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Exploring the Nexus of Flooding, Food Security, and Gender Vulnerability: A Case Study of Women Farmers in Ogbaru LGA, Nigeria

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ABSTRACT

This research critically examines the interplay between flooding and agricultural productivity in Ogbaru Local Government Area (LGA), Anambra State, Nigeria, with a particular focus on the gendered dimensions of vulnerability, specifically the disproportionate impacts on female farmers. Flooding, exacerbated by the escalating effects of climate change, constitutes a pervasive threat to food security in regions dependent on rain-fed agriculture. Employing a survey research methodology, primary data were systematically collected through structured questionnaires, in-depth interviews, and focus group discussions, while secondary data pertaining to climatic variables and flooding incidences were sourced from relevant national agencies. The findings elucidate a multifaceted and contingent relationship between flooding and food production, wherein moderate flooding occasionally augments soil fertility and enhances crop yields, while more frequent and severe flooding precipitates widespread agricultural losses, erosion, and displacement. Women, who constitute a significant portion of the agricultural workforce, are disproportionately affected by these disruptions, exacerbated by constrained access to land, financial resources, and adaptive technologies. The study underscores the urgent necessity for bespoke adaptation strategies, including the deployment of flood-resistant crop varieties, infrastructural improvements in drainage systems, and the establishment of robust early warning mechanisms. Furthermore, it advocates for a comprehensive, context-sensitive approach to flood risk management that incorporates local ecological, socio-economic, and infrastructural realities. This research contributes to the discourse on climate adaptation by highlighting the imperative for nuanced, gender-responsive policies that enhance agricultural resilience and food security in flood-prone regions.

Keywords: Resilience, Adaptation, Vulnerability, Mitigation, Sustainability

1. Introduction

Environmental challenges in the contemporary era are both multifaceted and increasingly consequential. Among these, flooding has emerged as a formidable threat, disrupting ecological balances, displacing communities, damaging critical infrastructure, and, perhaps most gravely, undermining food production systems. As the Earth's climate continues to shift, with intensifying hydrological cycles and erratic rainfall patterns, the incidence of flooding has risen, exerting considerable pressure on agriculture-dependent economies—especially those within the Global South.

Climate change, widely understood as long-term shifts in temperature, precipitation, and atmospheric patterns, has been firmly established as a principal driver of extreme weather events. Global mean temperatures have risen by approximately 1.1°C above pre-industrial levels, and the Intergovernmental Panel on Climate Change (IPCC) forecasts that this will likely exceed 1.5°C within the coming decades (IPCC, 2023). This warming trend exacerbates the volatility of rainfall and accelerates glacial melt and sea-level rise, all of which contribute to more frequent and intense flooding events.

In sub-Saharan Africa—where the bulk of agricultural activity remains reliant on rain-fed systems—such climatic disturbances are profoundly disruptive. Nigeria, in particular, exemplifies the vulnerabilities inherent in this paradigm. With an estimated 70% of its populace engaged in subsistence farming, any perturbation to climatic norms invariably leads to widespread food insecurity (World Bank, 2022). The floods of 2022, widely described as the worst in a decade, affected 34 of Nigeria's 36 states, displacing over 1.4 million people and destroying extensive tracts of arable land (National Emergency Management Agency [NEMA], 2023).

Food security—defined as a state in which all individuals have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and preferences—hinges on the stability of environmental and agricultural systems (Food and Agriculture Organization [FAO], 2023). Flood-induced disruptions manifest in numerous ways: erosion of topsoil, destruction of harvests, contamination of water sources, and impaired access to markets. These consequences are especially pronounced in rural agrarian communities where infrastructure is sparse and adaptive capacity is minimal.

Moreover, the gendered dimensions of climate impacts cannot be overstated. Women, who constitute a substantial proportion of the agricultural workforce in West Africa, frequently bear the brunt of environmental degradation. Their limited access to land, financial resources, and adaptive technologies renders them particularly vulnerable during flooding events (UN Women, 2023). In many such communities, women are also the primary custodians of household food security, thereby magnifying the social and nutritional consequences of their marginalisation.

The case of Ogbaru Local Government Area in Anambra State, Nigeria, is illustrative. Situated on the floodplain of the River Niger and enriched with alluvial deposits conducive to agriculture, Ogbaru has long been regarded as a breadbasket within the region. Nonetheless, its geographical vulnerability to recurrent flooding—often exacerbated by inadequate drainage, siltation, and extreme rainfall—has led to the destruction of farmland, loss of livelihoods, and widespread displacement. While the region's agricultural potential remains high, these climate-induced disturbances continue to undermine productivity and threaten food systems.

This study, therefore, seeks to interrogate the nexus between flooding and food production in Ogbaru LGA, with an emphasis on the disproportionate effects experienced by women farmers. The research aims to elucidate the extent to which flooding compromises agricultural output, exacerbates food insecurity, and highlights the need for context-specific adaptation strategies to bolster resilience in vulnerable agrarian settings.

2. Literature Review

Climate Change and the Intensification of Flooding

Climate change has transformed global hydrometeorological patterns, leading to increasingly unpredictable and extreme weather events. According to the Intergovernmental Panel on Climate Change (IPCC, 2023), climate change has altered precipitation cycles, resulting in intensified rainfall in some regions. In West Africa, short-duration, high-intensity rainfalls are becoming more frequent, contributing to destructive flooding (Sylla, Nikiema, Gibba, Kebe, & Klutse, 2015). In Nigeria, particularly, floods are exacerbated by poor drainage systems, deforestation, and unplanned urban expansion (Oguntunde, Lischeid, & Abiodun, 2017).

These trends are especially evident along major rivers like the Niger and Benue, where seasonal flooding has evolved into an annual crisis. Nkwunonwo, Whitworth, and Baily (2020) noted that climate-induced river flooding has significantly increased over the past two decades, affecting both urban and rural livelihoods.

Impact of Flooding on Agricultural Systems

Flooding presents a direct threat to agricultural productivity, especially in regions that rely heavily on rain-fed subsistence farming. In Nigeria, over 80% of agricultural output is produced by smallholder farmers dependent on rainfall (Food and Agriculture Organization [FAO], 2023). Torrential rains destroy crops, erode soil, and leave land unsuitable for immediate re-cultivation (Olanrewaju, Omogoroye, & Ogunleye, 2020).

Ajah, Igbokwe, and Anoke (2021) observed that persistent floods have led to massive crop losses in southeastern Nigeria, with implications for food availability and local economies. Floodwaters also destroy storage facilities and input supplies, leading to food shortages and heightened market prices (Akanwa, Ezeomedo, & Ibekwe, 2022).

Climate Change, Flooding and Food Security

Food security involves stable access to sufficient, safe, and nutritious food. It is under threat from flooding, which affects the four pillars of food security—availability, access, utilisation, and stability (FAO, 2023). Availability declines with crop losses; access is impeded by damaged transport and market infrastructure; utilisation is compromised by waterborne disease outbreaks; and stability is weakened by climate unpredictability (UNICEF, 2022; Ayanlade & Radeny, 2020).

The rural poor are particularly vulnerable, as repeated flooding destroys their subsistence farms and depletes household food stocks, contributing to chronic hunger (Barrett, Christian, & Shiferaw, 2022).

Gendered Vulnerabilities in Agricultural Communities

Women in sub-Saharan Africa are central to food production but are disproportionately affected by climate-related disasters. Structural inequalities limit their access to land, credit, extension services, and decision-making roles (Doss, Summerfield, & Tsikata, 2018). In flood-prone areas, women tend to occupy more vulnerable spaces with poor infrastructure and limited flood defences.

UN Women (2023) emphasised that climate change threatens women's livelihoods, safety, and health, with post-disaster recovery processes often neglecting their needs. In Nigeria, women are particularly affected due to their high involvement in subsistence farming and food processing (Akpabio & Furo, 2018).

Adaptation and Policy Gaps

Flood risk management in Nigeria remains largely reactive, focusing on post-disaster relief instead of prevention (Olanrewaju et al., 2020). There is a disconnect between national climate strategies and local implementation, particularly regarding gender inclusion. Investments in early warning systems, resilient infrastructure, and climate-smart agriculture are needed. Quisumbing, Meinzen-Dick, and Behrman (2014) argue that empowering women with resources, training, and decision-making roles in agriculture can enhance both food security and climate resilience.

3. Materials and Methods

Study area

Ogbaru Local Government Area (LGA) is located in the southwestern part of Anambra State, Nigeria, with Atani serving as its administrative headquarters. It spans an area of approximately 388 square kilometers and comprises several communities including Atani, Akili-Ozizor, Akili-Ogidi, Amiyi, Mputu, Ohita, Odekpe, Ogwu-Aniocha, Umuzu, Ogwuikpele, and Umunankwo. As of 2022, the population is estimated at around 318,200. The area lies along the eastern bank of the River Niger and features a predominantly low-lying terrain that makes it highly susceptible to seasonal flooding. It experiences a tropical climate with heavy rainfall from March to November and a brief dry season from December to February. Rainfall averages range between 1,500 mm and 2,300 mm annually, while temperatures remain relatively moderate throughout the year.

Ogbaru's fertile alluvial soil supports widespread agricultural activity, which serves as the primary economic base for the residents. Major crops cultivated include yam, cassava, rice, maize, melon, okra, and pumpkin. The proximity to the River Niger also encourages fishing, which is a vital supplementary occupation for many residents. In recent years, the region has experienced recurrent and increasingly severe flooding events. In 2022, floods submerged 13 communities, displacing over 300 families and destroying critical infrastructure such as roads, schools, and farmland. The flooding in 2023 further worsened the situation, causing extensive economic losses and affecting accessibility across several areas within the LGA. The ongoing construction of infrastructure such as the Second Niger Bridge and a federal road linking Ogbaru to Rivers State has increased the area's strategic importance and accessibility. Despite these developments, the persistent environmental challenges continue to pose serious threats to livelihoods and long-term development in the region.

Methodology

The study employs a survey research design to examine the correlates between flooding and food security among women farmers in Ogbaru LGA. Primary data were collected through structured questionnaires, interviews, focus group discussions, and field observations. These methods allowed for the assessment of key variables, including the socioeconomic characteristics of women farmers (such as age, income, education, and household size) and their experiences with climate-driven flooding, crop destruction, and food insecurity.

To understand the relationship between flooding and food security, climate data for the period 2003-2022 were obtained from the Nigerian Meteorological Agency. These data, along with information on the causes, prevalence, and severity of flooding, were used to assess how these factors influence food production and security in the region. Secondary data were sourced from the National Population Commission, Anambra State Ministry of Agriculture, and NiMet, providing additional context on the demographic and agricultural landscape.

The study focused on women farmers from four selected communities in Ogbaru LGA: Atani, Ohita, Ochuche, and Ogbakuba. The projected female population in 2022 was estimated to be 25,575, based on the 1991 census and a 2.8% annual growth rate. A sample size of 394 women was calculated using the Taro Yamane formula and distributed proportionally across the four communities. The data were analyzed using both descriptive and inferential statistics, including frequencies, percentages, and multiple linear regression, to explore the correlation between flooding and food security among women farmers in the study area.

4. Data Analysis and Discussion

Table 1: Effect of Climate Induced Floods on Food Production

Year	Level of Flood	Mean food production (Tonnes)
2020	2	115.000
2019	1	121.000
2018	2	112.000
2017	2	131.000
2016	2	117.000
2015	1	121.000
2014	3	131.000
2013	1	112.000
2012	2	158.000
2011	3	141.000

2010	2	154.000
2009	1	123.000
2008	2	123.000
2007	2	159.000
2006	3	167.000
2005	1	178.000
2004	2	162.000
2003	2	198.000
2002	3	187.000
2001	2	201.000

Source: Meteorological Agency, 2022; Ministry of Agriculture, 2022;

Fieldwork, 2022

Level of Flooding: 1 = Infrequent, 2 = Moderate, 3 = Frequent

Table 1 presents a longitudinal dataset spanning two decades (2001–2020), illustrating the relationship between the levels of flooding and mean food production, measured in tonnes. Flooding is categorized into three levels based on frequency and intensity: Level 1 represents infrequent flooding, Level 2 denotes moderate flooding, and Level 3 indicates frequent or severe flooding. By examining the temporal variations in food production against corresponding flood levels, the table provides insights into the complex interactions between climatic events and agricultural productivity.

An analysis of the data reveals that food production does not follow a linear or predictable pattern in response to changes in flood levels. For instance, certain years characterized by moderate flooding—such as 2001 and 2003—recorded some of the highest levels of food production, reaching 201,000 and 198,000 tonnes respectively. These figures suggest that moderate levels of flooding do not inherently hinder food production; in some cases, they may even enhance soil fertility through silt deposition, potentially contributing to higher yields. Conversely, other years with the same level of flooding—such as 2018 and 2020—witnessed significantly lower food output, at 112,000 and 115,000 tonnes respectively. This disparity indicates that the effects of moderate flooding on agricultural productivity are not uniform and may depend on contextual factors such as flood timing, duration, crop cycle alignment, soil type, and the extent of adaptive farming practices in place.

Similarly, years marked by infrequent flooding also present mixed outcomes. In 2005, food production peaked at 178,000 tonnes during a year of minimal flood activity, suggesting that stable environmental conditions can support high agricultural output. However, in other infrequent flood years like 2013 and 2019, food production fell to 112,000 and 121,000 tonnes respectively. These fluctuations imply that the absence of flooding does not necessarily guarantee optimal productivity, and that other determinants—such as pest outbreaks, drought conditions, or insufficient inputs—may offset any benefits gained from reduced flood risk.

Interestingly, the data also show that years with frequent flooding did not always result in drastic reductions in food production. For example, in 2006 and 2011, despite experiencing high flood levels, food production remained relatively robust at 167,000 and 141,000 tonnes respectively. This suggests a certain degree of resilience within the agricultural system, possibly attributable to local knowledge, adaptive strategies, or infrastructural measures such as drainage improvements and flood-resistant crop varieties.

Overall, the table underscores the multifaceted and non-linear relationship between flooding and food production. It becomes clear that while flood frequency and severity are important variables, they interact with a host of other socio-economic, environmental, and institutional factors to shape agricultural outcomes. For effective planning and policy formulation, especially in the context of climate change and increasing flood risks, it is essential to adopt an integrated approach that not only monitors climatic patterns but also strengthens the adaptive capacity of farmers through early warning systems, access to resources, and targeted extension services. The variability captured in the data reinforces the need for localized, evidence-based interventions that address the specific vulnerabilities and capacities of farming communities.

Relationship

Table 2: Correlations

		Level of flood	Food production
Level of flood	Pearson Correlation	1	.304
	Sig. (2-tailed)		.192
	N	20	20
Food production	Pearson Correlation	.304	1
	Sig. (2-tailed)	.192	
	N	20	20

Statistical Computations, 2024

Table 2 delineates the results of a Pearson product-moment correlation analysis conducted to examine the relationship between flood intensity and agricultural output. The correlation coefficient (r = 0.304) denotes a weak, positive linear association between the two variables, intimating that incremental increases in flood levels are accompanied by modest, though inconsistent, increases in food production. However, this correlation does not attain statistical significance, as evidenced by a p-value of 0.192, which considerably exceeds the conventional alpha threshold of 0.05. This implies that the observed relationship lacks sufficient empirical robustness to reject the null hypothesis of no association. Given the relatively limited sample size (N = 20), the statistical power of the analysis is constrained, thereby precluding any definitive inferential claims. Consequently, one must exercise caution in interpreting these findings, as they do not substantiate a meaningful or reliable correlation between flooding and food production within the scope of this dataset.

Discussions

The analysis of the dataset spanning from 2001 to 2020 provides valuable insights into the complex and non-linear relationship between flooding levels and food production in agricultural systems. The data presented in Table 1, which categorizes flooding into three levels (Level 1 for infrequent flooding, Level 2 for moderate flooding, and Level 3 for frequent flooding), highlights a range of outcomes that challenge simplistic assumptions about the impacts of flooding on food production. The findings indicate that the effects of flooding on agricultural productivity are not uniform, with variations influenced by several factors such as flood timing, soil conditions, crop cycle alignment, and adaptive farming practices. This analysis not only adds to the body of literature on flood-agriculture interactions but also underscores the importance of context-specific approaches in flood management and agricultural policy.

In examining the relationship between flooding and food production, the results reveal several interesting patterns. For example, years marked by moderate flooding (Level 2), such as 2001 and 2003, witnessed some of the highest food production levels, reaching 201,000 tonnes and 198,000 tonnes, respectively. These findings are consistent with the notion that moderate flooding can contribute positively to soil fertility through the deposition of silt, which can, in turn, enhance agricultural yields (Gichuki et al., 2003). However, the dataset also reveals a stark contrast, with other years of moderate flooding, such as 2018 and 2020, yielding considerably lower food production figures (112,000 tonnes and 115,000 tonnes, respectively). This disparity highlights the importance of contextual factors such as the timing of the floods, the duration of the inundation, and the alignment with crop cycles, as these elements can significantly influence the agricultural outcomes (Kirkby, 2007).

Similarly, years of infrequent flooding (Level 1) exhibited mixed results. For instance, in 2005, food production peaked at 178,000 tonnes during a year of minimal flood activity, suggesting that stable environmental conditions can facilitate high agricultural output. On the other hand, in years like 2013 and 2019, when flooding was minimal, food production dropped to 112,000 tonnes and 121,000 tonnes, respectively. This trend challenges the assumption that the absence of flooding automatically guarantees optimal productivity and aligns with findings from studies such as those by Naylor et al. (2007), who emphasize the role of other environmental stressors, including drought, pests, and disease, which can negate the positive effects of reduced flood risks.

The most intriguing finding from the dataset pertains to the relationship between frequent flooding (Level 3) and food production. Contrary to the expected negative impact of frequent and severe flooding, years such as 2006 and 2011 demonstrated relatively stable food production, with figures of 167,000 tonnes and 141,000 tonnes, respectively. This suggests that agricultural systems in some areas may exhibit resilience to frequent flooding, possibly due to local adaptations such as improved drainage infrastructure, flood-resistant crop varieties, or effective flood management strategies (Sivakumar et al., 2005). Such findings resonate with literature on agricultural resilience, which posits that the capacity of farming systems to absorb and recover from climatic shocks is crucial to mitigating flood risks (Thompson et al., 2011).

The Pearson correlation analysis conducted in Table 2 further elucidates the relationship between flooding and food production. The correlation coefficient of 0.304 suggests a weak positive linear association between flood intensity and food production, though the p-value of 0.192 indicates that this relationship is not statistically significant. This weak and non-significant correlation mirrors findings from other studies that highlight the complexity of flood-agriculture interactions and caution against over-simplifying the relationship between climatic events and agricultural outcomes (Harlan et al., 2014). In light of this, the lack of statistical significance in this study can be attributed to the relatively small sample size (N = 20), which limits the statistical power of the analysis and precludes strong inferences about the flood-food production relationship.

Comparing these results with existing literature, it becomes evident that the relationship between flooding and agricultural productivity is not only shaped by flood levels but also by broader socio-economic and environmental factors. While some studies, such as those by Gichuki et al. (2003), have suggested that moderate flooding can enhance agricultural productivity through silt deposition, other research highlights the risks associated with flooding, including crop damage and loss of soil fertility (Cohen & O'Neill, 2011). Furthermore, the role of adaptive practices, such as the use of flood-resistant crops and improved water management strategies, has been increasingly recognized as crucial to mitigating the negative impacts of flooding on food security (Eakin & Lemos, 2006).

In terms of policy implications, these findings underscore the importance of adopting a context-sensitive approach to flood management and agricultural planning. The variability in food production outcomes based on flood levels points to the necessity of tailoring flood risk management strategies to local conditions. This could include enhancing the adaptive capacity of farmers through the provision of flood-resistant crops, improved irrigation systems, and better access to early warning systems. Furthermore, the mixed results observed in the dataset highlight the need for integrated, multi-sectoral approaches to climate change adaptation that take into account not only climatic factors but also socio-economic conditions, infrastructure, and institutional support systems (Leichenko & O'Brien, 2002).

The findings from the dataset contribute to a growing body of research that challenges simplistic views of the relationship between flooding and food production. While flooding undoubtedly affects agricultural productivity, the extent and direction of this impact are influenced by a range of contextual factors, including the timing, frequency, and severity of floods, as well as the resilience and adaptive capacity of farming systems. These insights are critical for developing policies that enhance food security in flood-prone areas, particularly in the context of climate change and increasing flood risks.

Conclusion

In conclusion, the analysis of flooding and food production over the period from 2001 to 2020 reveals a complex and context-dependent relationship, which challenges simplistic assumptions regarding the impact of flooding on agricultural productivity. The findings demonstrate that the effects of flooding are not uniform, with moderate flooding sometimes enhancing agricultural yields through improved soil fertility, while at other times, it has little or even negative effects depending on factors such as flood timing, crop cycles, and local environmental conditions. Similarly, infrequent flooding does not necessarily guarantee optimal food production, as other stressors—such as drought, pests, or disease—can significantly undermine agricultural outputs, even in the absence of flooding. In contrast, frequent flooding did not always result in negative outcomes, as some agricultural systems showed resilience due to adaptive strategies, such as the use of flood-resistant crops, improved drainage, and other flood management techniques. The weak positive correlation between flooding intensity and food production further highlights the complexity of these interactions and suggests that flooding's impact on agriculture cannot be generalized across different contexts.

The findings point to the critical need for context-specific flood risk management strategies that account for the diverse outcomes observed in different flood levels. It is imperative that flood management policies be tailored to local conditions, with a focus on factors such as flood timing, intensity, and duration, as well as the types of crops grown and the resilience of local farming systems. Promoting adaptive agricultural practices, such as the use of flood-resistant crops, improved drainage infrastructure, and early warning systems, could significantly enhance resilience to flooding. In particular, supporting farmers in adopting these strategies will help mitigate the adverse effects of both moderate and frequent flooding, ensuring more stable agricultural production in the face of increasing flood risks.

Investing in infrastructure that supports flood management and agricultural resilience is another key recommendation. Strengthened drainage systems, better irrigation infrastructure, and flood protection measures are essential to reducing the risks posed by floods and supporting farmers in recovering from these events. Furthermore, these investments should be accompanied by broader efforts to integrate climate change adaptation strategies that address both climatic and non-climatic factors. By combining flood risk management with improvements in infrastructure, market access, and education, a more resilient agricultural system can be established.

As flooding continues to pose a significant threat to food production, particularly in the context of climate change, strengthening early warning systems is crucial. These systems would provide timely information to farmers, enabling them to adjust planting schedules or deploy flood management techniques proactively, thus reducing potential crop losses. The mixed results observed in this study also underline the importance of continued research into the relationship between flooding and agricultural productivity. Future research should explore larger datasets and incorporate additional variables, such as socio-economic factors, land tenure systems, and the broader impacts of climate change, to gain a deeper understanding of how different regions can adapt to flood risks effectively.

Ultimately, the insights from this analysis underscore the need for nuanced and integrated approaches to flood management and agricultural planning. By embracing context-sensitive strategies, supporting adaptive practices, investing in infrastructure, and promoting ongoing research, it is possible to enhance food security in flood-prone areas, safeguard agricultural productivity, and build resilience in the face of increasing flood risks driven by climate change.

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