

# Farmers' Perception and Adaptive Capacity to Climate Change and Variability in Some Selected Villages of Nigeria

Gwari, B.M<sup>1</sup>, Owolabi, E.S<sup>2</sup>, Dantata, D<sup>2</sup>, Abdulazeez, M<sup>3</sup> and Mubarak, UJ<sup>4</sup>

<sup>1,3,4</sup> *Environmental Studies Division, NIFFR PMB 6006 Niger State, Nigeria*

<sup>2</sup> *Federal University of Kashere, Gombe, Gombe State Nigeria*

**Abstract:** The study was carried out to evaluate how farmers in some selected villages in Kwaya Kusar Local Government Area, Southern Borno Nigeria, have perceived and adapted to climate change. Data was collected from 120 farmers through simple random sampling procedure. Purposive sampling was also used in the selection of key informants who have opinions and experience on the topic of study. Interviews as well as structured questionnaire were administered on respondents through Personal contact, with assistance of employed trained enumerators in their various communities. The analysis revealed that about 66.8% of the respondents were male, 59.1% were literate and 75% of the respondents had involved in farming for more than 5 years. This implies that majority of the respondents had been in farming for many years. Majority of the farmers in Selected villages had a perception that climate was changing and the effects of these changes includes drying up of seedlings after germination, increase in soil erosion in some cases, loss of farmlands and crops due to flooding, water shortage according to their responses. As a result of these farmers had responded by adapting. In this regard, age of the household, education, access to information on climate change through extension services, access to credit, changes in temperature and precipitation were found to have significant influence on the probability of farmers to perceive and/or adapt to climate change. With the level of perception to climate change being more than that of adaptation, the study suggests that more policy efforts should be geared towards helping farmers to adapt to climate change. The paper suggested policy frame work geared toward the improvement of the livelihood of rural women and the farmers in general.

**Key words:** Farmers, climate change, perceptions, adaptation, Kwaya Kusar.

## I. INTRODUCTION

It is a generally accepted among researchers that climate change poses serious challenges to development in Nigeria. This is due to the fact that the ninety percent of Nigerian population depend on rain-fed agriculture, which is heavily sensitive to climate change. Seventy percent of Nigerian is arid, semi-arid, or categorized as dry sub-humid; areas that are prone to desertification and drought [1]. In addition, the Nigeria Savanna area is fragile because of over cultivation, overgrazing, erosion, and deforestation. The country is expected to experience changing patterns of rainfall, increased temperatures leading to increased evaporation rates, and

flooding; these will in turn lead to greater levels of land degradation and loss of surface and ground water potential.

Agriculture employs over 70% of the population, contributes about 41% of GDP, accounts for 5% total export and provides 88% of non-oil earnings. Besides, almost all sectors of agriculture which are crop production, livestock farming, fishery etc. depend on climate whose variability have meant that local farmers who implement their regular annual farm business plans risk total failure due to climate change effects [2].

Adverse climate effects can influence farming outputs at any stage from cultivation through the final harvest. Even if there is sufficient rain, its irregularity can affect yields adversely if rains fail to arrive during the crucial growing stage of the crops [3].

Substantial body of research on climate change and agriculture has been carried out having developed interest in this on this important subject [4]. Climate change is expected to influence crop and livestock production, fisheries, water resources and other components of agricultural systems. It is evidence that climate change will have a strong impact on Nigeria particularly in the areas of agriculture, land use, energy consumption, biodiversity, fisheries, health and water resources [5].

Nigeria like other countries of sub-Saharan Africa is highly vulnerable to the impacts of climate change [6]. According to Shiru, (2018)[7], though climate change is a threat to agriculture and non-agricultural socio-economic development, agricultural production activities are generally vulnerable to climate change than other sectors. A report by BNRCC, (2011)[8], showed that, in the absence of adaptation, climate change could result in a loss of between 2 to 11 percent of Nigeria's GDP by 2020, rising to between 6 to 30 percent by the year 2050 and this could have advance effects on the livelihoods of the local farmers.

The farming communities of Kwaya Kusar Local Government Area reported losses in their agricultural production due to erratic rain, increased temperature, perils of flood and drought, and scarcity of water. According to farmers, climate related hazards such as flood, drought and erratic rainfall were

not new phenomena to them, but their socio-economic effects had increased in intensity and coverage across decades. Even though they are exposed to those hazards and have a low adaptive capacity, they have survived and coped by making tactical responses to these changes. Adaptation is widely defined as the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects which moderates harm or exploits beneficial opportunities [9]. In Nigeria, adaptation had been practiced before the concept of "climate change" became more prominent [10]. However, these local adaptations have not been valued and documented so far, and hence, recognizing and documenting the local adaptation strategies is an important entry point to strengthen the resilience of local people to climate change. Analyzing local adaptation is, therefore, important to inform policy for future successful adaptation of the agricultural sector to the impact of climate change.

The overall aim of this study is to provide research evidence based policy findings that would contribute to enhancing farmers' capacity to adapt to the impact of climate change in this local Government Area. To this end, the specific objectives are to:

- i. Assess the perception of farmers towards climate change and variability because perception is a precondition for adaptation;
- ii. Assess the barriers and determinants of climate change adaptation options at the farm levels and;
- iii. Identify and document local options for climate change adaptation of the farmers

## II. STRATEGIES TO MITIGATE IMPACTS OF CLIMATE CHANGES

To approach the issue of climate change appropriately, one must take into account local communities understanding of climate change, since they perceive climate as having a strong spiritual, emotional, and physical dimension. It is therefore assumed that these communities have an inborn, adaptive knowledge from which to draw and survive in high-stress ecological and socio-economic conditions. Thus, the human responses are critical to understanding and estimating the effects of climate change on production and food supply for ease of adaptation. Accounting for these adaptations and adjustments is necessary in order to estimate climate change mitigations and responses [11]. They are identification of production systems which are most resilient to climate variability. These are the production systems with the ability to adjust or recover from negative impacts and take advantage of positive impacts of the current climate variability. One of the factors that contribute to increasing resiliency

of agricultural systems is the identification of appropriate mixes of production activities. According to IPCC, 2014, [12] establishing crop/livestock mixed systems, using a mix of crop species, cultivar types and sowing dates, combining less productive drought - resistant cultivars and high yield but water sensitive crops are strategies introduced that modify production systems.

Nevertheless rural communities in Nigeria have always managed their resources and livelihoods in the face of challenging environmental and socio-economic conditions [13]. They have to a large extent been able to develop their livelihood strategies in a way which enables them to constantly cope with and adapt to an erratic climate change, severe pest attack, changing agricultural policies at local, national, global levels and other natural factors [14].

There is need to gain as much information as possible, and learn the positions of rural farmers and their needs, about what they know about climate change, in order to offer adaptation practices that meet these needs (14) and (15). This study therefore intends to assess farmers perception of impact of climate change on food crop production, it also describe socio-economic characteristics of the respondents, examine farmers perception on climate change, identify impact of climate change on crop production and to ascertain adaptation strategies adopted to mitigate effect of climate

## III. METHODOLOGY

Kwaya Kusar local Government Area is located between lat. 10.42°88'' and log. 11.87, 93''. It has a population projection (using 3.5% growth rate) of 79,700 [16]. It has an area of 795 km<sup>2</sup> and has a density of 100.2/ km<sup>2</sup> (Figure 1). It is located at the bottom of the famous Biu plateau, Northeastern part of Nigeria. Temperature of the area varies from 31°C to 40°C. It was chosen because it is among the vulnerable to drought and poverty as well as reduced crop yield in southern part of Borno State.

Four settlements of Guwal Bahai, Billa-Kogu, Milda were purposively selected for the study due to rural settings of these areas. Purposive sampling was also used in the selection of key informants who have opinions and experience on the topic of study. Structured interview schedule was administered on respondents through Personal contact, with assistance of employed trained enumerators in their various communities. The total of 120 farmers participated in the study. Each village had 30 farmers from Guwal, Billa-Kogu, Bahai and Milda representing the four districts of the Local Government Area. Data collected were subjected to descriptive statistics, such as frequency counts, tables and percentages.

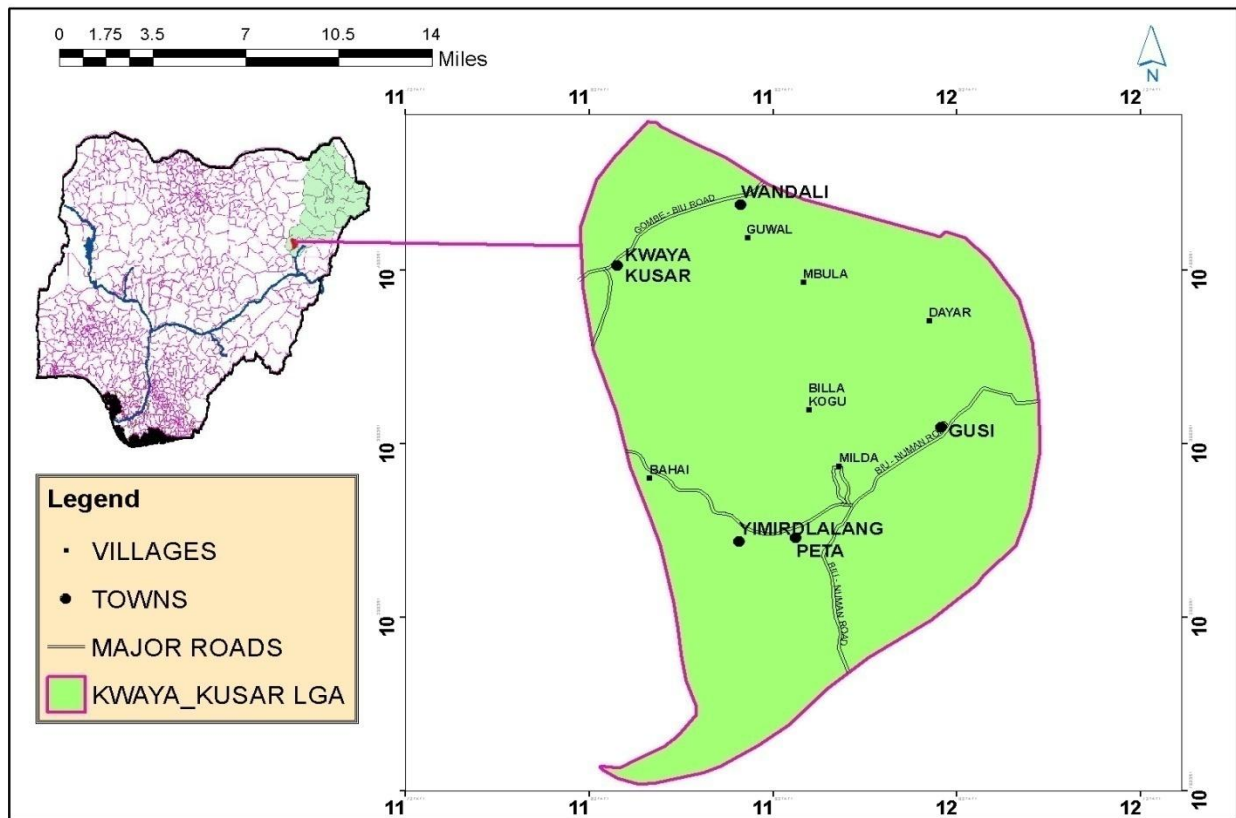


Figure 1: Map of Kwaya Kusar Local Government area

IV. RESULT AND DISCUSSION

Socio-Economic Characteristics of the Respondents

Table 1 show that 33.3% of the respondents were above 51 years of age, 16.7% fell between the age range of 41-45 while 22.5% and 12.5% were between the age ranges of 46-50, and 36-40 years respectively, also 8.3% fell between the age range of 31-35 and 6.8% were less than 30 years of age. Data further shows that about 66.8% of the respondents were male, 59.1% were literate and 75% of the respondents had involved in farming for more than 5 years. This implies that majority of the respondents had being in farming for many years.

Table 1: Socio-Economic Characteristics of the Respondents

Variables Age	Frequency	Percentage
>30	8	6.7
31-35	10	8.3
36-40	15	12.5
41-45	20	16.7
46-50	27	22.5
51 and Above	40	33.3
Total	120	100
Sex	Frequency	Percentage
Male	85	70.8
Female	35	29.2

Total	120	100
Education level	Frequency	Percentage
No formal Education	10	26.7
Primary Education	20	16.7
Junior Secondary Education	25	20.8
Senior Secondary Education	32	8.3
Tertiary Education	16	13.3
Adult education	17	14.2
Total	120	100
Years of Farming Experience	Frequency	Percentage
1-5	30	25
6-10	20	16.7
11-15	18	15
16-20	24	20.8
21 and Above	28	22.5
Total	120	100

Source: Field Survey 2019

*Farmers’ perception on climate change*

Data in Table 2 revealed the responses of sampled farmers perception on climate change in their area as 20% indicated they observed an increase in temperature over the years, 16.7% of the farmers observed that rainfall started late compare to previous, 10.8 % indicated that there was no clear-cut season, 14.2% indicated that they experienced flood with serious consequences over the years while 10.8% and 27.5 % unusual heavy rainfall and experience of more longer days and nights respectively as the determinant of climate change in their environment. This result conform with Lobell,(2008) [14] and Ole et al, (2009) [12] who reported that 89.0%, 72.0% and 65.0% of the respondents respectively indicated higher temperature, water evaporation from the ground is fast and delayed rainfall as the determinants of climate change.

Table 2: Farmers’ perception on climate change

Perception	Frequency	Percentage
Higher temperature	24	20
Delayed rainfall and drought	13	10.8
Undefined season	20	16.7
Flood with serious consequences	17	14.2
Unusual heavy rainfall	13	10.8
More longer days than night	26	21.7
No response	7	5.8
	120	100

Field Survey, 2019

*Impact of Climate Change on Agriculture*

Table 3 revealed the responses of sampled farmers’ opinion on the effects of climate change on agriculture and their environment in general. They revealed that crop failure /declining yield is the dominant impact (25%), drying up of seedling after germination account for 15.8%, increase in soil erosion (8.3%) and loss of farm lands and crops due to flooding (10.8 %). Others include drying up of streams which account for 18.3% and water shortage in the study recorded 21.7%. These agree with findings of Onu & Ikehi (2016) [11] who reported that performance of agriculture sector depends largely on the return of good rains and the timely and adequate provision of agricultural inputs.

Table 3: Impacts of climate change on Agriculture

Impacts	Frequency	Percentage
Drying of seedling after germination	19	15.8
Crop failures and declining yield	19	25
Increase in soil erosion	10	8.3
Loss of farm lands and crops due to flooding	13	10.8
Drying up of streams	22	18.3

Water shortage	26	21.7
	120	100

Field Survey 2019

*Perceived adaptation strategies to mitigate impact of climate change on crop production*

Table 4 presents adaptation strategies actually adopted by the respondents. These strategies are: crop diversification (10%), small business (15%), early planting (24.7%), changes from crop production to livestock production (8.3%) while 30% and 12.5% of the respondents implement use of chemicals and pesticides and access to credit facilities respectively. These agree with findings of Yirga, (2007) [18], Pattanayak et al (2003) [19 ] and Caviglia-Harris (2002) [20] who observed that a positive relationship exists between the level of adoption and the availability of credit since credit eases the cash constraints and allows farmers to buy inputs such as fertilizer, improved crop varieties and irrigation facilities.

Table 4: Perceived adaptation strategies to mitigate impact of climate change on crop production

Adaptation Strategies	Frequency	Percentage
Crop diversification	12	10
Small business	18	15
Early planting	29	24.7
Changes from crop production to livestock production	10	8.3
Use of chemicals and pesticides	36	30
Access to credit facilities	15	12.5
	120	100

Field Survey, 2019

*Farmers Perceived Barriers to Adaptation*

Table 5 presents sampled farmers perceived barriers or hindrances for farmers to adapt to climate change in the study area. The factors affecting the farmers to adaptation include inadequate credits facilities representing 35.83 % of the respondents. Others are inadequate farming inputs and technology representing the highest percentage of the respondents of 41.67. Some farmers were of the view that lack of knowledge and lack of information constitute barriers to adaptation with 14.17 % and 8.33 % respectively. This agrees with the work of Glwadys (2009), [21] who reported that lack of access to credit facilities and extension services are the main factors that inhibits adaptive capacity of farmers. Related studies Maddison (2006) [22] and Nhemachena & Hassan (2007) [23] reported that farming experience, just like farmers’ education level, increases the probability of uptake of adaptation measures to climate change. As such, farmers with higher levels of education are more likely to perceive climate change and adapt better.

Table 5: Farmers Perceived Barriers to Adaptation

Barriers to adaptation	Frequency	Percentage
Lack of information	10	8.33
Lack of knowledge	17	14.17
In adequate farming inputs and technology	50	41.67
Inadequate credits facilities	43	35.83
	120	100

Field Survey, 2019

## V. CONCLUSIONS AND RECOMMENDATIONS

The study set out to evaluate farmers' perceptions and adaptation to climate change in Kwaya Kusar local Government Area. It was found out that majority of the farmers were well aware that climate was changing and it was the cause of the recurrent droughts that were ravaging the Local farmers. Majority of the farmers noted that there was an increase in temperature, delayed rainfall, unidentified seasons, unusual heavy rainfall and flood with serious consequences. As such, most farmers had undertaken necessary adaptation measures to counter the adverse effects of climate change. The most common adaptation strategies among farming households who perceived increases in temperature were: early planting of their crops, crop diversification, use of chemicals and pesticides, access to credit facilities from the Federal Government, engages in small businesses and

The results from the study also show that the age of the household head, education, farming experience, access to information on climate change, access to extension services, more credit facilities and availability of farming inputs were crucial factors in influencing the likelihood of farmers to adapt to climate change in Kwaya Kusar Farming villages. Any policy aimed at enhancing the adaptive capacity of the farmers in the study area should thus consider making use the factors mentioned afore. The study also revealed that women also engaged in farming activities like the men counterparts. This has important policy implication because those women would therefore need to be empowered through women groups and associations, since this can have significant positive impacts for increasing the uptake of adaptation measures by the farmers. The policy framework can also consider promoting women by helping them get access to education, assets, and other critical services such as credit facilities and farming inputs etc. This would be pursued vigorously to see to the improvement of rural women livelihood as they struggle to cope with adverse effect of climate change and also to the generality of poor farmers.

## ACKNOWLEDGEMENTS

We thank the people in our study sites for their generous support, without which this study would not have been possible. We gratefully acknowledge the efforts of our fieldwork assistants, Mr. Emmanuel Nganjiwa and Mr. Philip Bwala.

## REFERENCES

- [1] Nigerian Meteorological Agency, NiMet (2012). Nigeria Climate Review (59 pp.).
- [2] Federal Ministry of Environment (2014). United Nations Climate Change Nigeria. National Communication (NC). NC 2.
- [3] Anabaraonye, B. et al. (2019). Educating farmers and fishermen in rural areas in Nigeria on climate change mitigation and adaptation for global sustainability. *International Journal of Scientific & Engineering Research*, 10(4), 1391-1398.
- [4] Amobi, D & Onitsha, T. (2015). Governance and climate change in Nigeria: A public policy perspective. *Journal of Policy and Development Studies*, 9(2), 199-210.
- [5] Abdulkadir, A. (2017). Climate change and its implications on human existence in Nigeria: review. *Bayero Journal of Pure and Applied Sciences*, 10(2), 152-158.
- [6] IPCC(2018): Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press
- [7] Shiru, M.S. (2018). Trend Analysis of Droughts During Crop Growing Seasons of Nigeria. *Sustainability*, 10(3), 871.
- [8] BNRCC (Building Nigeria's Response to Climate Change) (2011). *National adaptation strategy and plan of action on climate change for Nigeria* (NASPA-CCN). Caviglia-Harris, J. (2002). Sustainable Agricultural Practices in Rondônia, Brazil: Do Local Farmer Organizations Impact Adoption Rates? Department of Economics and Finance, Salisbury University.
- [9] Onu, F.M., & Ikehi, M. E. (2016). Mitigation and adaptation strategies to the effects of climate change on the environment and agriculture in Nigeria. *Journal of Agriculture and Veterinary Science* Volume 9, Issue 4 Ver. I (Apr. 2016), PP 26-20
- [10] Apata T. G., Samuel, K. D., & Adeola, A. O. (2009). Analysis of Climate change perception and Adaptation among Arable Food Crop Farmers in south Western Nigeria paper presented at the conference of International Association of Agricultural Economics pp. 2-9.
- [11] IPCC, (2014): Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA
- [12] Ole, M., Cheikh, M., Anette, R., & Awa, D. (2009). Farmers Perceptions of Climate Change and Agricultural Strategies in Rural Sahel. *Journal of Environmental Management* 4(3) 804-816.
- [13] Building Nigeria's Response to Climate Change (BNRCC) (2008). Annual Workshop of Nigerian Environmental Study Team (NEST): The Recent Global and Local Action on Climate Change, held at Hotel Millennium, Abuja, Nigeria; 8-9th October, 2008
- [14] Lobell, D.B., Burke, M.B., Tebaldi C, Mastrandrea, M.D., Falcon, W.P., & Naylor, R.L. (2008). Prioritizing Climate Change Adaptation Needs for Food Security in 2030, *Science* 319 (5863), PP. 607-10.
- [15] Hassan, R & Nhemachena, C (2008) Determinants of African Farmers' Strategies for adaptation to climate change. *African Journal of Resource Economics* 2 (1) pp 83-104.
- [16] Molu, E. L. (2008). Turning up the heat on African Agriculture: The impact of climate change on Cameroon's agriculture, *African Journal of Agriculture and Resource Economics* 2 (1) pp 45-64.
- [17] NPC, (2017). National Population Commission Projection, 2016

- <http://www.citypopulation.de/php/nigeria-admin.php?adm2id=NGA008018>
- [18] Yirga, C. T. (2007). The dynamics of soil degradation and incentives for optimal management in Central Highlands of Ethiopia. PhD thesis. Department of Agricultural Economics, Extension, and Rural Development. University of Pretoria, South Africa.
- [19] Pattanayak, S.K., Mercer, D.E., Sills, E & Jui-Chen, Y. (2003). Taking stock of agroforestry adoption studies. *Agroforestry Systems* 57 (3), 173–186.
- [20] Caviglia-Harris, J. (2002). Sustainable Agricultural Practices in Rondônia, Brazil: Do Local Farmer Organizations Impact Adoption Rates? Department of Economics and Finance, Salisbury University.
- [21] Glwadys A. G (2009). Understanding Farmers' Perceptions and Adaptations to Climate Change and Variability. The Case of the Limpopo Basin, South Africa IFPRI Discussion Paper 00849. February 2009
- [22] Maddison, D. (2006). The perception and adaptation to climate change in Africa. CEEPA. Discussion Paper No. 10. Centre for Environmental Economics and Policy in Africa. University of Pretoria, Pretoria, South Africa.
- [23] Nhemachena, C., & Hassan, R. (2007). Micro-level analysis of farmers' adaptation to climate change in Southern Africa. IFPRI Discussion Paper No. 00714. International Food Policy Research Institute, Washington, D.C.