

# **THE NIGERIAN GEOGRAPHICAL JOURNAL**

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**THE  
NIGERIAN  
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# THE NIGERIAN GEOGRAPHICAL JOURNAL

Edited by  
Professor Philip O. Phil-Eze

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Volume 10 No. 2 (2015)

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## CLIMATE CHANGE AND VULNERABILITY OF THE RIVERINE COMMUNITIES IN NIGER STATE, NIGERIA

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### ABSTRACT

Most of the sub-Sahara African population lives in vulnerable environment, and highly dependent on natural resources such as rain-fed crop production for their livelihood which made the region most vulnerable to climate change impact. This paper examines the vulnerability of riverine communities downstream of Shiroro Dam. Hydrological data (1975- 2012) were analysed and questionnaires were administered during field work to determine the environmental and socio-economic vulnerability of the study area. The crucial information were extracted, coded, ranked and analysed using SPSS 16.0. This was used to determine communities' vulnerability based on their response about flooding events, susceptibility, risk and capacity. The analysis depicts a noticeable fluctuation in the hydrological data thereby resulting to variation in communities' exposure to impending natural hazard like flood. The questionnaire analysis reveals varying levels of communities' physical environment and socio-economic vulnerability. The community vulnerability gives an indication to the fact that interventions should be community-based rather than general and broad based decision that characterized disaster risk management in the country.

**Keywords:** Climate Change, Flood, Socio-economic Risk, Capacity and Rural Livelihood

### INTRODUCTION

Climate change and its impact on relevant socio-economic sectors are major threat to sustainable agriculture and human livelihood. Most of the sub-Sahara African population lives in vulnerable environment, and highly dependent on natural resources such as rain-fed crop production for their livelihood thus, making the zone one of the most

vulnerable to climate change/variability impact. Climate change impact is compounded by human activities such as over cultivation, overgrazing, poor land management among others. These have been escalating natural resource degradation (land, water and vegetation). The 2012 flooding event was one of the worst with its devastating impact across the country in recent times; several



building were destroyed and lives lost, the floods ravaged crops and severed transportation routes throughout the country particularly in most vulnerable communities. Consequently, vulnerability of most rural communities across the country has been on increase due to the impact of climate change. United Nations Intergovernmental Panel on Climate Change (IPCC) in 2007 defines vulnerability as the degree to which a system is susceptible to or unable to cope with adverse effects of climate change, including climate variability.

In Nigeria like any other developing nation, agriculture is the dominant economic activity of the rural communities and this has continued to attract population to the flood plain areas across the country. These are considered to be the most vulnerable. As stated by Ethlet and Roger (2004), "vulnerability pushes people into poverty, keeps them in poverty and stop them from coming out of poverty". Large proportion of these communities are mostly subsistence farmers who raise crops and livestock for food and sale to earn income hence, climate change inducing extreme weather condition such as flood, drought and desertification fluctuates agricultural production thereby escalating poverty and threatening the attainment of food security and sustainable human livelihood. Most recent awareness of heightened flood risk associated with living in flood prone areas may change the price signals that currently place premium on coastal and riverside properties (Adger, *et.al*, 2005). The rural communities in the country are the poorest across the country coupled with the fact that these

communities are characterized by high rainfall variability in the spread and intensity. As the rise in the number of natural catastrophes is predominantly attributable to weather-related events like storms and floods, with no relevant increase in geophysical events such as earthquakes, tsunamis, and volcanic eruptions, there is some justification in assuming that changes in the atmosphere and global warming in particular, play a relevant role (Peter, 2016). The increasing vulnerability necessitate the need to identify the varying vulnerability levels and factors at community level for the development and identification of community based strategies for coping with current climate change thereby providing good starting point for disaster risk reduction. The vulnerability of developing countries and their populations to increased climate variability and change is of great concern and has attracted considerable research interest over the past decades with calls for increased funding for adaptation (Patt, *et al*, 2010).

The frequency and intensity of flood have been on increase in recent time and this is affecting most flood plain communities across the country particularly downstream settlements. The 2012 flooding events was the most devastating in history as vast flood plains in the country that traditionally attract human settlement and economic activities, as well as support livelihood experienced devastating effect of flood. From droughts to flooding rains and damaging frosts to heat-waves, there is no doubt that climate extremes are of substantial societal importance (Lisa,



2016). Crops are washed away leading to agricultural losses and reduce income thereby aggravating poverty and food insecurity with more people and communities at risk. By implication, these aggravate the vulnerability of vast riverine communities across the country. Global Hunger Index (GHI, 2012) observed that food security under land, water, and energy stress poses daunting challenges. Flood commonly affects rural community lives and their daily livelihood patterns.

### STUDY AREA

In 1983, work at the dam was started and in 1984 Shiroro Electric Dam reservoir was successfully impounded. Kaduna River is the major river feeding the lake which is one of the principal tributaries of river Niger, its source is from Plateau Mountains and travels a distance of about 350km before emptying into the reservoir. The river is joined by tributaries such as river Sarkin Pawa and river Dinya. The construction of the reservoir generally altered the natural equilibrium that pre-existed with the ecosystem particularly across the downstream. Gurmana district is made up of other communities such as Gussoro in Shiroro Local Government Area (LGA) of Niger State and is located between 6° 51' E - 9° 59' E and 6° 65' N - 10° 02' N. The major socio-economic activity is agriculture accordingly, attracts the inhabitant to flood plain.

### METHODOLOGY

Hydrological and meteorological data (1975- 2012) were analysed using curve estimation of fit to visualize hydro-meteorological trend that aggravate the

vulnerability of the riverine communities downstream of Shiroro reservoir. Questionnaires were administered during 2010/ 2011 Students' field work to the villages, these questionnaire were coded and analysed to determine the environmental and socio-economic vulnerability of the study area using SPSS 16.0. The level of vulnerability of different social groups to climate change was determined by both socio- economic and environmental factors (Deressa *et. al*, 2008).

Percentage and cumulative percentage frequency of respondents on occurrence of phenomena were used to determine communities' vulnerability based on the fact that percentage response of over 70% to a particular phenomena was an indication of very significant impact on the community. Occurrences beyond 60% and less than 70% signal significant impact, greater than 50% and less than 60% revealed average impact and less than 50% was an indication of less than average impact on the community (Table 1). These were used to determine rural communities' vulnerability level based on their response about flooding events, susceptibility, risk and capacity for the two villages which were numerically defined as 4, 3, 2 & 1 indicating extremely, highly, moderately and least vulnerable respectively.



**Table 1: Community Percentage Response and Vulnerability Level**

Community % Response	Vulnerability Level	Vulnerability Interpretation
% >70	4	Extremely Vulnerable
60 < % ≤ 70	3	Highly Vulnerable
50 < % ≤ 60	2	Moderately Vulnerable
% ≤ 50	1	Least Vulnerable

Vulnerability is the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt (Adger, 2006). In this study, vulnerability is examined in terms of exposure to hazard, socio-economic risk and capacity (Fig. 1). Vulnerability and exposure are dynamic; varying across temporal and spatial scales, and depends

on economic, social, geographic, demographic, cultural, institutional, governance, and environmental factors (Cardon, 2012). The figures depict the fact that communities' vulnerability is a function of environmental hazard, socio-economic risk and lack of capacity that frequently aggravate vulnerability across the riverine communities downstream of Shiroro dam, Niger State.



**Fig. 1: Theoretical Frame Work for Riverine Community Vulnerability**

## RESULT

Trend analysis confirms increased rainfall amount, inflow, out flow and evaporation (Figs. 2-5). This trend is an indication of increased vulnerability due to the increase in rainfall amount, escalating inflow and discharge in recent times thereby, aggravating flood potential with its negative impact on communities that are mainly subsistence farmers. Economic losses from floods have greatly increased, principally driven by the expanding exposure of assets at risk (Kundzewicz *et.al*, 2013). This trend signals the fact that these wide spread ecosystem, its vital resource, and sustainability of relevant socio-economic sector like agriculture is

endangered across the country. As summarized by Oli *et.al* (2007), that climate change could be a factor that tips fragile states into socio-economic and political collapse. Rural communities as well as the livelihood of the inhabitants are highly vulnerable to climate change since the escalating trend of discharge is a threat to agricultural sustainability subsequently aggravating individual and communities' poverty level. By implication, the riverine communities downstream whose livelihood depends on the sustainability of these crucial resource is threatened by adverse impact of impending flood hazard and low capacity.

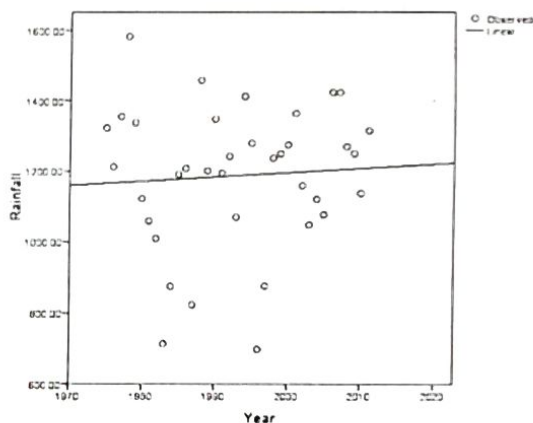


Fig. 2: Rainfall Amount Trend

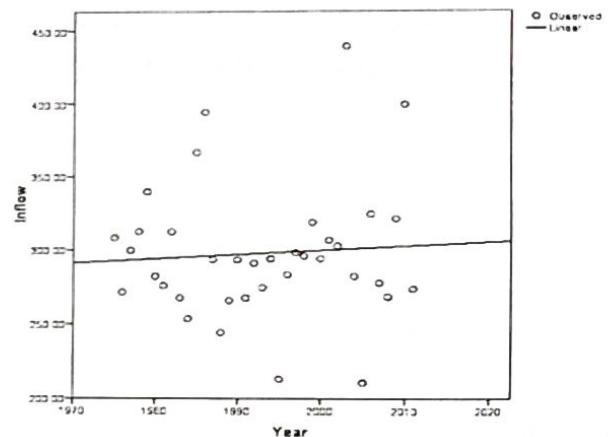


Fig. 3: Inflow Trend

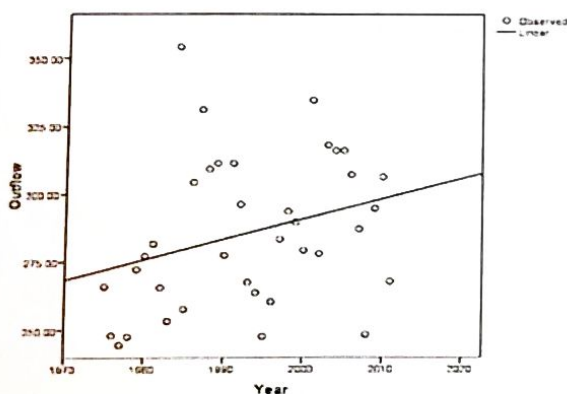


Fig. 4: Outflow Trend

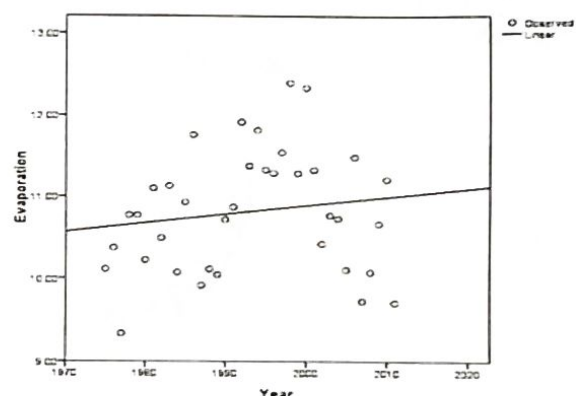


Fig. 5: Evaporation Trend



The hydrological analysis reviews positive trend in the entire parameter; increased rainfall amount, evaporation, escalating inflow and outflow. This indicates that climate change/variability is impacting on the hydrological parameters such as inflow and outflow and consequently accelerating the intensity and spread of flooding in recent times. The increased evaporation trend will aggravate run off, erosion, flooding and environmental degradation of the riverine communities. The adverse impact of these on the biophysical environment and the socio-economic processes of the riverine communities has been a major concern for stakeholders in disaster management. These have continued to pose greater threat to the sustainability of the ecosystem and socio-economic development thereby, escalating poverty, human suffering and shock. Birkmann, (2011) defined vulnerability as the tendency of exposed elements such as human beings, their livelihoods, and assets to suffer adverse effects when impacted by hazard events.

From the foregoing, it is pertinent that climate change constitutes both environmental and socio-economic challenges for most part of Nigeria particularly those with high level of exposure across the vast flood plain in the country. Since the positive trend could be a function of changes in rainfall pattern, spatio-temporal distribution of rainfall, particularly in terms of timing, quantity and intensity thereby, leading to

positive/negative change from normal. Observations provide a key foundation for understanding their long-term variability and change and for providing the underpinning for climate model evaluation and projections (Lisa, 2016). This trend is endangering the sustainability of the riverine communities that rely on subsistent agriculture which equally depends on sustainability of flood plain resource; moisture and fertile alluvial soil.

Similarly, the respondents indicate that the household are extremely vulnerable to flood as most households are affected by varying levels of flood. However, the frequency of flooding is higher in Gurmana than Gussoro. Hazard refers to the possible, future occurrence of natural or human-induced physical events that may have adverse effects on vulnerable and exposed elements (Birkmann, 2006). The major elements affected by flooding is agriculture as most crops are cultivated along the flood plain and washed away as flood persist for more than three days such that crops are wash away or decay in flood water, collapse of infrastructure such as buildings, road, loss of properties and in extreme cases lost of life. Flood problems and flood damage are more severe in Gurmana than Gussoro and the effect of flood is always severe for the families in the two communities. Flood experience and preparedness is more in Gurmana, an indication of higher flood hazard during the rainy season in Gurmana (Table 2).



**Table 2: Community Hazard Level**

Hazard Indication	Vulnerability Level	
	Gussoro	Gurmana
Household Experience on Flooding	4	4
Flood frequency	2	3
Causes of flooding	3	4
Sources of flood water	3	4
Element often affected by flooding	2	3
Effect of flooding on the families	3	3
Flood experience and preparedness	3	4
Preparedness on ground	3	4

The questionnaire analysis also indicate that majority of the respondents identified varying risk levels in Gurmana than Gussoro (Table 3), risk is described as Probability x consequence (Jones, and Boer, 2003). The two communities mainly engage in agricultural practice and most of them are employed under agricultural sector, few members of the community are unemployed and some live with disability. Despite the fact that communities' major environmental problem is flooding, large proportion of the community do not have access to safe drinking water and the main

source of water available to them is stream water, particularly in Gurumana. The worst scenario is the condition of the primary health care centres and the distance to the immediate hospital. This is worst in Gurmana as in most cases patients have to cross River Kaduna in boat and travel for about 45 minutes to one hour before reaching the nearest hospital. These could lead to outbreak of diseases and epidemics as well as deny the inhabitants access to medical services consequently, endangering livelihood and escalating communities' vulnerability.

**Table 3: Community Risk Level**

Risk Indication	Vulnerability Level	
	Gussoro	Gurmana
Household member with Disability	1	1
Household member unemployed	2	2
Number on Agriculture	3	3
Number on Household work	3	3
Source Household Drinking water	3	4
Household Toilet facility	3	4
Type household health facility	3	3
Distance to the nearest hospital	3	4



Similarly, the low capacity of the inhabitants of the two communities is an indication that the communities still have high level of illiteracy despite the continuous advocacy of education for all across the country. Household income is generally tied to agriculture, indicating that there is little diversification of economy and the two communities have high dependence level as the household size is generally large (10 and above). Infrastructural facilities are generally poor in Gurmana and the two communities only have rural market. Availability of CBOs, Credit cooperative and Micro-finance is also poor in Gurmana which is an indication of communities' low capacity. Community flood management Institution,

Government flood management Institution, Community flood management plan and Community flood awareness programme are generally poor in the two communities thereby aggravating community flood vulnerability (Table 4). Measuring vulnerability is complicated both in terms of defining vulnerability in different contexts, identifying variables and relating cause and effect (Adger, 2006). Consequently, the low capacity typical of riverine communities in addition to socio-economic risk of these communities is a threat to sustainable agricultural practice hence, aggravating community vulnerability and attainment of food security across the country.

**Table 4: Community Capacity Level**

Capacity Indication	Vulnerability Level	
	Gussoro	Gurmana
Household Education	3	3
Household Income	3	2
Household size	3	3
Distance to major Road	2	4
Distance to market	1	1
Availability of CBOs, Credit cooperative and Micro-finance	2	3
Community flood management Institution	3	4
Government flood management Institution	4	4
Community flood management plan	3	3
Community flood awareness programme	2	3

Generally, these increased communities risk as well as the low capacity of the communities to anticipate, cope, resist and recover from the impact of flood hazard constitutes a major problem across the riverine communities. The communities'

vulnerability is dynamic across the country due to dependence on natural resources for livelihood, which intensified individual and community poverty level and increased insecurity. Practical adaptation initiatives tend to focus on risks that are already



problematic (Barry and Johanna, 2006). This trend indicates the need to identify strategies for building Communities' capacity to adapt to the changing environment, development of rural infrastructure, provision of safe net /financial services, spatial planning and development and institution of early warning programs for the attainment of food security and sustainable rural livelihood. Resilience strategies should imply communities not only being able to cope and recover but also changing to reflect different priorities arising from the disaster (Patrick, 2009). Furthermore, there must be increased public awareness to increase understanding and perception of vulnerability and its factors among citizens for the development of self-efficacy and more flood sensitive behaviour for enhanced community resilience.

## CONCLUSION

The escalating trends of hydrological parameter (rainfall amount, inflow and outflow) have continued to aggravate flood hazard coupled with high socio-economic risk and low capacity typical of these vulnerable communities has been threatening agricultural practices and attainment of food security across the country. The threat of climate change to agricultural sector and rural livelihood is no longer an illusion. Consequently, this threat depicts the need for proactive approaches towards disaster risk reduction in these vulnerable areas. It is very pertinent to develop institutions that will determine, document, map and identify the varying socio-economic threats that

have continued to escalate the downstream vulnerability across the country for adequate preparedness. These will enhance development and institution of early warning schemes, capacity building, adaptation strategies and promotion of best practices as pathway towards Disaster Risk Reduction (DRR) and enhance rural livelihood. Further, the disparity in communities' vulnerability gives an indication to the fact that interventions should be community-based rather than general and broad based decision that characterized disaster risk management in the country.

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