of recovery and adaptation, while limited access to finance, weak housing conditions, and poor

communication channels reduce their capacity to cope effectively. Strengthening resilience in these communities requires targeted action at multiple levels. In the short term, local authorities should improve early warning systems, community sensitization, and small grant programs for women's groups. Over the medium term, priorities should include better drainage, improved housing, and inclusive participation of women in disaster management. In the long term, sustained empowerment through access to credit, education, and training on climate adaptation and livelihood diversification is essential to reinforce resilience.

Theoretically, this study adds to the understanding of gendered disaster resilience by showing how socio-economic variables interact to influence women's adaptive capacity in a coastal Nigerian setting. It aligns with the Social-Ecological Resilience Theory, which emphasizes that resilience grows from the balance between individual agency and broader structural systems. The results underline the importance of gender-sensitive approaches to disaster management, calling for integration of women's experiences and capacities into Nigeria's flood resilience policies. By connecting lived realities to theoretical insights, the study highlights how gender, income, and social capital together shape resilience, offering valuable guidance for building equitable and sustainable flood management frameworks in vulnerable coastal communities.

Recommendations

Based on the findings, a set of short-term, medium-term, and long-term measures is recommended to strengthen women's resilience to flooding in Odukpani. In the short term, local authorities and community leaders should prioritize improving access to timely early warning systems, conducting regular flood preparedness training for women, and promoting awareness campaigns on household-level adaptation strategies. Medium-term measures should focus on enhancing economic empowerment through livelihood diversification, access to microcredit schemes, and vocational skills training to reduce dependency on flood-sensitive occupations such as farming and fishing. Additionally, strengthening community-based support networks and improving coordination between women's groups, local councils, and NGOs will foster collective resilience. In the long term, policy interventions should emphasize investment in flood-resilient housing, drainage systems, and basic infrastructure, alongside integrating gender-sensitive approaches into state and national flood management frameworks. These combined efforts will not only reduce women's vulnerability but also build a stronger, more inclusive foundation for sustainable community resilience in Odukpani's coastal areas.

References

- Abraham, C. M., Ansa, I., Jimmy, U. J., Osogi, M. A., Udoh, I. J., & Idika, C. K. Imoh. IJ (2025). Contributions of Community Based Natural Resources in Socio-Economic Development of Indigenous Coastal Dwellers in Odukpani, Cross River State, Nigeria. *Saudi J. Humanities Soc Sci*, 10(4), 145-154.
- Akhir, N. M., Aun, N. S. M., Selamat, M. N., & Amin, A. S. (2021). Exploring factors influencing resilience among flood victims in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 11(6), 969-981.
- Akpan, U. N. A., Assian, U. E., & Akpan, K. (2024). Adaptation strategies for, Nigerian coastal communities facing rising sea levels and encouragement of agricultural activities: a comprehensive review. *Poljoprivredna tehnika*, 49(3), 31-42.
- Anam, B. E., Unimna, F. A., & Ironbar, V. E. (2024). Assessing the impact of Niger Delta Development Commission interventions on road construction and economic activities in Cross River and Akwa Ibom States, Nigeria. *Journal of Infrastructure, Policy and Development*, 8(14), 9794.

- Azad, M. J., & Pritchard, B. (2023). The importance of women's roles in adaptive capacity and resilience to flooding in rural Bangladesh. *International journal of disaster risk reduction*, 90, 103660.
- Bari, A. M., Intesar, A., Al Mamun, A., Debnath, B., Islam, A. R. M. T., Alam, G. M., & Parvez, M. S. (2024). Gender-based vulnerability and adaptive capacity in the disaster-prone coastal areas from an intersectionality perspective. *Climate Risk Management*, 43, 100581.
- Chisty, M. A., Dola, S. E. A., Khan, N. A., & Rahman, M. M. (2021). Intersectionality, vulnerability and resilience: Why it is important to review the diversifications within groups at risk to achieve a resilient community. *Continuity & Resilience Review*, 3(2), 119-131.
- Chisty, M. A., Rahman, M. M., Khan, N. A., & Dola, S. E. A. (2021). Assessing community disaster resilience in flood-prone areas of Bangladesh: From a gender lens. *Water*, 14(1), 40.
- Cvetković, V. M., & Ivković, T. (2022). Social Resilience to Flood Disasters: Demographic, Socio-economic and Psychological Factors of Impact. *Academic Perspective Procedia*, 5(2), 299-317.
- Efe, S. I. (2011). Spatial variation in flood risk and vulnerability in Nigeria. *GeoJournal*, 76(6), 613–625.
- Fahad, S., Hossain, M. S., Huong, N. T. L., Nassani, A. A., Haffar, M., & Naeem, M. R. (2023). An assessment of rural household vulnerability and resilience in natural hazards: evidence from flood prone areas. *Environment, Development and Sustainability*, 25(6), 5561-5577.
- Gaisie, E., Adu-Gyamfi, A., & Owusu-Ansah, J. K. (2022). Gender and household resilience to flooding in informal settlements in Accra, Ghana. *Journal of Environmental Planning and Management*, 65(8), 1390-1413.
- Haque, C. E., Azad, M. A. K., & Choudhury, M. U. I. (2022). Social learning, innovative adaptation and community resilience to disasters: the case of flash floods in Bangladesh. *Disaster Prevention and Management: An International Journal*, 31(5), 601-618.
- Jerin, T., Azad, M. A. K., & Khan, M. N. (2023). Climate change-triggered vulnerability assessment of the flood-prone communities in Bangladesh: A gender perspective. *International journal of disaster risk reduction*, 95, 103851.
- Kantamaneni, K., Panneer, S., Sudha Rani, N. N. V., Palaniswamy, U., Bhat, L. D., Jimenez-Bescos, C., & Rice, L. (2022). Impact of coastal disasters on women in urban slums: A new index. *Sustainability*, 14(6), 3472.
- Naz, F., & Saqib, S. E. (2021). Gender-based differences in flood vulnerability among men and women in the char farming households of Bangladesh. *Natural Hazards*, 106(1), 655-677.
- Nchor, J. U. (2023). Livelihood strategies and their determinants among informal households in Calabar, Nigeria. *Sustainability*, 15(4), 2855.
- Ndimele, P. E., Ojewole, A. E., Mekuleyi, G. O., Badmos, L. A., Agosu, C. M., Olatunbosun, E. S., ... & Ayodele, O. T. (2024). Vulnerability, resilience and adaptation of Lagos coastal communities to flooding. *Earth Science, Systems and Society*, 4(1), 10087.
- Nwankwo, C., & Uchegbu, S. N. (2019). Gendered flood risks and adaptation strategies in Nigeria. *Journal of Environmental Studies*, 15 (2), 45–58.
- Ogar, M. B. (2023). *Sacred Forests and Rivers: The Role of Indigenous Religion in Promoting Environmental Sustainability in Abanyom, Cross River State, Nigeria*. University of Johannesburg (South Africa).

- Polcarová, E., & Pupíková, J. (2022). Analysis of socially vulnerable communities and factors affecting their safety and resilience in disaster risk reduction. *Sustainability*, 14(18), 11380.
- Saad, R. (2021). Women and DRR in urban slums—building resilience through development. *International Journal of Disaster Risk Reduction*, 60, 102264.
- Shamsuddoha, M., Javed, M. A., Islam, M. S., Sultana, N., Imran, A., Rabbi, S. N. A., ... & Sharif, M. M. (2024). Impacts of climate change-induced natural hazards on women and their human rights implications: a study in the southwest coast of Bangladesh. *Journal of Migration and Health*, 9, 100221.
- Singh, P., Tabe, T., & Martin, T. (2022, January). The role of women in community resilience to climate change: A case study of an Indigenous Fijian community. In *Women's Studies International Forum* (Vol. 90, p. 102550). Pergamon.
- Wang, L., Cui, S., Li, Y., Huang, H., Manandhar, B., Nitivattananon, V., ... & Huang, W. (2022). A review of the flood management: from flood control to flood resilience. *Heliyon*, 8(11).
- Xu, W., Xie, Y., Yu, Q., & Proverbs, D. (2023). An evaluation of factors influencing the resilience of flood-affected communities in China. *Hydrology*, 10(2), 35.