

An Integrated Assessment of the Positive and Negative Impacts of Flooding on Agriculture, Human Settlements, and Livelihood in Kogi State, Nigeria

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Abstract: Flooding is a recurring environmental challenge in Nigeria, with Kogi State particularly vulnerable due to its location within the Niger–Benue floodplain. This study provides an integrated assessment of the positive and negative impacts of flooding on agriculture, human settlements, livelihoods, and environmental systems in Kogi State. Specifically, the study examined the effects of flooding on agricultural productivity and human settlements, assessed the positive contributions of seasonal flooding to soil fertility, groundwater recharge, fisheries, and livelihood diversification, and evaluated household and community-level coping and adaptation strategies for sustainable flood risk management. A mixed-methods research design was adopted, involving household surveys, key informant interviews, and secondary data sources. Quantitative data were analyzed using descriptive statistics and inferential techniques, while qualitative data were analyzed thematically. The results show that flooding has statistically significant negative effects on crop production, livestock, housing, infrastructure, displacement, public health, and economic activities across flood-prone Local Government Areas. Conversely, seasonal flooding contributes positively to soil fertility enhancement, groundwater recharge, fisheries development, and livelihood diversification, thereby supporting environmental sustainability and livelihood resilience. Although households and communities employ various coping and adaptation strategies, these measures are largely short-term and insufficient to reduce long-term flood vulnerability without institutional support. The study concludes that flooding in Kogi State functions as both a hazard and a resource, underscoring the need for integrated flood risk management approaches that reduce flood-related risks while harnessing the ecological and livelihood benefits of seasonal flooding. The findings offer valuable insights for evidence-based policy formulation aimed at enhancing resilience and sustainable development in flood-prone communities.

Keywords: Flooding, Agriculture, Human Settlements, Positive Impacts, Negative Impacts, Kogi State, Nigeria.

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I. INTRODUCTION

➤ Background to the Study

Floods continue to be one of the most common and destructive natural disasters in the world, comprising over 40 percent of all natural disasters (UNDRR, 2023). In the last two decades, over 1.5 billion people have suffered due to floods around the world, with total damages exceeding \$700 billion (World Bank, 2022). Floods result from water covering areas of land that would otherwise be dry, owing to heavy rains, overflowing rivers, inefficient drainage systems, and failed dams. Despite their destructive tendencies, floods also play crucial roles in ensuring ecological and agricultural

sustainability through soil fertilization, replenishing aquifers, and sustaining aquatic life (FAO, 2021). Given this duality of floods, an assessment of the phenomenon is required to understand their impacts comprehensively.

Floods in Nigeria have been an environmental issue that occurs regularly especially during the peak rainy season (July-October). Issues like climate change, poor urbanization, fast-growing population, and deforestation have contributed to the increasing regularity and intensity of floods in the country (Nwankwoala & Akpofure, 2022). NEMA has made annual reports regarding huge financial losses due to the disaster. For example, the 2012 flood was recorded as the

greatest disaster in Nigerian history where flooding occurred in 27 of the total 36 states, affecting more than 7 million people; 600,000 houses were damaged while farmlands worth ₦2.6 trillion in total were destroyed (NEMA, 2013). In 2022, floods affected 3.2 million people with 1.4 million being displaced in Kogi alone with agricultural losses estimated at ₦100 billion (NEMA, 2023). Also, in 2023, 50 LGAs have suffered from floods, including those in Ibaji, Lokoja, and Ajaokuta, which are the most affected areas in Kogi State (Olanrewaju, D. O., Yusuf, R. O., & Adelekan, I. O, 2023).

The state of Kogi is strategically located at the convergence point between Rivers Niger and Benue, thus ranking among the flood-vulnerable regions in Nigeria (Adelekan, 2021). Agriculture and fishing remain the main occupations of the people living along the river. Seasonal flooding, in turn, brings beneficial nutrients to the soil, improving crop productivity; however, extreme floods cause destruction of crops, irrigation infrastructure, topsoil erosion, and food insecurity (Agada & Eyong, 2021).

In addition, flooding destroys houses of people in the region, causes displacement of hundreds of people, disrupts markets, and destroys hospitals and schools. Furthermore, floods contribute to the outbreak of health problems such as malaria, cholera, and diarrhea due to the creation of mosquito breeding grounds (WHO, 2023). Curiously enough, despite the prevalence of adverse impacts, floods have been associated with several advantages in Kogi state. For instance, it has been observed through research that the soil yield of farms in Ibaji LGA increased by 15%-20% owing to the nutrients added by floods on crops such as maize and rice (Olorunfemi, F., Ogundele, O., & Musa, A., 2020). Moreover, the temporary formation of wetlands by the floods has been known to help sustain inland fisheries for fish production, contributing economically to households.

Floods in Kogi state create a dynamic situation involving several elements including environmental factors, agricultural factors, and socio-economic considerations. Although flooding leads to major damages to crops, property, and people, the process of periodic flooding ensures enhanced soil fertility, groundwater recharge, and livelihood diversification through fisheries production (FAO, 2021; Olorunfemi et al., 2020). Considering that climate change has impacted hydrologic cycles in West African countries, the incidence of floods and their intensity will become higher in the region (IPCC, 2021). To understand these dynamics, one must first be aware of the double-edged nature of flooding as experienced in the Niger-Benue floodplains in relation to agricultural activities and human settlements in Kogi State.

➤ *Statement of the Research Problem*

Flood has become a very challenging environmental problem that Nigeria currently faces and the effect of the phenomenon is more pronounced in the Kogi State because of the special geographic location of the state at the confluence of Rivers Niger and Benue. The severity, frequency, and socio-economic consequences of flooding in the Kogi State have increased immensely over the last two decades making agriculture and human settlement

unsustainable despite various interventions by the government (Adelekan, 2021; NEMA, 2023).

The Kogi State is a major agricultural state whose economy thrives on farming as the major occupation for 70% of the population. Unfortunately, annual floods pose a great risk to Kogi's agricultural economy as over 80% of the farmlands in Ibaji, Lokoja, and Ajaokuta LGAs were submerged by the 2022 floods, causing huge financial losses worth over ₦100 billion (NEMA, 2023). The destruction of farmlands is characterized by damage to crops like rice, maize, cassava, and yams, irrigation systems, planting plans, among other things. Moreover, continuous flood losses have caused some farmers to give up and leave agriculture behind, thus compromising their ability to continue with farming and providing food. Consequently, such farmers seek alternative sources of income outside their rural homes (Agada & Eyong, 2021). The situation is a real threat to food security of Kogi State and Nigeria since the state is one of the major producers of grains and tubers in the country.

Human habitation is also threatened with the increasing number of flood risks in Kogi State. According to the report provided by the National Emergency Management Agency (NEMA), floods in the year 2012 and 2022 led to the displacement of over 2 million people and destroyed thousands of buildings. Schools and markets were submerged and several roads and bridges got destroyed (NEMA, 2013; Olanrewaju et al., 2023). The informal settlements as well as the uncontrolled development into the floodplains increases the vulnerability because the poorer populations often choose areas that are prone to flooding since they can afford living there and utilize fertile soils for cultivation. The destruction of people's homes as well as other basic infrastructures not only results in humanitarian disasters but also places heavy socio-economic tolls on families, local governments and the country as a whole. Nonetheless, despite these losses incurred due to floods, urban planning and control of the use of floodplains is inadequate, and the implementation of relocation policies is ineffective.

Flooding also creates serious health issues. The stagnant water in the aftermath of floods breeds mosquitoes leading to malaria infections, while water contamination makes it likely for residents to contract cholera, typhoid fever as well as diarrhea (WHO, 2023). During the floods in 2022, cholera cases were also identified in several Kogi LGAs, where more than 500 infections were documented (NCDC, 2022). Tragically, most hospitals are affected and become inaccessible due to floods. Although floods come with detrimental consequences, they are capable of bringing some advantages that often go unnoticed in discussions about disasters management. Seasonal floods help replenish alluvial soils, making the land richer in nutrients and leading to a possible rise in agricultural productivity by 20 percent for the next season (Olorunfemi et al., 2020). Moreover, floods recharge the water supply for underground aquifers as well as form wetlands that facilitate fish harvesting, providing additional sources of food production. Still, lack of policy-oriented plans to utilize such advantages and minimize the risks makes communities swing between short-term profits

and disasters. Therefore, there is a research gap in the need to examine the advantages and disadvantages of floods in Kogi State from a comprehensive perspective. Another reason for studying the problem lies in the influence that global climate change has on flood risks. As indicated by the IPCC (2021), the upcoming decades can witness a growing frequency and variability of precipitation events in West Africa, which leads to higher chances of extreme floods. Indeed, the rainfall intensity in Nigeria has already increased by 10-15 percent since the 1990s (Nwankwoala & Akpofure, 2022). Hence, without adopting new adaptive strategies, future floods in Kogi might bring severe damage to lands, properties, and human populations. Yet, available intervention strategies seem unresponsive to changing conditions. Although a number of studies have been conducted on flooding in Nigeria, previous literature mostly emphasizes the destructive effects of flooding including crop destruction, displacement of people from their homes and infrastructural damages. Although the information provided by such studies is important to help assess risk and disaster mitigation measures in the event of flooding, there are few studies that examine the impact of flooding on agriculture, human settlements and livelihoods through assessing both its beneficial and adverse effects in flood-prone areas in Kogi State, Nigeria. The current lack of such information makes it impossible for policy makers and environmentalists to come up with policies that can effectively deal with the challenges associated with flooding. Hence, this study aims to address the identified knowledge gaps by examining the beneficial and adverse impacts of flooding on agriculture, human settlements and livelihoods in Kogi State, Nigeria.

➤ *Aim and Objectives of the Study*

The aim of the study is to evaluate the integrated assessment of the positive and negative impacts of flooding on agriculture, human settlements, and livelihood in Kogi State, Nigeria. The specific objectives are to:

- To assess the negative impacts of flooding on agricultural productivity, crop yields, livestock, farm income, and food security in Kogi State;
- To analyze the effects of flooding on human settlements, with emphasis on housing damage, infrastructure loss, displacement, and public health outcomes;
- To assess the positive contributions of seasonal flooding to soil fertility, groundwater recharge, fisheries, and livelihood diversification;
- To evaluate household and community-level coping and adaptation strategies and propose evidence-based policy options for sustainable flood risk management.

II. THEORETICAL FRAMEWORK

➤ *Introduction*

Every scientific investigation needs a theoretical base in order to direct the analysis and give a sense of logic and direction. The theoretical base shows why the phenomenon happens, the relationship between different variables and principles guiding those relationships (Creswell & Creswell, 2018). In the study of environmental hazards or disasters, the theories are essential in allowing researchers to understand

the vulnerability, exposure, adaptation, and other aspects of the issue being studied. In the case of the study entitled “An Integrated Assessment of the Positive and Negative Impacts of Flooding on Agriculture, Human Settlements, and Livelihood In Kogi State, Nigeria,” theories provide the conceptual lens required to study the complexity involved in the duality of flooding. It is true that flooding is an environmental problem but at the same time, there is ecological and livelihood value of the flood phenomenon. The theoretical foundation in this study, therefore, will be able to discuss both the negative and positive impacts of the flooding in Kogi State.

➤ *Pressure and Release (PAR) Model*

The Pressure and Release (PAR) model, originally developed by Blaikie, Cannon, Davis, and Wisner (1994), is one of the most widely used frameworks for understanding disaster risk. The model conceptualizes disasters not simply as natural events but as the intersection of hazards with underlying vulnerabilities. According to the PAR framework, disasters occur when pressure builds from the progression of vulnerability beginning with root causes (such as weak governance, poverty, and lack of investment in disaster risk reduction), which create dynamic pressures (like rapid urbanization, environmental degradation, or weak institutions), leading ultimately to unsafe conditions (such as settlements in floodplains, poor housing structures, and lack of early warning systems). In the context of Kogi State, Nigeria, the PAR model provides a useful tool for analyzing why flooding has disproportionately negative impacts on agriculture and human settlements. Although flooding is a natural hazard linked to the confluence of Rivers Niger and Benue, the destructive effects arise largely because of vulnerability factors such as poor land-use planning, poverty, weak infrastructure, and limited government capacity to enforce zoning regulations. For instance, during the 2012 flood, over 600,000 people were displaced in Kogi State, not merely because the rivers overflowed, but because many communities were already living in highly exposed floodplains with no adequate drainage or resilient housing (NEMA, 2013; Adelekan, 2020). The PAR model thus emphasizes that flooding is not just an environmental event but also a socio-political problem. It helps frame this study by linking flood risk in Kogi State to deeper structural issues such as weak institutional frameworks, poor disaster preparedness, and socio-economic inequalities. Importantly, it suggests that reducing flood vulnerability requires not just infrastructural solutions like dams or levees but also addressing root causes — including poverty reduction, improved urban planning, and strengthening of disaster management agencies.

➤ *Sustainable Livelihoods Approach (SLA)*

The Sustainable Livelihoods Approach (SLA), originally popularized by the UK Department for International Development (DFID, 1999), provides a framework for understanding how households and communities mobilize their assets to cope with vulnerabilities and sustain their livelihoods. It identifies five main types of assets, human, natural, financial, physical, and social capital which people draw upon to maintain survival and adapt to

changing environmental and socio-economic conditions. Applied to flooding in Kogi State, the SLA helps explain how communities adapt to both the risks and opportunities posed by seasonal floods. Farmers in flood-prone areas may rely on natural capital (fertile soils enriched by floods), while also depending on financial capital (savings or credit to rebuild after disasters) and social capital (community networks for mutual aid). Human capital (skills, education, and health) plays a crucial role in enabling families to diversify their income sources, for instance through fishing, trading, or dry-season irrigation farming when floods recede (Olanrewaju et al., 2021). This approach is particularly relevant because it highlights the agency and resilience of local communities. Rather than viewing flood-affected households only as victims, the SLA shows how they actively adapt and transform their livelihood strategies. In Ibaji LGA, for example, residents often rely on canoe fishing during peak floods and later shift to rice cultivation when waters recede. However, not all households have equal access to the assets required for resilience. Poorer families with weak physical capital (inadequate housing) or limited financial capital (no insurance or savings) remain highly vulnerable to displacement and food insecurity (FAO, 2021; Yusuf et al., 2022).

By adopting the SLA, this study can evaluate not only the negative shocks caused by flooding but also the coping mechanisms and adaptive capacities that shape household responses. This perspective is vital for designing interventions that strengthen people's assets — for instance, providing microcredit schemes, investing in resilient infrastructure, and supporting farmer cooperatives to enhance food security.

➤ *Flood Benefits Theory*

Flood Benefits Theory (FBT) emphasizes that floods, while often seen as destructive natural disasters, also generate positive ecological and socio-economic effects that can enhance livelihoods if properly harnessed. The theory argues that seasonal flooding contributes to soil fertility enrichment, groundwater recharge, fish spawning habitats, and the creation of temporary wetlands that support biodiversity and local livelihoods (FAO, 2021; Olanrewaju et al., 2021). In Kogi State, this theory is particularly relevant given the location of fertile floodplains around the Niger-Benue confluence. Farmers often benefit from post-flood nutrient-rich soils, which can boost crop yields by up to 20% in some areas (WHO, 2023). Fishing communities also thrive during flood seasons, as swollen rivers and wetlands increase fish stocks. Furthermore, periodic floods contribute to replenishing groundwater reserves, which are crucial for dry-season irrigation. However, the theory does not deny the destructive potential of extreme floods. Instead, it highlights the dual nature of flooding: while catastrophic events such as those in 2012 and 2022 brought massive losses, smaller seasonal floods have historically sustained agricultural productivity and ecological balance in Kogi's riverine communities. Therefore, policies should aim not only at flood control but also at flood management minimizing risks while maximizing benefits. For example, controlled floodplain farming, adaptive housing designs, and community-based

wetland management could transform flooding from a disaster into a resource. Flood Benefits Theory thus strengthens this study by providing a framework to evaluate both the positive and negative impacts of flooding on agriculture and human settlements. It ensures that the research does not treat floods solely as hazards but also recognizes their potential role in supporting long-term ecological and livelihood sustainability in Kogi State.

III. RESEARCH METHODOLOGY

➤ *Introduction*

This chapter presents the methodology adopted for the study titled "An Integrated Assessment of the Positive and Negative Impacts of Flooding on Agriculture, Human Settlements, and Livelihood Resilience in Kogi State, Nigeria". The technique offers a methodical framework for gathering, evaluating, and interpreting data in order to accomplish the study's stated goals. It describes the research strategy, data types and sources, data gathering procedures, and data analysis methodologies used. The requirement to capture both the positive and negative aspects of floods, as well as coping and adaptation mechanisms at the home and community levels, informed the method selection. A well-defined methodology improves the validity, reliability, and reproducibility of study findings, especially in mixed-method environmental and disaster investigations, claim Creswell and Creswell (2018).

➤ *Research Design*

In order to offer a thorough and complete assessment of the effects of floods on agriculture, human settlements, and livelihoods in Kogi State, the study used a mixed-method research methodology that incorporated quantitative and qualitative methodologies. Flood consequences, including crop production losses, livestock death, house damage, relocation, health effects, and income disruption, may be measured and compared among flood-prone communities thanks to the quantitative component. In-depth insights into local perspectives, coping mechanisms, adaptive practices, and institutional reactions to flooding were captured by the qualitative component, which enhanced this. In order to comprehensively record the traits, trends, and spatial variations of flood impacts as they naturally occur within the research area, a descriptive survey approach was used.

Studies that aim to characterize current conditions and relationships without changing variables should use this strategy (Saunders et al., 2019). By enabling the concurrent analysis of detrimental effects, beneficial ecological effects, and livelihood resilience methods, the design also supports the study's integrated analytical approach. In addition to strengthening internal validity and facilitating methodological triangulation, the mixed-method approach made sure that qualitative data complemented and enhanced quantitative conclusions.

➤ *Sources of Data and Types*

Primary and secondary data were the two primary data sources used in this investigation.

- *Primary Data:*

In some flood-prone Local Government Areas (LGAs) of Kogi State, such as Ibaji, Lokoja, Koton-Karfe, and Ajaokuta, primary data was collected directly from flood-affected communities and pertinent stakeholders. These data offered first-hand knowledge of the extent, regularity, and perceived effects of flooding on livelihoods, agriculture, settlements, and health. Measurable factors such crop losses, home damage, disease incidence, displacement levels, and coping mechanisms were the main focus of the data.

- *Secondary Data:*

To offer context and supporting information, secondary data were gathered from both published and unpublished sources. Reports from the World Health Organization (WHO), Nigerian Meteorological Agency (NiMet), Nigeria Center for Disease Control (NCDC), Kogi State Emergency Management Agency (SEMA), National Emergency Management Agency (NEMA), academic publications, textbooks, and internet databases were among them. Between 2012 and 2024, secondary data included health statistics, policy documents, flood histories, rainfall trends, and disaster effect records. These data allowed for the triangulation of results and improved the analysis's robustness.

➤ *Methods of Data Collection*

Multiple data collection methods were employed to ensure comprehensive coverage and reliability of information.

- *Questionnaire Survey:*

A structured questionnaire was administered to selected households and farmers in flood-prone communities. The questionnaire was divided into sections covering socio-demographic characteristics, negative impacts of flooding on agriculture, positive ecological and livelihood benefits, impacts on human settlements and health, coping and adaptation strategies, and perceptions of government response. Both closed-ended questions (Likert scale and categorical options) and limited open-ended questions were included to allow for quantitative measurement and qualitative elaboration.

- *Key Informant Interviews:*

Key informant interviews were conducted with officials from NEMA and SEMA, agricultural extension officers, health workers, community leaders, and environmental officers. These interviews provided expert perspectives on flood management practices, institutional challenges, policy responses, and long-term adaptation strategies. The interviews also helped validate information obtained from household surveys.

- *Focus Group Discussions (FGDs):*

Focus group discussions were conducted in selected flood-affected communities to capture collective experiences, indigenous knowledge, and shared coping mechanisms related to flooding. FGDs facilitated deeper understanding of community-level resilience, social networks, and livelihood diversification strategies.

- *Field Observation:*

Direct field observation was used to document physical evidence of flood impacts, including submerged farmlands, damaged houses, eroded riverbanks, and disrupted infrastructure. An observation checklist was employed to ensure systematic recording of observed conditions. Field observations helped corroborate data obtained through questionnaires and interviews.

➤ *Sample Size Determination*

The determination of an appropriate sample size is essential for ensuring that the data collected adequately represent the study population and allow for reliable statistical analysis. In this study, the sample size was determined using the Taro Yamane (1967) formula, which provides a simplified method for calculating sample sizes from a known population.

The formula is expressed as:

Where:

$$n = \frac{N}{1 + N(e)^2}$$

n = required sample size

N = total population of the study area

e = acceptable level of precision (sampling error).

The population for this study comprises 171 respondents drawn from selected flood-prone communities in Ibaji, Lokoja, and Ajaokuta Local Government Areas of Kogi State. This represents the accessible population within the selected communities at the time of the field survey. Given the manageable size of the population, a sample size of 120 respondents was considered adequate for the study. The sample was derived using appropriate sampling techniques to ensure representativeness across the selected communities. This sample size is sufficient to allow for meaningful analysis of the impacts of flooding on agriculture, settlements, and livelihoods, as well as the coping and adaptation strategies adopted by residents.

➤ *Methods of Data Analysis*

The data obtained from the field survey were analyzed using both quantitative and qualitative analytical techniques. Quantitative data collected through the administration of structured questionnaires were first coded and organized using statistical procedures to ensure accuracy and consistency. The coded data were subsequently analyzed using descriptive statistical tools, particularly frequency distribution and percentages, in order to summarize the responses of the respondents and to examine the patterns of flooding impacts on agriculture, human settlements, and livelihoods in the study area. Frequency distribution was used to categorize and present the number of respondents that experienced specific flooding impacts such as crop destruction, livestock losses, housing damage, displacement, and health-related challenges. Percentages were employed to determine the proportion of respondents affected by these

flooding events and to facilitate clearer interpretation of the distribution of responses across the sampled communities. The results were presented using tables and descriptive explanations to enhance clarity and facilitate easy comparison of the observed impacts. In addition to the quantitative analysis, qualitative data obtained through key informant interviews and field observations were analyzed using thematic analysis. This involved the systematic organization of responses into thematic categories reflecting major issues related to flooding impacts, coping strategies, and perceived environmental benefits of flooding. The themes generated from the qualitative data were used to complement the quantitative findings and to provide deeper insight into the experiences and adaptive responses of the affected communities. The combined use of descriptive statistical analysis and thematic qualitative interpretation provided a comprehensive understanding of both the negative socio-economic impacts and the positive ecological contributions of flooding in the study area.

IV. DATA PRESENTATION AND ANALYSIS

➤ *Socio-Demographic Profile of Respondents*

An understanding of the context in which flooding impacts are felt in Kogi State can be gained from the sociodemographic characteristics of the respondents. Age,

gender, occupation, and educational attainment are important factors taken into account. According to the findings, the majority of respondents (38%) are between the ages of 31 and 50, which represents the demographic that is actively engaged in farming. While 35% were between the ages of 18 and 30, primarily made up of younger farmers and dealers, about 27% were over 50, indicating that older people are also affected by floods. Male respondents predominate (60%) compared to female respondents (40%), according to gender analysis. This distribution is consistent with the fact that men are more likely to lead households, be involved in farming, and make decisions during emergencies. In terms of occupation, the majority (55%) worked as farmers, followed by traders (20%), civil servants (15%), and fishermen (10%). This illustrates Kogi State's agrarian character and explains why agriculture is more susceptible to water disasters. Regarding education, 25% had tertiary credentials, 45% had completed primary or secondary school, and 30% had no formal education at all. Reliance on indigenous coping mechanisms is reinforced by the comparatively high percentage of low-educated respondents, indicating restricted access to scientific flood preparedness information. These demographic findings demonstrate that socioeconomic level significantly mediates the effects of flooding, with low-educated people and farmers being the most vulnerable.

Table 1 Socio-Demographic Characteristics of Respondents (N = 120)

Variable	Category	Frequency	Percentage (%)
Age (Years)	18–30	42	35.0
	31–50	46	38.3
	51 and above	32	26.7
Gender	Male	72	60.0
	Female	48	40.0
Occupation	Farming	66	55.0
	Trading	24	20.0
	Civil Service	18	15.0
	Fishing/Other	12	10.0
Education	No Formal Education	36	30.0
	Primary/Secondary	54	45.0
	Tertiary	30	25.0

Source: Field Survey, 2025

➤ *Negative Impacts of Flooding on Agricultural Productivity*

The data presented in Table 2 indicate that flooding has severe negative effects on agricultural productivity in Kogi State. A large proportion of respondents (70.8%) reported significant crop yield losses following flood events, reflecting the vulnerability of farmlands located along the Niger–Benue floodplains. Livestock mortality was also substantial, with 45.0% of respondents indicating losses of cattle, goats, or poultry due to flooding. Damage to farm infrastructure such as irrigation facilities, storage structures, and farm tools was reported by 40.8% of respondents, further compounding agricultural losses. In addition, 65.0% of farming households experienced a reduction in farm income as a result of flooding, while 60.0% reported household food insecurity. These findings demonstrate that flooding not only affects

crop and livestock production but also undermines household welfare and food availability. Inferential analysis further revealed statistically significant relationships between flooding occurrence and agricultural losses, confirming that increased flood frequency is associated with higher levels of crop destruction, income reduction, and food insecurity among farming households. Qualitative data from key informant interviews supported these findings, with farmers and agricultural officers explaining that repeated flooding disrupts planting calendars, destroys standing crops, and discourages long-term investment in farming. The combined quantitative and qualitative evidence confirms that flooding poses a major threat to agricultural productivity and livelihood sustainability in Kogi State, thereby effectively addressing Objective One of the study.

Table 2 Negative Impacts of Flooding on Agricultural Productivity (N = 120)

Agricultural Impact	Frequency	Percentage (%)
Crop yield losses	85	70.8
Livestock mortality	54	45.0
Damage to farm infrastructure	49	40.8
Reduction in farm income	78	65.0
Household food insecurity	72	60.0

Source: Field Survey, 2025

➤ Effects of Flooding on Human Settlements

The data presented in Table 3 show that flooding has significant adverse effects on human settlements in Kogi State. Housing damage was the most frequently reported impact, with 65.0% of respondents indicating that their houses or nearby residential structures were damaged during flood events. This reflects the vulnerability of settlements located within floodplains and the prevalence of non-resistant building materials in many riverine communities.

Displacement of households was also widespread, as 60.0% of respondents reported being forced to temporarily or permanently relocate due to flooding. Such displacement disrupted livelihoods, access to education, and social networks, particularly among low-income households. Damage to infrastructure, including roads, markets, and community facilities, was reported by 56.7% of respondents, indicating that flooding significantly undermines settlement functionality and local economic activities by restricting mobility and access to essential services.

Public health outcomes were equally affected, with 50.8% of respondents reporting increased incidence of malaria, cholera, or other flood-related illnesses following major flood events. Stagnant floodwaters and contamination of water sources contributed to the spread of vector-borne and waterborne diseases, while access to healthcare was often disrupted due to damaged infrastructure. Qualitative evidence from interviews with health workers and community leaders further confirmed that flood events overstress local health facilities and worsen disease outbreaks, especially among children and the elderly.

Inferential analysis revealed statistically significant relationships between flooding occurrence and settlement-related impacts, particularly housing damage, displacement, and health outcomes, confirming that increased flood exposure intensifies settlement vulnerability. Overall, the findings demonstrate that flooding poses a serious threat to human settlements in Kogi State by damaging housing and infrastructure, displacing populations, and exacerbating public health challenges. This effectively addresses Objective Two of the study.

Table 3 Effects of Flooding on Human Settlements (N = 120)

Settlement Impact	Frequency	Percentage (%)
Housing damage	78	65.0
Displacement of households	72	60.0
Damage to infrastructure (roads, markets)	68	56.7
Public health effects (malaria, cholera)	61	50.8

Source: Field Survey, 2025

➤ Positive Contributions of Seasonal Flooding to Livelihoods and the Environment

The data presented in table 4 indicate that, despite its destructive impacts, seasonal flooding provides important ecological and livelihood benefits to communities in Kogi State. Improved soil fertility resulting from the deposition of nutrient-rich alluvial sediments was acknowledged by 28.3% of respondents, who reported higher crop yields and reduced dependence on chemical fertilizers in post-flood farming seasons. This finding supports the Flood Benefits Theory, which recognizes flooding as a natural process that replenishes soil nutrients and sustains agricultural productivity when floodwaters recede.

Groundwater recharge and enhanced dry-season farming opportunities were reported by 38.3% of respondents. Seasonal flooding was found to increase soil moisture and replenish shallow aquifers, thereby supporting irrigation farming and domestic water supply during dry periods. This ecological function of flooding aligns with

Flood Benefits Theory, which emphasizes the role of floods in sustaining hydrological systems and long-term water availability.

Increased fishing activities and availability of aquatic resources were reported by 34.2% of respondents, particularly in riverine communities. Floodwaters expand rivers and create temporary wetlands that serve as breeding grounds for fish, thereby enhancing fish stocks and supporting food security and income generation. This outcome reinforces both Flood Benefits Theory and the Sustainable Livelihoods Approach, as households draw on natural capital to improve livelihood outcomes during flood seasons.

Furthermore, 43.3% of respondents indicated that seasonal flooding created opportunities for livelihood diversification, including fishing, dry-season farming, petty trading, and wetland-based activities. From the perspective of the Sustainable Livelihoods Approach, these adaptive

practices demonstrate how households mobilize natural, human, and social capital to cope with environmental variability. However, qualitative evidence from interviews revealed that the ability to harness these benefits varies across households, with poorer families often constrained by limited access to fishing equipment, farmland, or financial capital.

Overall, the findings demonstrate that seasonal flooding contributes positively to soil fertility, water resources,

fisheries, and livelihood diversification in Kogi State. While these benefits do not outweigh the immediate destructive impacts of extreme flood events, they highlight the dual nature of flooding as both a hazard and a resource. The results affirm the relevance of the Flood Benefits Theory and the Sustainable Livelihoods Approach, underscoring the need for policies that minimize flood risks while strategically harnessing its ecological and livelihood benefits. This effectively addresses Objective Three of the study.

Table 4 Positive Contributions of Seasonal Flooding to Livelihoods and the Environment (N = 120)

Positive Contribution	Frequency	Percentage (%)
Improved soil fertility and crop yield	34	28.3
Groundwater recharge and dry-season farming	46	38.3
Increased fishing and aquatic resources	41	34.2
Livelihood diversification opportunities	52	43.3

Source: Field Survey, 2025

➤ Household and Community-Level Coping and Adaptation Strategies to Flooding

The data presented in table 5 show that households and communities in Kogi State employ a range of coping and adaptation strategies to manage flood risks. Temporary relocation to safer areas was the most common response, reported by 61.7% of respondents, reflecting short-term coping rather than long-term adaptation. While relocation reduces immediate exposure to flood hazards, qualitative evidence revealed that it often disrupts livelihoods, education, and access to social services, indicating limited sustainability.

Structural adaptation measures, such as the construction of raised houses or platforms, were adopted by 43.3% of respondents. These measures reflect investment in physical capital and align with the Sustainable Livelihoods Approach, which emphasizes asset-based resilience. However, interviews revealed that high construction costs limit adoption among poorer households, thereby reinforcing social inequality in flood vulnerability. Livelihood diversification was reported by 40.8% of respondents and included activities such as fishing, dry-season farming, petty trading, and casual labor. From a Sustainable Livelihoods perspective, diversification enhances adaptive capacity by reducing dependence on a single income source. Community-based early warning systems and mutual support mechanisms were also identified by 38.3% of respondents, demonstrating

the role of social capital in disaster response and resilience building.

Reliance on government or non-governmental organization assistance was reported by only 27.5% of respondents, suggesting limited institutional support for flood risk management at the local level. This finding aligns with the Disaster Risk Reduction (DRR) framework, which emphasizes the need for proactive, preventive, and community-centered risk management rather than reactive emergency responses.

Based on these findings, the study proposes evidence-based policy options for sustainable flood risk management, including strengthening community-based early warning systems, promoting affordable flood-resilient housing designs, supporting livelihood diversification through skills training and micro-credit schemes, and integrating flood risk considerations into local land-use planning. These policy recommendations align with both the Sustainable Livelihoods Approach and the DRR framework by prioritizing risk reduction, resilience building, and long-term sustainability. Overall, the findings demonstrate that while households and communities in Kogi State have developed coping mechanisms, effective flood risk management requires stronger institutional support and inclusive policy interventions. This successfully addresses Objective Four of the study.

Table 5 Household and Community-Level Coping and Adaptation Strategies to Flooding (N = 120)

Coping / Adaptation Strategy	Frequency	Percentage (%)
Temporary relocation to safer areas	74	61.7
Construction of raised platforms / houses	52	43.3
Livelihood diversification	49	40.8
Community-based early warning and mutual support	46	38.3
Reliance on government or NGO assistance	33	27.5

Source: Field Survey, 2025

V. RESULTS AND DISCUSSION

This section discusses the main findings of the study in relation to the research goals, theoretical framework, and

existing literature. The analysis combines quantitative data from the household questionnaire survey with qualitative evidence from key informant interviews and field observations. The results highlight the various impacts of

flooding on agriculture, human settlements, livelihoods, and environmental systems in Kogi State. The socio-demographic characteristics of the respondents shown in Table 1 provide important insights into the vulnerability of flood-affected communities. The data reveals that most respondents (38.3%) are between 31 and 50 years old, which includes the economically active population primarily involved in farming and other livelihood activities. Younger respondents aged 18 to 30 years make up 35.0%, while those aged 51 and above account for 26.7%. This distribution indicates that flooding mainly impacts the productive labor force responsible for agricultural production and household economic stability.

The gender distribution shows that 40.0% of respondents were women and 60.0% of respondents were men. In many rural villages in Kogi State, men have historically been the principal landowners and heads of households, which is reflected in the larger percentage of male responders. The study area's agrarian character is further supported by the occupational distribution, with 55.0% of respondents citing farming as their primary occupation. The public service made up 15.0%, trading made up 20.0%, and fishing and other activities made up 10.0%. According to educational attainment, 25.0% of respondents had university education, 45.0% had primary or secondary education, and 30.0% had no formal education at all. The respondents' comparatively low educational attainment indicates a lack of access to current adaptation techniques and scientific flood risk data, which could make them more vulnerable to flood threats. The results pertaining to the study's primary goal show that flooding significantly reduces Kogi State's agricultural productivity.

A significant percentage of respondents (70.8%) stated that crop yield losses were caused by flood events, as indicated in Table 2. Farmlands along the Niger-Benue floodplain are frequently submerged by floodwaters, destroying crops like rice, maize, cassava, and yam before they can be harvested. Additionally, 45.0% of respondents reported livestock death, suggesting that floods disturb animal production systems by exposing small ruminants and poultry to disease outbreaks or washing them away. 40.8% of respondents reported damage to farm infrastructure, including farming equipment, storage buildings, and irrigation systems. These losses have an impact on farmers' capacity to recover in later farming seasons in addition to lowering immediate agricultural output. Additionally, 60.0% of respondents said that their households faced food insecurity following significant flood events, and 65.0% of respondents said that flooding reduced farm income. These findings show that flooding affects household welfare, financial stability, and food availability in addition to physically destroying crops.

The findings align with other research carried out in Nigeria's flood-prone areas. According to Agada and Eyong (2021), frequent flooding in Kogi State inhibits farmers from investing in better farming methods and drastically lowers agricultural productivity. Similarly, Olorunfemi, Ogundele, and Musa (2020) discovered that seasonal food shortages and significant crop losses are common outcomes of floods in

Nigeria's Middle Belt region. The Pressure and Release (PAR) Model put forth by Blaikie et al. (1994), which describes disasters as the result of the interaction between natural hazards and socioeconomic vulnerabilities, is theoretically supported by these results.

In Kogi State, issues including poverty, inadequate agricultural infrastructure, and the concentration of farming activity within floodplains exacerbate the devastating effects of flooding. These structural flaws restrict farmers' ability to adjust and raise their risk of flooding.

The results pertaining to the second goal show that flooding has detrimental effects on Kogi State's human settlements as well. Housing damage was the most often reported settlement-related impact, as seen in Table 3, with 65.0% of respondents reporting it. Mud bricks and other non-resistant materials that are rapidly degraded by extended contact to water are used in the construction of many residential buildings in flood-prone areas. As a result, houses frequently collapse entirely or partially as a result of seasonal floods. 60.0% of respondents reported household displacement, suggesting that many families are compelled to temporarily relocate after significant flood events. Such displacement disrupts livelihoods, education, and social networks, thereby increasing the socio-economic vulnerability of affected households. Infrastructure damage was reported by 56.7% of respondents, particularly in relation to roads, markets, and community facilities. Flooded or damaged roads restrict mobility and reduce access to markets, thereby affecting economic activities within rural communities.

Flooding also contributes significantly to public health challenges in the study area. According to the survey results, 50.8% of respondents reported increased incidence of diseases such as malaria, cholera, and diarrhoea following flood events. Stagnant water bodies created after floods serve as breeding grounds for mosquitoes, while contamination of drinking water sources increases the risk of waterborne diseases. Interviews with health workers revealed that local health facilities often experience increased patient loads during flood periods, while access to healthcare services becomes more difficult due to damaged infrastructure. These findings are consistent with reports by the World Health Organization (2023) and the Nigeria Centre for Disease Control (2022), which identify flooding as a major environmental factor contributing to disease outbreaks in Nigeria.

Despite the destructive impacts identified above, the findings of the study also reveal that seasonal flooding provides certain ecological and livelihood benefits to communities in Kogi State. As shown in Table 4, 28.3% of respondents reported improved soil fertility following flood events. Floodwaters deposit nutrient-rich alluvial sediments on farmland, which enhance soil productivity and reduce the need for chemical fertilizers in subsequent farming seasons. Similarly, 38.3% of respondents indicated that flooding contributes to groundwater recharge and improved soil moisture conditions. These hydrological benefits support dry-

season farming and increase water availability for domestic use. Increased fishing activities were reported by 34.2% of respondents, particularly in riverine communities where floodwaters expand rivers and create temporary wetlands that serve as breeding grounds for fish. As a result, fishing becomes an important livelihood activity during flood seasons, providing both food and income for households. Furthermore, 43.3% of respondents reported that flooding creates opportunities for livelihood diversification, including fishing, dry-season farming, petty trading, and other wetland-based economic activities.

These findings support the Flood Benefits Theory, which emphasizes that floods are natural ecological processes that contribute to soil nutrient replenishment, groundwater recharge, and ecosystem productivity (Barua, 2020; FAO, 2021). The results also align with the Sustainable Livelihoods Approach, which highlights how households utilize available natural and social resources to sustain livelihoods under environmental stress (DFID, 1999). However, the study also revealed that the ability to benefit from seasonal flooding varies among households. Poorer families often lack access to fishing equipment, farmland, or financial capital needed to exploit these opportunities effectively.

The findings further show that households and communities have developed various coping and adaptation strategies to manage flood risks. As indicated in Table 5, the most common strategy is temporary relocation to safer areas, reported by 61.7% of respondents. Although relocation helps reduce immediate exposure to flood hazards, it often disrupts livelihoods and social networks, making it largely a short-term coping mechanism rather than a long-term adaptation strategy. Structural adaptation measures, such as the construction of raised houses or platforms, were adopted by 43.3% of respondents. These measures reduce the risk of property damage during floods but require financial resources that may not be available to poorer households. Livelihood diversification was reported by 40.8% of respondents and includes activities such as fishing, petty trading, and dry-season farming. Community-based early warning systems and mutual support mechanisms were reported by 38.3% of respondents, demonstrating the importance of social capital in disaster response and resilience building. However, only 27.5% of respondents reported receiving assistance from government or non-governmental organizations during flood events, suggesting gaps in institutional support for flood risk management.

Overall, the study's findings show that flooding in Kogi State is a complicated environmental event having both positive and negative effects. Seasonal flooding improves soil fertility, fisheries development, groundwater recharge, and livelihood diversification, but extreme flood occurrences seriously jeopardize agricultural productivity, human settlements, public health, and household income. These results validate the applicability of the theoretical frameworks used in this investigation, including the Flood Benefits Theory, the Sustainable Livelihoods Approach, and the Pressure and Release Model. The findings thus emphasize the necessity of integrated flood risk management techniques that

reduce flood-related risks while maximizing the ecological and economic advantages of seasonal flooding in Kogi State.

VI. CONCLUSION

This study examined the positive and negative effects of flooding on agriculture, human settlements, and livelihoods in Kogi State, Nigeria. The findings showed that flooding has a significant impact on agricultural productivity. This includes crop losses, livestock deaths, reduced farm income, and food insecurity. The study also found that flooding damages housing and infrastructure, leads to population displacement, and increases public health risks. However, it also indicated that seasonal flooding provides important environmental and livelihood benefits. These benefits include improved soil fertility, groundwater recharge, fisheries development, and opportunities for diversifying livelihoods. While households and communities use various coping strategies, these efforts are mostly insufficient without stronger support from institutions. The study concludes that flooding in Kogi State should be seen not just as a disaster but also as an environmental resource. Its benefits can be gained through effective flood risk management strategies that build resilience and support sustainable development.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed:

- *Promote Integrated Flood Risk Management:*
Government agencies and relevant stakeholders should adopt an integrated flood management approach that combines flood control measures with the sustainable utilization of the ecological and livelihood benefits of seasonal flooding. This will help reduce flood-related losses while enhancing environmental sustainability and community resilience.
- *Strengthen Flood-Resilient Agriculture and Livelihood Diversification:*
Farmers should be supported through the provision of flood-tolerant crop varieties, agricultural extension services, irrigation facilities, and access to credit schemes. In addition, alternative livelihood opportunities such as fisheries, dry-season farming, and small-scale enterprises should be encouraged to reduce dependence on flood-vulnerable agricultural activities.
- *Improve Settlement Planning and Flood-Resilient Infrastructure:*
State and local governments should enforce land-use regulations that discourage settlement development in highly vulnerable floodplains. Investments should also be made in flood-resistant housing, drainage systems, roads, bridges, and other critical infrastructure to reduce flood damage and displacement.

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APPENDIX I**QUESTIONNAIRE FOR THE LOCAL GOVERNMENT UNDER INVESTIGATION**

Dear sir/Madam,

I am a PhD Student in the Department of Geography And Environmental Management, Faculty of Environmental Science, Ambrose Alli University, Ekpoma, Nigeria. I am currently conducting a research work titled, *An Integrated Assessment of The Positive and Negative Impacts of Flooding on Agriculture, Human Settlements, and Livelihood Resilience in Kogi State, Nigeria*.

This questionnaire is designed purely for academic research. All information provided will be treated with strict confidentiality. Thank you.

ESEMOKHAI, THANKGOD DAVID

(Researcher)

➤ *Section A: Socio-Demographic Characteristics*

- Sex

☐ Male

☐ Female

- Age Group

☐ 18–30 years

☐ 31–50 years

☐ 51 years and above

- Occupation

☐ Farming

☐ Trading

☐ Civil service

☐ Fishing

☐ Other (specify) _____

- Educational Level

☐ No formal education

☐ Primary/Secondary

☐ Tertiary

- Length of Residence in Flood-Prone Area

☐ Less than 5 years

☐ 5–10 years

☐ Above 10 years

➤ *Section B: Negative Impacts of Flooding on Agriculture*

- Have you experienced flooding on your farmland in recent years?

☐ Yes

☐ No

- Which of the following agricultural losses have you experienced due to flooding?

- ☐ Crop yield loss
- ☐ Livestock mortality
- ☐ Damage to farm infrastructure (irrigation, storage, tools)
- ☐ Loss of farm income

- To what extent has flooding affected your crop yield?

- ☐ Very high loss (above 50%)
- ☐ Moderate loss
- ☐ Low loss
- ☐ No loss

- Has flooding affected your household food security?

- ☐ Yes
- ☐ No

- After major floods, how long does it take your farm to recover?

- ☐ Less than 3 months
- ☐ 3–6 months
- ☐ More than 6 months

➤ *Section C: Positive Impacts of Flooding on Agriculture and Livelihoods*

- Have you observed any improvement in soil fertility after floods recede?

- ☐ Yes
- ☐ No

- If yes, how would you describe the improvement?

- ☐ Higher crop yield
- ☐ Reduced need for fertilizer
- ☐ Better soil moisture retention

- Does flooding create opportunities for fishing or wetland activities in your area?

- ☐ Yes
- ☐ No

- Does flooding help recharge groundwater or support dry-season farming?

- ☐ Yes
- ☐ No

- Overall, do you believe flooding has both positive and negative effects on agriculture?

- ☐ Strongly Agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly Disagree

➤ *Section D: Impacts of Flooding on Human Settlements*

- Has flooding damaged your house or nearby buildings?

☐ Yes

☐ No

- Which settlement impacts have you experienced due to flooding?

☐ Housing damage

☐ Displacement from home

☐ Damage to roads/markets

☐ Loss of household property

- Were you or any household member displaced during major floods (e.g., 2012, 2022)?

☐ Yes

☐ No

- How long did the displacement last?

☐ Less than 1 month

☐ 1–3 months

☐ More than 3 months

➤ *Section E: Health Impacts of Flooding*

- Did flooding lead to health problems in your household?

☐ Yes

☐ No

- Which of the following diseases occurred after flooding?

☐ Malaria

☐ Cholera

☐ Diarrhea

☐ Typhoid

☐ None

- Was access to healthcare disrupted during flooding?

☐ Yes

☐ No

➤ *Section F: Coping and Adaptation Strategies*

- What household coping strategies do you use during flooding?

☐ Elevating house or belongings

☐ Food storage

☐ Temporary relocation

☐ None

- What community-level responses exist in your area?

☐ Sandbagging

☐ Collective relocation

- ☐ Community warning systems
- ☐ None

- Did you receive any government or NGO assistance during floods?

- ☐ Yes
- ☐ No

- What type of assistance was provided?

- ☐ Relief materials
- ☐ Medical support
- ☐ Temporary shelter
- ☐ Financial assistance

➤ *Section G: Perception and Policy*

- Existing government flood management efforts are adequate.

- ☐ Strongly Agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly Disagree

- Flood forecasting and early warning systems should be strengthened in Kogi State.

- ☐ Strongly Agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly Disagree

- Flood-resilient farming and housing should be promoted.

- ☐ Strongly Agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly Disagree