Impact of Climate Change Extremes on the Socioeconomic Wellbeing of Households in Doma LGA, Nasarawa State, Nigeria

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ABSTRACT

Climate change continues to pose a significant threat to the socioeconomic welfare of families in rural Nigeria, especially within the Doma Local Government Area (LGA) in Nasarawa State. This research investigates the effects of extreme climatic change on the socioeconomic welfare of households in Doma LGA. The information gathered from household surveys, field observations, and interviews with key informants was utilised to assess the effects of climate change. Employing a mixed-methods strategy with a cohort of 1,123 households to collect primary data. The quantitative data was inputted into Microsoft Excel 2010 and the Statistical Package for Social Science (SPSS) 16 software. The findings were further illustrated through tables, graphs, and charts, and Pearson's Chi-square (χ^2) test of independence was utilised for each cross-tabulated table to ascertain if the observed relationships between variables are statistically significant. Cramér's V was calculated as an indicator of impact size (degree of connection). Cross-tabulation was used to analyse the combined distribution of essential demographic, socioeconomic, and hazard-related factors across the three research sites — Alagye, Agbashi, and Akpanaja — in Doma LGA. The results indicate that extreme climate change phenomena, such as erratic precipitation and rising temperatures, considerably diminish agricultural output, lower household earnings, escalate poverty rates, and foster food insecurity. The research highlights essential elements such as household gender, age, occupation, income, and educational attainment as pivotal influences on household resilience to climate-related adversities. The findings indicate that the repercussions of climate change influence the socioeconomic welfare of households. This study offers empirically supported suggestions for policymakers and development professionals to create focused strategies that enhance household resilience to climate fluctuations in Doma LGA, Nigeria.

Keywords: Climate change, extremes, socioeconomic wellbeing, household resilience, food insecurity

INTRODUCTION

Climate change constitutes a paramount danger to sustainable development and human welfare in the 21st century. The reports from the Intergovernmental Panel on Climate Change (IPCC) reveal that global temperatures have increased by roughly 1.1°C compared to pre-industrial levels, leading to heightened weather extremes such as extended droughts, excessive precipitation, flooding, and unpredictable temperature fluctuations. In Sub-Saharan Africa, notably Nigeria, the impacts of climate change are especially acute, jeopardising at-risk communities reliant on climate-dependent industries like agriculture. Climate change and variability have emerged as local occurrences as much as they are global. Nonetheless, its impact is already being experienced across nearly all sizes and geographies, with severe occurrences including heavy rainfall, heat waves, drought, and arid periods influencing a significant portion of rural areas globally, including Africa (Kong'ani, Mutune, & Thenya, 2018).

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Nasarawa State, situated in Nigeria's North-Central area, features a savanna climate marked by pronounced rainy and dry seasons. The Doma Local Government Area is primarily agricultural, with more than 70% of its inhabitants reliant on rainfed farming for their sustenance.

In recent decades, climate variability has markedly strengthened, seen in the postponed arrival of precipitation, premature termination of rainfall, heightened frequency and severity of droughts, and erratic distribution of rainfall. These climate extremes significantly affect agricultural output, household earnings, food stability, and the general socioeconomic health of rural families.

Doma LGA is particularly vulnerable to fluctuations and alterations in climate. The economy and the welfare of its populace rely on rain-dependent agriculture; consequently, climate change could result in heightened food insecurity, soil erosion, land degradation, excessive flooding causing disease outbreaks such as malaria, and harm to infrastructure and communities. The notion of socioeconomic wellness includes various facets such as income, food security, health condition, education, and availability of essential services. Climate-related disturbances affect these aspects through multiple channels: diminished agricultural output lowers household earnings; food scarcity intensifies as production falters; health issues arise from malnutrition and climate-associated illnesses; and adaptive measures frequently entail liquidating productive assets or removing children from educational institutions.

Notwithstanding the seriousness of this matter, there exists a paucity of empirical studies that thoroughly record and examine the distinct effects of catastrophic climate change on the socioeconomic welfare of households in Doma LGA. Furthermore, the research region has been undergoing a heightened occurrence of severe weather phenomena and a rise in frequency, resulting in significant socio-economic repercussions. This research seeks to address this knowledge deficiency by offering evidence-based insights into the effects of climate change on the socioeconomic welfare of households in the designated region. This study evaluate the impact of climate change extremes on various dimensions of household socioeconomic wellbeing and developed climate adaptation and mitigation strategies tailored to the local context in the study area.

LITERATURE REVIEW

2.1: Climate Change and Household Socioeconomic Wellbeing.

Socioeconomic welfare comprises various interconnected facets such as employment, earnings, nutritional stability, health status, and educational attainment. Climate change influences these aspects via intricate mechanisms. Diminished agricultural output results in lower household earnings, which then leads to decreased consumption and heightened poverty levels. Food scarcity arises as output diminishes and food costs escalate. Health results decline as a consequence of hunger and climate-associated illnesses (Raimi, Vivien, & Oluwatoyin, 2021).

Abaje and Magaji (2022) discovered in their research conducted in Nigeria that fluctuations in climate heightened the prevalence of poverty and diminished the average household income by 27%. Anugwa (2020) similarly reported in Nigeria that agricultural failures caused by drought compelled households to resort to maladaptive coping mechanisms such as liquidating productive assets, diminishing food intake, and removing children from educational institutions. These adaptive strategies frequently sustain cycles of poverty and diminish long-term household fortitude. Literature predominantly discusses its metrics to comprehend the extent of climate effects.

Olowoporoku (2022) asserted that there exists quantitative literature offering several metrics like age, gender, marital status, occupation, income, and educational attainment. Moreover, Indicator and qualitative literature (Barnett, 2020) have investigated their domain to assess the extent of climatic effects by quantifying fatalities, property destruction, infrastructure damage, utility disruption, and land degradation. In Nigeria, especially within the Sudano-Sahelian region encompassing Nasarawa State, variability in precipitation is recognised as the foremost factor influencing changes in agricultural production.

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Research conducted by Ayo-Lawal, Ilevbare, Omotoso, Omimakinde, & Ukwuoma (2022) indicates that fluctuations in climate in Nigeria have resulted in considerable declines in agricultural output and a heightened frequency of crop failures. The drought in Northern Nigeria in 2015 led to extensive agricultural collapse, impacting more than 2.2 million individuals. The inability of farmers to anticipate the timing and distribution of rainfall has compelled numerous individuals to return to conventional subsistence farming methods, thereby diminishing productivity and revenue.

2.2. Conceptual Framework: Socioeconomic Wellbeing

Socioeconomic wellbeing is a complex notion that encapsulates the comprehensive quality of life and living circumstances of families. This paradigm delineates socioeconomic wellness as consisting of five fundamental dimensions:

2.2.1: Financial Prosperity

Evaluated by household earnings from diverse origins (agricultural, small-scale commerce, and salaried jobs), income consistency, and income progression. This component reflects households' financial ability to fulfilll essential requirements and engage in constructive endeavours.

2.2.2: Nutritional Stability

Evaluated via dietary variety, meal frequency, consumption habits, and household attitudes about food accessibility. Food security is a vital result of agricultural output, which is directly influenced by climate fluctuations.

2.2.3. Accumulation of Assets

Assessed by possession of productive resources (land, machinery, cattle), consumer goods (housing, automobiles), and financial holdings (savings, insurance). Asset possession influences financial resilience in times of crisis and the ability to engage in productive investment.

2.2.4; Wellness and Learning

Assessed via disease prevalence, healthcare consumption, school enrolment statistics, and educational achievement levels. These signify investments in human capital crucial for sustained welfare and robustness.

2.2.5. Availability of Services

Access to financing, support services, agricultural resources, water supply, and energy. Access to services improves households' capacity to embrace innovations and manage crises. The paradigm acknowledges that climate change influences these aspects via direct effects (crop destruction, resource exhaustion) and indirect pathways (income reduction, diminished investments in health and education). Household resilience—shaped by adaptive capacity elements such as education, asset possession, social capital, and information access—intervenes between climate exposure and welfare results. This paradigm directs the empirical examination of the connections between climate and wellbeing in Doma LGA.

The primary theoretical frameworks for examining climate variability and extreme occurrences are socio-economic and bio-physical vulnerability. The socioeconomic vulnerability assessment methodology primarily focuses on determining the socioeconomic condition of households (Karfakis, Lipper, and Smulders, 2012). Diversity in gender, age, marital status, profession, income, education, and handicap. The ramifications of climate change presently encompass, among other issues, extreme droughts, water shortages, devastating fires, increasing sea levels, inundation, and disastrous storms (Interdonato, Calabrese, Taormina, Iacuzzo, Lentini, & Taormina, 2016).

The planet is currently experiencing a rate of warming unprecedented in documented history. Elevated temperatures over time are altering climatic patterns and disturbing the natural equilibrium. This presents

numerous hazards to humanity and all other living forms on the planet. Climatic conditions are intrinsically fluctuating, varying from one year to the next and throughout decades. Variability is associated with and constitutes a fundamental aspect of climate change (Said, Kamis, Abdul Maulud, Jauhari, & Mohammed, 2024).

2.2.6: Factors Influencing Climate Change Impact on Socioeconomic Wellbeing of Households in Doma LGA

2.2.6.1: Climate Exposure and Variability

Climate conditions in Doma LGA are marked by rising temperatures and unpredictable precipitation patterns. Examination of a decade's worth of meteorological data indicates a mean temperature rise of 0.8° across the timeframe, alongside a heightened occurrence of days surpassing 35°C. Rainfall assessment indicates a decline in total annual precipitation, heightened variability (standard deviation), and alterations in seasonal trends. These weather extremes immediately subject households to production disruptions, jeopardising income and food stability. Households possessing extensive landholdings have more significant absolute losses due to crop failure, whereas those with smaller landholdings lack adequate income resilience.

Buhaug & Von Uexkull (2021) noted that every nation globally is currently undergoing alterations in temperature, variations in precipitation patterns, and a rising incidence of severe weather phenomena along with other consequences of climate change. The consequences include elevated sea levels, inundations, aridity, and infrastructure degradation. The ongoing alterations in climatic factors worldwide have intensified a universal apprehension, as they increasingly pose a risk not only to the sustainable advancement of global societies but also to the entirety of human life (Räsänen et al., 2016). Buhaug & Von Uexkull (2021) underscored that climate change predominantly influences livelihoods, ecosystems, and the socio-economic advancement of communities, shaping the trajectory of human welfare and progress.

2.2.6.2: Household Asset Ownership and Wealth Status

The possession of assets greatly affects a household's ability to withstand climate disturbances and allocate resources for adaption strategies. Affluent households possessing expansive land, substantial cattle, and additional non-land assets are better equipped with financial reserves to manage output setbacks. These families can more readily obtain loans, invest in enhanced variety and technologies, and diversify their income streams. Research indicates that households in the wealthiest quintile possess resilience scores that are 3.5 times greater than those in the lowest quintile. In contrast, households with limited assets are unable to execute adaptation techniques and instead rely on coping mechanisms that jeopardise their long-term welfare (Edith, Boniface, Mikalitsa, 2022).

2.2.6.3: Education and Human Capital

Education improves familial comprehension of climate hazards and the ability to execute adaption measures. Household leaders possessing secondary or higher education exhibit a 55% greater implementation of enhanced practices in comparison to illiterate agriculturalists. Education enhances the accessibility and comprehension of meteorological data, hence improving agricultural decision-making. Formal education enhances prospects for non-agricultural jobs, facilitating income diversification. Nevertheless, the mean educational attainment of household heads in Doma LGA is at 4.2 years, constraining adaptive capability. Enrolment figures at educational institutions diminish during periods of drought as households emphasise immediate financial gain over academic pursuits (Olowoporoku, 2022).

2.2.6.4: Social Capital and Community Support Systems

Social capital, expressed via community organisations, cooperative support systems, and trust networks, promotes the exchange of information and collective adaptability. Households affiliated with farmer groups exhibit greater rates of adaptation adoption (52% compared to 28% for non-members). Community-oriented savings collectives offer lending options for resilience-enhancing investments. Women's organisations enhance

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household food security by diversifying revenue sources. Nonetheless, the usefulness of groups differs, with certain groups being inactive or dominated by elites, thereby constraining the distribution of benefits. Inadequate connections between community organisations and governmental bodies hinder access to public assistance programs (Räsänen et al, 2016).

MATERIALS AND METHODS

3.1 Study Area Description

Doma Local Government Area is positioned in Nasarawa State, North-Central Nigeria, lying between latitudes 9°30'N and 10°5'N, and longitudes 8°20'E and 8°50'E. The Local Government Area encompasses an estimated surface area of 1,180 km² and has a population of roughly 183,826, according to 2016 census estimates. The region exhibits a tropical savanna climate marked by pronounced rainy (May-October) and dry (November-April) periods. The mean yearly precipitation varies between 1,000 and 1,200 mm, although considerable fluctuations from year to year are noted. The average yearly temperature is roughly 24-26°C. (Nigerian Meteorological Agency, 2024). The economy is primarily agricultural, featuring key crops such as maize, sorghum, millet, and groundnuts. The cultivation of livestock, including cattle, goats, and sheep, holds significant importance.

Doma is situated in the southern region of Nasarawa State and functions as the headquarters of both Doma District and Doma Local Government Area. The locality is generally defined by rolling topography that is favourable for residential construction. Picture 3.1 illustrates the position of Doma LGA inside the map of Nasarawa State; conversely, picture 3.2 presents the Google Earth image of Doma Locality.

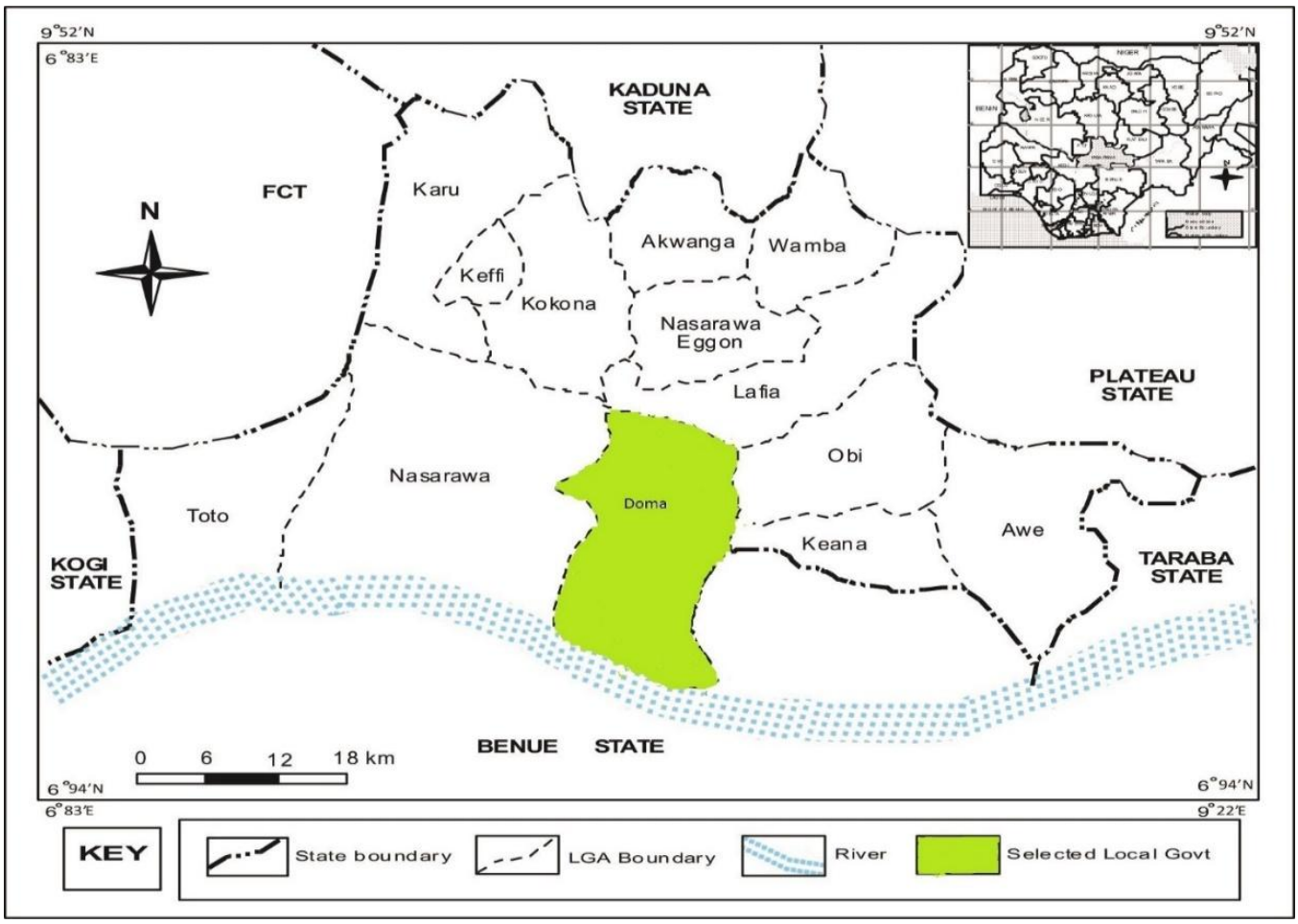


Figure 3.1: Map of Nasarawa State showing the Study Area.

Source: Nasarawa State Ministry of Lands and Survey, Lafia

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3.2 Research Design

This research utilises a mixed-methods design that combines both quantitative and qualitative methodologies. The quantitative aspect comprised household surveys utilising a standardised questionnaire distributed to 1,123 randomly chosen heads of households. The sample size was calculated via Taro Yamane's formula with a margin of error set at (0.05). Stratified random selection was utilised to choose homes from three villages in Doma LGA, guaranteeing representation of all socioeconomic categories. Data gathering occurred throughout a two-month timeframe (June-July 2026) during the rainy season to document seasonal fluctuations in domestic activities and climatic effects. Three prominent communities were intentionally chosen for this research in Doma LGA.

3.2.1: Alagye Locality

Alagye village is situated in the western region of Doma LGA; it is a modest community that has coexisted with Doma locality and has evolved from a farming settlement and tiny neighbourhood into a District headquarters. The landscape consists of a flat expanse. The escalation of flooding in this community in recent years illustrates the broader effects of climate change on the livelihoods of households in the region. Figure 3.1 depicts the satellite imagery of Alagye Locality, utilised for the arbitrary selection of household heads owing to the erratic arrangement of the community.



Figure 3.3: Image map of Alagye locality.

Source: Google Earth.

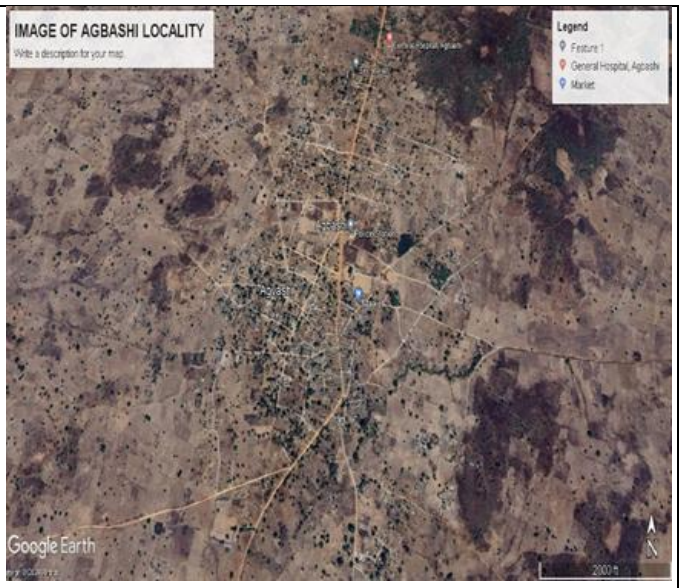


Figure 3.4: Image map of Agbashi locality.

Source: Google Earth.

3.2.2: Agbashi Locality

Agbashi settlement is located at the Southern part of Doma LGA, it has an undulating topography but with most part of the settlement being flat suitable for agriculture. It is also an ancient town that serves as the headquarters of a Development area and District headquarters. Figure 4.2 shows the satellite imagery of Agbashi Locality that guided the random selection of selected households.

3.2.3: Akpanaja Locality

Akpanaja village located at the bank of river Benue is the District headquarters of Akpanaja District, is a more hazard-prone area because of its location. With altitudes generally below 50ft above sea level, Akpanaja is highly susceptible to river level rise. The settlement has developed chaotically, with a number of communal clashes with neighbouring ethnic groups.

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Figure 3.5: Showing the image map of Akpanaja locality.

3.2.4: Sample size and sampling procedure.

The multi-tiered random sample method was employed to choose the villages and houses involved in the interviews. In total, 1,123 households were chosen for the interview within the designated villages. The study employed the Cletus formula for population projection and Taro Yamene equation to determine the sample size. The sampling process followed two stages: (1) determination of the study population by exponential population projection, and (2) determination of home sample size using the Taro Yamane (1967) formula. The formula for exponential population growth was utilised:

$Pt = Po\ (1 + r)^t$ where Pt = projected population, Po = base-year population, r = annual growth rate, and t = the projection interval in years. Using the 1996 census figure (Po) and the 2024 projected figure (Pt) previously known for each locality, with t = 28 years (1996–2024), the locality-specific yearly growth rate r was determined by rearranging the formula: $r = (Pt / Po)^{(1/t)} - 1$.

Worked example for Alagye: Po (1996) = 3,007; Pt (2024) = 5,825; t = 28. $r = (5,825 / 3,007)^{(1/28)} - 1 = 0.0691$, i.e., an annual growth rate of around 2.39%. The same approach used to Agbashi and Akpanaja provided an identical inferred growth rate of 2.39%, demonstrating internal consistency of the original 1991–1996–2024 series.

Table 1: Population Projection (1996–2024) and Sample Size Determination

Locality	1991 Census	1996 Projected	2024 Projected	Annual r (%)	Sample Size 2024 (n)
ALAGYE	2,594	3,007	5,825	2.39	374
AGBASHI	2,636	3,055	5,919	2.39	375
AKPANAJA	2,514	2,914	5,645	2.39	374
Total	7,744	8,976	17,389	—	1,123

Source: Author's reviewed, 2024.

Sample Size Determination

The Taro Yamane (1967) equation was employed to ascertain the household sample size from the population of each locality: $n = N / (1 + N e^2)$

Let n represent the sample size, N denote the population of the locality, and e signify the margin of error, established at 0.05 (5%). Utilising this equation for the 2024 demographic statistics: for Alagye, $n = 5,825 / (1 + 5,825 \times 0.05^2) = 374$; for Agbashi, $n = 5,919 / (1 + 5,919 \times 0.05^2) = 375$; and for Akpanaja, $n = 5,645 / (1 + 5,645 \times 0.05^2) = 374$ — resulting in a total study sample size of 1,123 households, with 993 questionnaires (88.8%) returned and verified for analysis (320 from Alagye, 345 from Agbashi, and 328 from Akpanaja).

3.2.5: Selection of households for surveys

Despite the presence of many households in certain residences, only a single household was chosen for the interview, with the questionnaire directed to the leader of that home. The term household head is utilised in its conventional context to denote spouses in married-couple families and either male or female occupants in single-headed households.

3.2.6: Data Sources

Principal data domestic survey. A structured survey was executed with a conventional questionnaire. The survey, conducted among household heads, aimed to gather data on familial attributes (size, age, gender, educational and marital status, primary income source) as well as additional factors like local views on climate change and their strategies for adapting to variable rainfall patterns, including seasonal distribution, quantity, and intensity. A sample of 1,123 participants was obtained through interviews.

3.2.7: Field Observation.

Field observations were conducted multiple times. Observations were conducted during the field visit about the effects of climate variability and change on sources of livelihood. Moreover, assessments were conducted within the residences, agricultural lands, and adjacent areas of the participants, accompanied by photographic documentation. Ultimately, the data collected from alternative sources was corroborated by observations.

3.2.8: Data Collection Instruments

Household surveys employed a systematic questionnaire addressing: (i) demographic and socioeconomic attributes of households, (ii) climatic information (precipitation, temperature, and windstorms) was sourced from the Nigerian Meteorological Agency for the years 2014 to 2024 to assess climatic patterns.

4. Results of Statistical Analysis

To assess the statistical significance of the observed relationships among variables related to the data, the Chi-square (χ^2) test of independence, developed by Pearson, was utilised for each cross-tabulated table. The computation of Cramér's V resulted in the formulation of a metric for the magnitude of influence, referred to as the degree of association. A value of 0.10 suggested that the effect was minimal, a value of 0.30 suggested that the influence was moderate, and a value of 0.50 or above suggested that the impact was substantial. Following the assessment, a critical threshold of $\alpha = 0.05$ was employed for the analysis.

Interpretation of key results:

4.1: Gender × Marital Status

Despite the absence of a statistically significant correlation between gender and marital status ($p = 0.974$), the distribution of marital status is almost indistinguishable across male-headed and female-headed households. This

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is true regardless of any lack of link between the two groups. Among household leaders, married individuals constitute the largest proportion of both genders, followed by divorced individuals, while single or widowed persons represent a lesser fraction. Given that the proportionate distribution is almost same for both genders, one may infer that the marital status of the individuals in this sample is allocated in a way that is gender-independent.

Table 4.1: Gender and Marital Status

Marital Status	Male (n)	Male (%)	Female (n)	Female (%)
Married	330	56.6%	240	58.1%
Divorced	117	20.1%	83	20.1%
Single	59	10.1%	44	10.7%
Widowed	72	12.4%	48	11.6%
Total	578	100%	415	100%

Source: Author's survey, 2024.

4.2: Occupation × Income Bracket

The proportion of households within each income category is almost uniform across various professions, indicating a mostly uniform, low-income demographic among occupational sectors. The correlation between profession and earnings is not significantly associated (p = 0.9995), as seen in Table 5. 2. The predominant responders are farmers, mostly situated among the lower income brackets, mirroring the pattern seen among public officers, traders, and several other professions. A minimal amount of households in any occupation earn above ₦5 million annually, reflecting the widespread low-income, agriculture-reliant lifestyles within the LGA.

Table 4.2: Occupation and Income Bracket

Occupation	<₦1m	₦1-2m	₦3-4m	₦5m+	Row Total
Farmers	188 (33%)	167 (29%)	154 (27%)	67 (12%)	576
Civil Servants	58 (32%)	50 (28%)	48 (27%)	20 (11%)	176
Traders	38 (32%)	34 (29%)	31 (26%)	13 (11%)	116
Others	39 (31%)	36 (28%)	32 (25%)	18 (14%)	125

Source: Author's survey, 2024.

4.3 Age Group × Educational Attainment

Table 5 illustrates that there is no meaningful correlation between age demographics and educational attainment (p = 1.000); educational levels are almost same across different age groups, suggesting that there has been no substantial improvement in education throughout successive generations. Conversely, the allocation of educational qualifications remains rather stable across different age demographics, with no evident generational shift toward increased educational achievement among younger participants. Primary education is the most commonly achieved level of education across all age groups.

Table 4.3: Age Group and Educational Attainment

Age Group	No Formal	Primary	Secondary	Tertiary	Religious
18-27	40 (23%)	55 (32%)	42 (24%)	26 (15%)	5 (3%)
28-37	39 (24%)	55 (33%)	44 (26%)	24 (14%)	4 (2%)
38-47	41 (24%)	58 (34%)	43 (25%)	24 (14%)	7 (4%)
48-57	41 (24%)	56 (33%)	43 (25%)	25 (15%)	7 (4%)
58-67	43 (25%)	58 (33%)	42 (24%)	26 (15%)	6 (3%)
68+	29 (24%)	41 (34%)	29 (24%)	20 (16%)	4 (3%)

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Source: Author's survey, 2024.

4.4 Hazard Type × Locality

The aggregate count of documented damage incidents resulting from erosion, windstorms, and floods was organised by the following localities:

Table 4. 4: Hazard Type by Locality

Locality	Flooding	Windstorms	Erosion	Total
Agbashi	37	35	31	103
Akpanaja	37	41	60	138
Alagye	29	28	21	78
Total	103	104	112	319

Source: Author's survey, 2024.

Akpanaja had the highest overall hazard load, with erosion-induced damage as the main factor. Conversely, Alagye documented the least occurrences among all three categories of dangers. The harm caused by floods, windstorms, and erosion (Tables 6-8) does not exhibit a statistically significant correlation with locale when analysed separately (all $p > 0.05$). This suggests that the predominant damage patterns are mostly consistent across the three locations, even when the overall event totals vary.

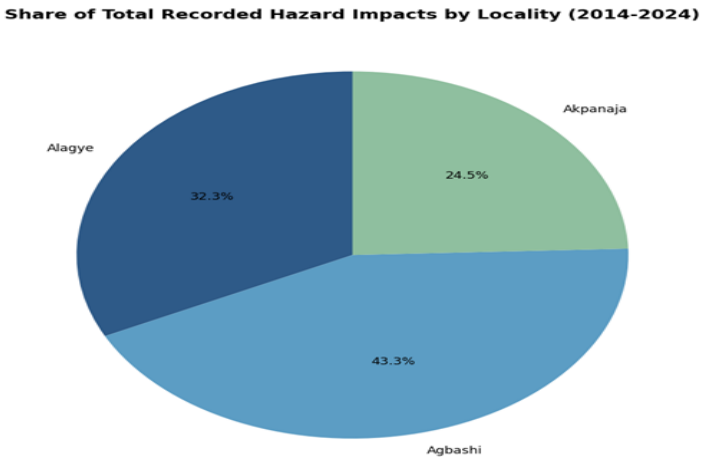


Figure 4.1: Share of total recorded hazard impacts by locality (2014-2024).

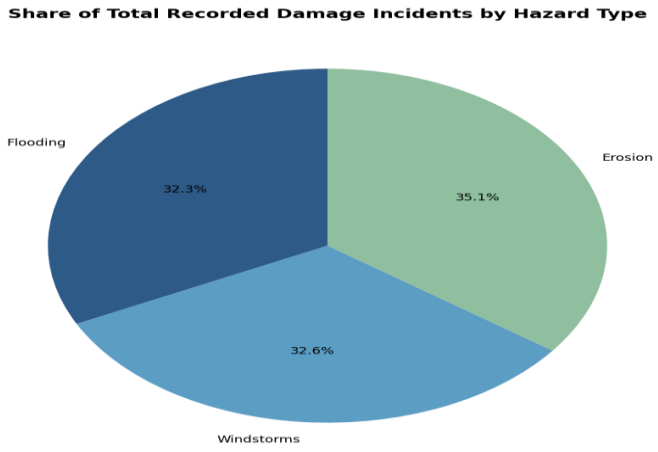


Figure 4.2: Share of total recorded damage incidents by hazard type.

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DISCUSSION OF FINDINGS

The demographic cross-tabulations (Tables 5.1-5.3) indicate a socioeconomically uniform population in Alagye, Agbashi, and Akpanaja. Gender does not significantly affect the distribution of marital status, employment does not substantially impact income levels, and age does not considerably influence educational achievement. This uniformity is revealing: it indicates that susceptibility to climatic extremes in Doma LGA is not limited to a certain demographic category based on gender, profession, or age, but rather is a widely experienced phenomenon across the surveyed households. This outcome parallels the research conducted by Otitoju & Enete: Gender and Climate Change Adaptation among Rural Households in Nigeria (2020).

Conversely, access to fundamental utilities such as water sources varies considerably by region. Surface water (river/stream/lake) serves as the primary drinking water supply for all three villages, however its reliance is much greater in Akpanaja (54.8%) and Alagye (56.0%) compared to Agbashi (45.0%), which exhibits a considerably larger dependency on public standpipes. Dependence on unrefined and climate-exposed water sources (such as surface water and unprotected wells) renders homes susceptible to pollution during flooding and to shortages during droughts, exacerbating the health challenges caused by climate extremes. This outcome aligns with the research conducted by Etana (2024): Livelihood susceptibility of rural families to climatic variability and transformation**.**

An agroecological system-oriented methodology in northwestern Ethiopia.

Concerning hazard impacts, although the chi-square analyses for flood, windstorm, and erosion damage did not yield statistical significance based on damage-type distribution among localities, the raw data reveals that Akpanaja bears the most considerable cumulative hazard burden (138 documented incidents), primarily due to erosion (60 incidents, which include the majority of livestock losses and the only recorded fatality, along with damage to educational and health facilities caused by erosion). Consult plate 5.1.

This enhances the study performed by Wambui, Opere, Githaiga, and Karanja (2018) about the impacts of climate variability and change on biodiversity in Lake Nakuru, Kenya. Alagye recorded the fewest total occurrences (78), however had the highest crop tonnage losses from floods and the most considerable animal fatalities from windstorms, indicating that infrequent incidents may nonetheless lead to severe agricultural and pastoral detriment.

Flooding is recognised as the hazard responsible for the most agricultural devastation, at 5,948 tonnes, so positioning it as a crucial element in regional food security challenges. This corresponds with the study by Hahn, Riederer, & Foster (2009): The Livelihood Vulnerability Index: A pragmatic approach for assessing risks related to climate variability and change, shown via a case study in Mozambique. The data collectively suggests that while the demographic and socioeconomic traits of the human population experiencing climate extremes in Doma LGA are fairly uniform, the physical exposure to hazards and the presence of resilient infrastructure (like water sources) vary considerably by location, indicating that adaptation strategies should be tailored to geographic contexts rather than demographic specifics.

SUMMARY OF FINDINGS

Household leaders in the three regions are mostly married, exhibiting similar marital-status trends for both genders (no significant correlation, $p = 0.974$). Farming is the primary vocation, with the majority of families in all professions earning less than ₦2 million per year; income levels show little variation among jobs ($p = 0.9995$). Primary education is the predominant level of achievement across all age demographics, with little differences between younger and older individuals ($p = 1.000$).

The source of drinking water varies markedly by region ($p < 0.001$): surface water is prevalent in Akpanaja and Alagye, while Agbashi has a somewhat higher dependence on public standpipes. Akpanaja documented the most significant overall hazard-related destruction (138 occurrences, 2014-2024), mostly attributed to erosion; conversely, Alagye reported the least incidents (78) however had the most substantial agricultural losses due to

floods and animal losses from windstorms. Flooding resulted in the highest quantity of agricultural losses (5,948 tonnes across the three regions), establishing it as the most significant threat for food security in the dataset.

None of the three hazard classifications (flood, windstorm, erosion) exhibited a statistically significant variation in their internal damage-category distribution among localities, indicating that hazards impact comparable categories of assets (structures, livestock, human life, infrastructure) universally, despite variations in overall severity.

RECOMMENDATIONS

Emphasise investment in water infrastructure in Akpanaja and Alagye, where reliance on surface water surpasses 54%, by enhancing safeguarded boreholes and piped networks to mitigate flood-related contamination risks. Implement erosion mitigation strategies (gully restoration, terracing, and afforestation) primarily in Akpanaja, due to its excessive incidence of erosion-induced structural failures, livestock casualties, and the only erosion-related deaths in the LGA.

Enhance flood early-warning mechanisms and post-flood agricultural recovery assistance (seed/input replacement) in all three regions, since flooding causes the most significant crop losses irrespective of location. Demographic variables (such as gender, employment, and age) do not substantially forecast vulnerability results; thus, formulate interventions as universal, locality-specific initiatives instead of group-specific ones to effectively engage the widest array of at-risk families. Implement livelihood diversification initiatives for agricultural families, who constitute the predominant occupational demographic and are mostly situated in lower income tiers, to mitigate reliance on climate-sensitive farming practices. Perform further multivariate analysis (such as logistic regression on livelihood vulnerability index scores) to see whether the service-access discrepancies revealed here correlate with variations in the wider socioeconomic welfare variables used in other parts of the research.

CONCLUSION

This examination reveals that families in Doma LGA possess a mostly comparable demographic and socioeconomic profile irrespective of gender, profession, or age; nonetheless, they encounter markedly divergent degrees of vulnerability to climatic threats and access to essential infrastructure based on their specific area. Akpanaja stands out as the community with the highest total impact from hazard-induced destruction, especially due to erosion, but Alagye and Agbashi encounter unique yet equally significant threats associated with water resources. The susceptibility within this dataset is influenced more by local exposure and infrastructural deficiencies than by personal demographic traits; thus, climate adaptation and disaster risk reduction strategies for Doma LGA will be most efficacious when formulated as localised interventions that tackle water security and erosion/flood management at the community level, rather than depending exclusively on demographic criteria.

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