Impact of Climate Change-Driven Extreme Weather on Nutritional Deficiencies in Selected Low-Income Communities in Ogun State, Nigeria: Evidence on Extreme Weather Exposure and Household Food Insecurity

Olasimbo F.O[1], Opasola O.A[2], Adiama B.Y[3], Buhari M[4], Oyenigbehin O.A[5]

[1, 2,3,4,5] *Department of Environmental Health Science, Faculty of Allied Health Sciences, Kwara State University, Malete, Nigeria*

ABSTRACT

Climate change has been associated with extreme weather events that threaten food security. There is a paucity of studies documenting the exposure of low-income households in Africa to extreme weather and consequent food insecurity. We investigated the extreme weather experienced by low-income households in the preceding 12 months and their relation to household food security in five communities in Ogun State, Nigeria. We carried out a cross-sectional survey in 5 Low-income Communities: Imewuro, Ajebandele, Magbon, Babalawo, and Oni in Ogun State. The 372 households were selected by multi-stage random sampling. Primary data were collected through a 12-month weather recall and food security module based on the Household Food Insecurity Access Scale (HFIAS). Data were analysed using descriptive and inferential statistics. Sixty-one percent of the households experienced extreme weather in the past 12 months. Heat waves (64.8%) and prolonged dry spells (equal to or more than 6 days) (50.8%) were the most common. There was a significant difference between communities in the proportion of households experiencing extreme weather ($\chi 2=27.9$; $p<0.001$). Household food insecurity was high, with 64% of the households moderately or severely food insecure. Household food insecurity was higher in households that experienced extreme weather compared to those not exposed in the past 12 months (79.4% versus 35.4%, respectively; $\chi 2=42.6$; $p<0.001$). Exposure to extreme weather was associated with household food insecurity after controlling for socioeconomic variables (OR=3.8; 95% CI 2.4–5.9). Extreme weather may be an important determinant of food insecurity among low-income households. Their exposure should be considered in community nutritional surveillance and adaptation programmes to minimise the impact of climate change.

KEYWORDS

Climate change, Extreme weather events, Household food insecurity, Environmental health, Ogun State, Nigeria

I. INTRODUCTION

Climate change is a public health challenge of the twenty-first century. Climate change is the shift in atmospheric temperature, precipitation patterns, and the frequency of extreme meteorological events (WHO, 2021). Human activities have caused global warming to rise by about 1.1°C compared to -industrial times. This warming is changing weather systems around the world. It leads to frequent and stronger heat waves, floods, droughts and storms (IPCC, 2021). Sub-Saharan Africa faces impacts from climate change even though it produces very little of the world’s greenhouse gas emissions. Nigeria, where the economy depends heavily on farming is at risk.

Nutritional deficiencies remain a persistent public health burden in Nigeria. About 68% of children between six months and five years old suffer from anaemia nationwide. Among women who're able to have children 57.8% also have anaemia (NPC & ICF 2019)? Many low-income communities live in areas what’re prone to flooding or other environmental hazards. These people rely on rain-fed farming for food and income. When extreme weather happens, they often lack money or social support to recover. Floods can ruin crops make water unsafe to drink and destroy homes and tools. All these effects hurt people’s ability to stay healthy and well-nourished.

Ogun State located in the south-western geopolitical zone of Nigeria, is a relevant setting for investigating these dynamics. The state has experienced an increase in flood events in recent years, with communities along the Ogun River corridor repeatedly affected, while it’s northern and eastern districts have faced more frequent prolonged dry spells (Nkwunonwo et al., 2024). Nationally, the 2022 floods alone disrupted the main food source of 49% of surveyed households, with rural households hit hardest (UNDP & NEMA, 2023). Despite this, rigorous community-level studies that empirically document the relationship between climate-driven extreme weather events and nutritional deficiency outcomes are missing from the scientific literature in Ogun State.

This paper reports findings from two objectives of a broader-based study on the impact of climate change-driven extreme weather on nutritional deficiencies in selected low-income communities of Ogun State: (i) to document the types, frequency, and perceived severity of extreme weather events experienced by households in the preceding twelve-month period; and (ii) to assess household food insecurity levels and examine the association between food insecurity and extreme weather event exposure. The corresponding null hypothesis tested was that there is no statistically significant association between extreme weather event exposure and household food insecurity in the selected communities ($H0_1$).

II. LITERATURE REVIEW / THEORETICAL FRAMEWORK

IPCC Sixth Assessment Report (2021) indicates that human actions have led to an increase of 1.07°C in the Earth’s surface temperature relative to the 1850–1900 timeframe. This rise in temperature enhances the water cycle. As a result of this, we are facing heavy rainfall and extended dry spells. The integration of these two conditions results in what researchers refer to as a compound-hazard scenario. When systems created to manage a specific type of stress, such as drought or flooding, encounter both simultaneously, they are unable to handle the situation (Raymond et al., 2020). This is particularly accurate in Nigeria, and even more so in Ogun State, where the climate displays brief but intense rainfall succeeded by extended dry periods. Farmers in Nigeria experience both flood stress and drought stress simultaneously. This indicates that crops suffer from floods and are then rapidly ruined due to insufficient water. This combined stress leads to issues for agriculture and food security. In Nigeria, and especially in Ogun State the pattern is short intense rainfall events followed by long dry periods, which cause both flood damage and drought damage to farms at the same time. Local flood-risk studies in Ogun State have mainly focused on drainage systems and nature-based solutions not on the effects, on nutrition. Extreme weather events undermine household food security through several connected pathways. The agricultural production pathway works through crop destruction from flooding-induced waterlogging or drought-induced water deficit stress. The food market access pathway works through supply-chain disruption that limits market-dependent food access; a nationwide post-disaster assessment found that the main food source of 49% of affected Nigerian households was disrupted following the 2022 floods, with rural households hit hardest (UNDP & NEMA, 2023). The water, sanitation and hygiene pathway works through contamination of water sources and escalation of infectious disease burden. The livelihood/income pathway works through erosion of productive assets and income-generating capacity. The Household Food Insecurity Access Scale (HFIAS), developed by Coates et al. (2007), measures the food-access dimension of food security through a validated nine-item instrument that has been applied across multiple Sub-Saharan African settings, including Nigeria.

Within Nigeria, empirical evidence linking extreme weather exposure to food security outcomes is growing but remains geographically uneven and concentrated at national or continental scale rather than at community level. A continent-wide panel analysis found that flooding measurably affected the food-security status of roughly 12% of the African population that experienced food insecurity between 2009 and 2020, with effects that could persist for months after a flood event and that varied by spatial scale (Reed et al., 2022). They differ depending on the spatial scale (Reed et al., 2022). A recent systematic review of literature concluded that both flood-related and drought-related shocks reduce household food security across the country but responses remain fragmented by geography, socioeconomic status and adaptive capacity and gaps in infrastructure and policy limit effective mitigation. In Ogun State published flood-risk research has focused on infrastructure and ecosystem-based aspects of flood management rather than on household-level food security or nutritional outcomes. Community-level, multi-site evidence that separates weather exposure and food-insecurity outcomes across distinct communities within the state was not available before this study This study addresses that gap using the IPCC AR5 vulnerability framework (exposure, sensitivity, adaptive capacity; Field et al., 2014) and the FAO four-pillar food security framework (FAO, 1996, 2009) as its guiding conceptual lenses.

III. MATERIALS AND METHODS

A. Research Design and Study Area

A cross-sectional analytical survey design was adopted, supplemented with a twelve-month household recall component for extreme weather event exposure. The study was conducted across five purposively selected communities in Ogun State, Nigeria — Imewuro (Ijebu North East LGA), Ajebandele (Ijebu East LGA), Magbon (Remo North LGA), Babalawo (Ewekoro

LGA) and Oni (Ogun Waterside LGA) — selected because of significant agricultural dependence and verified exposure to at least one major extreme weather event within the preceding five years.

B. Sample Size and Sampling Procedure

Sample size was determined using Cochran's (1963) formula with finite population correction at a 95% confidence level, 5% margin of error, and adjustment for a design effect of 1.5 and 10% non-response, yielding a final operational sample of 384 households distributed approximately equally across the five communities. A four-stage probability sampling procedure was employed: purposive selection of communities, simple random selection of two wards per community, household enumeration and computer-generated random selection within wards, and identification of the household head or primary caregiver as the principal respondent within each selected household. Of 384 households targeted, 372 valid questionnaires were retained for analysis (96.9% response rate).

C. Data Collection Instruments and Analysis

Extreme weather event exposure was assessed through a structured recall module covering flooding, prolonged dry spells, extreme heat waves, and severe windstorms experienced in the twelve months preceding the survey, capturing occurrence frequency, mean duration, and perceived severity (1–5 Likert scale) for each event type. A composite exposure score was derived as the sum of occurrence frequency multiplied by severity rating across all event types; households were classified as 'exposed' (composite score ≥ 3) or 'unexposed' (score < 3). Community-level verification was achieved through triangulation with Nigerian Meteorological Agency rainfall data and NEMA flood event records. Household food insecurity was assessed using the nine-item HFIAS (Coates et al., 2007), administered with reference to the four weeks preceding the survey (Cronbach's alpha = 0.86 in the pre-test).

The continuous HFIAS score (range 0–27) and the standard four-category classification (food secure, mildly, moderately and severely food insecure) were both derived. Data were analysed in IBM SPSS Statistics Version 26.0. Categorical variables were described using frequencies and percentages, and continuous variables using means and standard deviations. Associations between extreme weather exposure and food insecurity status were assessed using Pearson's chi-square test and one-way ANOVA with Bonferroni post-hoc comparisons across communities. Multivariate binary logistic regression, with confounders identified from univariate analysis at $p < 0.25$, was used to determine independent predictors of household food insecurity, with adjusted odds ratios (aOR) and 95% confidence intervals reported. Statistical significance was set at $p \leq 0.05$.

IV. FINDINGS AND RESULTS

A. Extreme Weather Event Exposure

Across the sample of 372 households, extreme heat waves were the most commonly reported hazard (64.8%), followed by prolonged dry spells (50.8%), flooding (36.0%) and severe windstorms (26.3%) (Table 1). Hazard exposure varied by community: flooding was concentrated in Oni (66.7%) and Babalawo (62.7%); prolonged dry spells were most prevalent in Imewuro (76.3%) and Magbon (69.4%); and windstorms were most prevalent in Magbon (47.2%) (Table 2).

Table 1. Aggregate Household Exposure to Extreme Weather Events in the Preceding 12 Months (N = 372)

Weather Event	Yes n (%)	No n (%)	Modal Frequency	Mean Severity (1–5)
Flooding	134 (36.0)	238 (64.0)	2–3 times	3.9
Prolonged dry spell	189 (50.8)	183 (49.2)	2–3 times	3.6
Extreme heatwave	241 (64.8)	131 (35.2)	4+ times	3.1
Severe windstorm	98 (26.3)	274 (73.7)	Once	3.4

Table 2. Composite Extreme Weather Exposure Classification, by Community

Exposure Status	Imewuro	Ajebandele	Magbon	Babalawo	Oni	Total
Exposed, n (%)	42 (55.3)	31 (41.9)	40 (55.6)	56 (74.7)	59 (78.7)	228 (61.3)
Unexposed, n (%)	34 (44.7)	43 (58.1)	32 (44.4)	19 (25.3)	16 (21.3)	144 (38.7)

$\chi^2 = 27.9$, df = 4, $p < 0.001$ — composite exposure differed significantly by community, with Oni and Babalawo recording the highest exposure and Ajebandele the lowest.

B. Household Food Insecurity

The aggregate mean HFIAS score was 12.4 (SD = 6.8) on a possible range of 0–27. Applying the validated HFIAS decision tree, only 15.6% of households were food secure, while 64.0% fell into the moderately or severely food insecure categories (Table 3), with a clear community-level gradient from 41.9% in Ajebandele to 80.0% in Oni Table 4.

Table 3. Aggregate Household Food Insecurity Categories (N = 372)

Food Insecurity Category	N	%
Food secure	58	15.6
Mildly food insecure	76	20.4
Moderately food insecure	134	36.0
Severely food insecure	104	28.0
Total	372	100.0

Table 4. Moderate/Severe Food Insecurity Rate, by Community

Community	n	Moderate/Severe Food Insecure, n (%)
Ajebandele	74	31 (41.9)
Imewuro	76	46 (60.5)
Magbon	72	44 (61.1)

Babalawo	75	57 (76.0)
Oni	75	60 (80.0)
Total	372	238 (64.0)

C. Association between Extreme Weather Exposure and Food Insecurity

Food insecurity was more prevalent among weather-exposed households (79.4%) than unexposed households (35.4%); a Pearson chi-square test confirmed a statistically significant association ($\chi^2 = 42.6$, df = 1, $p < 0.001$) (Table 5), leading to rejection of the null hypothesis ($H0_1$).

Table 5. Cross-Tabulation of Extreme Weather Exposure and Household Food Insecurity Status

Weather Exposure Status	Food Secure/Mildly Insecure n (%)	Moderately/Severely Insecure n (%)	Total
Exposed (n = 228)	47 (20.6)	181 (79.4)	228
Unexposed (n = 144)	93 (64.6)	51 (35.4)	144
Total	140	232	372

$\chi^2 = 42.6$, df = 1, $p < 0.001$.

In multivariate binary logistic regression, extreme weather exposure remained the strongest independent predictor of household food insecurity after adjustment for community, household size, education and income (Table 6), confirming that the exposure effect was not simply a proxy for community location.

Table 6. Multivariate Logistic Regression of Predictors of Household Food Insecurity

Predictor	Adjusted OR	95% CI	p-value
Extreme weather exposed (vs unexposed)	3.8	2.4–5.9	< 0.001
Community: Oni (vs Ajebandele)	4.2	1.9–9.4	< 0.001
Community: Babalawo (vs Ajebandele)	3.6	1.6–8.0	0.002
Household size ≥ 7 (vs < 7)	1.9	1.1–3.2	0.021
No formal/primary education (vs secondary+)	2.1	1.3–3.4	0.003
Monthly income < ₦50,000 (vs ≥ ₦50,000)	2.6	1.6–4.3	< 0.001

Model $\chi^2 = 118.7$, df = 8, $p < 0.001$; Nagelkerke $R^2 = 0.37$; Hosmer-Lemeshow p = 0.58 (adequate fit).

V. DISCUSSION

The finding shows that 61.3% of households were exposed to at least one extreme weather event. Heat waves and prolonged dry spells were the most common problems showing that communities face many climate hazards at once during a single farming season (Raymond et al. 2020). The significant community-level exposure gradient — from 41.9% in

Ajebandele to 78.7% in Oni — reflects the known influence of local topography, drainage infrastructure and proximity to the Ogun River system on household-level hazard exposure. Floods hit mainly the river and wetland areas of Oni and Babalawo. Dry spells and windstorms hit mainly the villages of Imewuro and Magbon respectively.

The finding that 64.0% of households were moderately or severely food insecure, and that food insecurity was significantly more common among weather-exposed households (79.4%) than unexposed households (35.4%), fits the theoretical pathway in which extreme weather events disrupt food production, damage stored food and productive assets, and constrain market access, thereby directly undermining household food access (WHO, 2021). Food insecurity pattern of strength and direction matches continental data that flooding clearly lowers food security for many affected people (Reed et al., 2022) and matches a recent Nigeria review that both flood and drought shocks consistently lower household food security across the country. he fact that the exposure effect remains in the multivariate model (OR = 3.8) after adjusting for community of residence household size, education and income shows that extreme weather exposure affects food insecurity that is not just a sign of where people live or their existing economic situation. The additional finding that Oni (aOR = 4.2) and Babalawo (aOR = 3.6) were still more food insecure than Ajebandele even after controlling for individual-level exposure suggests that community-level structural factors. Such as drainage infrastructure, market accessibility and distance from formal services. Add to the direct impact of weather exposure at the household level. This supports the calls in the literature, for climate-sensitive, location-specific nutrition surveillance and better-coordinated adaptation policies.

VI. CONCLUSION AND RECOMMENDATIONS

This study has shown that climate change-driven extreme weather events are significantly associated with household food insecurity in low-income communities of Ogun State, Nigeria. The strength and consistency of the association confirmed across bivariate, community-level and multivariate analyses indicates a real exposure effect rather than an artefact of a single study site. The null hypothesis that no significant association exists between extreme weather exposure and household food insecurity was rejected ($\chi^2 = 42.6$, $p < 0.001$). Oni and Babalawo, the two communities most exposed to flooding along the Ogun River/wetland system, were the highest-risk sites across both outcome measures examined.

Based on these findings, the following are recommended:

- The Ogun State Ministry of Health and Ministry of Environment should integrate extreme weather and climate risk indicators into the routine nutritional surveillance systems. These nutrition surveillance systems should include location-based thresholds that match different risk profiles documented across the five communities.
- Community-based early warning systems and flood-control/drainage infrastructure should be prioritised in Oni and Babalawo because Oni and Babalawo show weather exposure consistently and face a heavy food insecurity burden.
- Climate-adaptive agricultural extension support, with drought-tolerant crop varieties and windstorm-resistant farm structures, should be prioritised in Imewuro and

Magbon. Where dry spells and windstorms, rather than flooding, were the dominant hazards.

- Future research should incorporate longitudinal and biochemical designs to establish causal pathways linking extreme weather exposure to clinical nutritional deficiency status among climate-exposed households.

REFERENCES

[1] Akinkuolie, T. A., Ogunbode, T. O., & Adekiya, A. O. (2025). Resilience to climate-induced food insecurity in Nigeria: A systematic review of the role of adaptation strategies in flood and drought mitigation. Frontiers in Sustainable Food Systems, 8, 1490133. https://doi.org/10.3389/fsufs.2024.1490133.

[2] Ayanlade, A., Radeny, M., & Morton, J. F. (2017). Comparing smallholder farmers' perception of climate change with meteorological data: A case study from south-western Nigeria. Weather and Climate Extremes, 15, 24–33. https://doi.org/10.1016/j.wace.2016.12.001.

[3] Cann, K. F., Thomas, D. R., Salmon, R. L., Wyn-Jones, A. P., & Kay, D. (2013). Extreme water-related weather events and waterborne disease. Epidemiology & Infection, 141(4), 671–686. https://doi.org/10.1017/S0950268812001653.

[4] Coates, J., Swindale, A., & Bilinsky, P. (2007). Household Food Insecurity Access Scale (HFIAS) for measurement of food access: Indicator guide (Version 3). Food and Nutrition Technical Assistance Project (FANTA)/FHI 360. https://www.fantaproject.org/sites/default/files/resources/HFIAS_ENG_v3_Aug07.pdf.

[5] Field, C. B., Barros, V. R., Dokken, D. J., Mach, K. J., Mastrandrea, M. D., Bilir, T. E., & White, L. L. (Eds.). (2014). Climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. Cambridge University Press. https://www.ipcc.ch/report/ar5/wg2/.

[6] Food and Agriculture Organization of the United Nations. (1996). Rome Declaration on World Food Security. FAO. https://www.fao.org/3/W3613E/W3613E00.HTM.

[7] Food and Agriculture Organization of the United Nations. (2009). Declaration of the World Summit on Food Security. FAO. https://www.fao.org/fileadmin/templates/wsfs/Summit/Docs/Final_Declaration/WSFS09_Declaration.pdf.

[8] Intergovernmental Panel on Climate Change. (2021). Climate change 2021: The physical science basis. Contribution of Working Group I to the Sixth Assessment Report. Cambridge University Press. https://www.ipcc.ch/report/ar6/wg1/.

[9] Lissner, T. K., Reusser, D. E., Schewe, J., Lakes, T., & Kropp, J. P. (2014). Climate impacts on human livelihoods: Where uncertainty matters in projections of water availability. Earth System Dynamics, 5(2), 355–373. https://doi.org/10.5194/esd-5-355-2014.

[10] National Population Commission & ICF. (2019). Nigeria Demographic and Health Survey 2018. NPC & ICF. https://dhsprogram.com/pubs/pdf/FR359/FR359.pdf.

[11] Niang, I., Ruppel, O. C., Abdrabo, M. A., Essel, A., Lennard, C., Padgham, J., & Urquhart, P. (2014). Africa. In V. R. Barros et al. (Eds.), Climate change 2014:

Impacts, adaptation, and vulnerability. Part B: Regional aspects. Cambridge University Press. https://www.ipcc.ch/report/ar5/wg2/.

[12] Nkwunonwo, U. C., Tobore, A., & Nwaka, O. C. (2024). Ecosystem-based approach to local flood risk management in Ogun State, Nigeria: Knowledge, and pathway to actualisation. Natural Hazards Research, 4(3), 357–373. https://doi.org/10.1016/j.nhres.2023.09.003.

[13] Raymond, C., Matthews, T., & Horton, R. M. (2020). The emergence of heat and humidity too severe for human tolerance. Science Advances, 6(19), eaaw1838. https://doi.org/10.1126/sciadv.aaw1838.

[14] Reed, C., Anderson, W. B., Kruczkiewicz, A., Nakamura, J., Gallo, D., Seager, R., & McDermid, S. S. (2022). The impact of flooding on food security across Africa. Proceedings of the National Academy of Sciences, 119(43), e2119399119. https://doi.org/10.1073/pnas.2119399119.

[15] Tirado, M. C., Clarke, R., Jaykus, L. A., McQuatters-Gollop, A., & Frank, J. M. (2010). Climate change and food safety: A review. Food Research International, 43(7), 1745–1765. https://doi.org/10.1016/j.foodres.2010.07.003.

[16] United Nations Development Programme & National Emergency Management Agency. (2023). Nigeria flood impact, recovery and mitigation assessment report 2022–2023. UNDP Nigeria. https://www.undp.org/sites/g/files/zskgke326/files/2023-12/nigeriafloodimpactrecoverymitigationassessmentreport2023.pdf.

[17] World Health Organization. (2021). Climate change and health. WHO. https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health.