



NEXUS OF CLIMATE CHANGE ADAPTATION AND FOOD SECURITY SITUATION IN SUB-SAHARAN AFRICA: A CASE OF IRRIGATION FARMERS IN KATSINA, NIGERIA

Sulaiman Umar

Department of Agricultural Economics and Rural Sociology,
Institute for Agricultural Research, Ahmadu Bello University, P.M.B. 1044, Zaria-Nigeria.
Corresponding Author's E-mail: umars@abu.edu.ng **Tel.:** 08068488698

ABSTRACT

Climate change is a reality hitting hard on vulnerable communities resulting in adverse effects such as hunger and food insecurity. This study is prompted by the need to assess how communities of irrigation households survive climate change using adaptation strategies and how that affects their food security statuses. A sample of 200 respondents spread across two of the three agricultural zones of Katsina State were selected and interviewed using structured questionnaire. The data obtained were analysed using SPSS. The study found that the most important adaptation strategies employed by the respondents are: mixed cropping, changed sowing date and seed selection. It was also affirmed that there is an increasing prevalence of food insecurity in the study area with 78.5% of the respondents reporting various degrees of the phenomenon. The study concluded that, the more climate change adaptation strategies employed by a household, the higher its likelihood of being food secured ($p < 0.05$). It was therefore, recommended that households combine more of the adaptation strategies for enhanced food security.

Keywords: Adaptation, Climate change, Food security, Irrigation, Katsina.

INTRODUCTION

In recent times there has been an increasing interest in the study of climate change. It is no longer news that the global climate is getting warmer and the effect of climate change and ozone layer depletion on the society is as enormous as it is detrimental (Intergovernmental Panel on Climate Change [IPCC], 2001; Umar and Musa, 2015). The detrimental effects of global warming include erratic weather conditions in most places worldwide and which in turn influences agricultural productivity and food security (Fayiga and Adedoyin, 2011; Nelson *et al.*, 2009). Climate change has been defined as statistically significant variations in climate condition that persists for an extended period, typically for decades or longer. It is any change in climate, rainfall or productivity caused by natural variability and direct or indirect human activities that alter the composition of the atmosphere (IPCC, 2001; IPCC, 2007; United Nations, 1998).

Agriculture and human development will continue to be adversely affected by climate change and that populations in the developing nations, which are already vulnerable and food insecure are likely to be the worst hit and that further climatic changes pose huge challenges to food security. With the current spate of climate change, millions of children in Africa and Asia are at the risk of malnourishment by the year 2050. Hence, the need for this type of research that associates with the rural farmers and try to assess problems and solutions from their point of view is right and timely (Nelson *et al.*, 2010). Hence, efforts should be geared towards improving the strategies for coping with and adapting to this global phenomenon. It is increasingly realized that mitigation and adaptation (both of which constitute coping strategies) shall not be pursued independent of each other but as compliments (Nelson *et al.*, 2009; Nyong



et al., 2007). The fact that local communities have survived till today with fast population growth rates testifies that they have developed indigenous mechanisms and strategies to cope with changes in environmental conditions such as climate. The need to look inward at community-based adaptation strategies to climate change is gaining tremendous recognition as both farming activities and climate change manifestations are location specific (Nyong *et al.*, 2007; Umar and Musa, 2015).

According to (United Nations, 1998) food security can be defined as “People having at all times, physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life”. It is expected that farming households that adopt and use effective adaptation strategies against climate will exhibit higher resilience and food security indices in their societies. Effective response of farmers to climate change means higher food security, and any increase in food security translates into more resources for the (rural) poor. These resources, in turn, enhance their resilience to climate change and reduce their vulnerability (Nelson *et al.*, 2009).

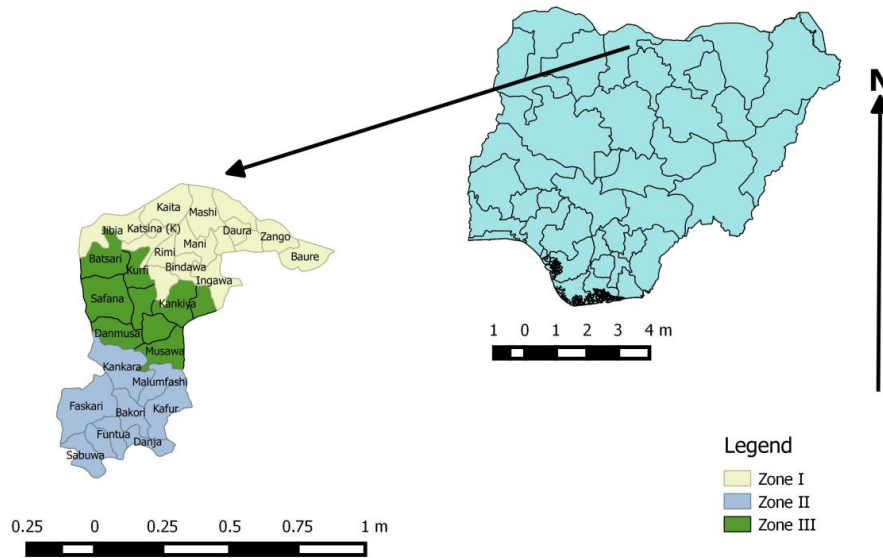
The objectives of this study were to:

- i. Identify the climate change adaptation strategies used among irrigation farmers in the study area;
- ii. determine the food security situation among the responding households; and
- iii. evaluate the influence of these climate change adaptation strategies on food security in the study area.

MATERIALS AND METHODS

The Study Area

This study was conducted in Katsina State, North-Western Nigeria. Katsina State has a total land area of 23,938 square kilometres located between longitudes 11⁰ and 13⁰ East; and latitudes 6⁰ and 9⁰ North. The projected population of the State was put at 7,452,629 in 2014 from the 2006 figure of 5,792,578 at a growth rate of 3.2% per annum (National Population Commission [NC], (2006). Majority of the population are Hausa/Fulani Muslims. It is a landlocked State neighbouring Niger Republic to the north; Jigawa and Kano States to the east; Kaduna to the south and Zamfara State to the west. The climate is semi-arid with average annual rainfall of about 689 mm falling between May and September. The major crops grown are maize, cotton, groundnut, millet, sorghum, cowpea and vegetables among others. The State lies within three agro-ecological zones: Sahel Savannah, Sudan Savannah and Northern Guinea Savannah. Likewise, Katsina State Agricultural and Rural Development Authority, the state apparatus responsible for agricultural and rural development and extension, stratified the state into three agricultural zones. These are: Zone I (Ajiwa), Zone II (Funtua) and Zone III (Dutsinma) as shown in Figure 1.



MAP OF KATSINA STATE SHOWING THE STUDY LOCATIONS

Figure 1: Map of Katsina State showing the different agricultural zones

Sampling Procedure

Multi-stage sampling procedure was applied for the purpose of this research. Zones I and III (Ajiwa and Dutsinma) were purposively selected out of the three agricultural zones of KTARDA because as arid and semi-arid, sahel and sudan savannahs they are more prone to the vagaries of climate change. This study targeted household heads who happen to be registered irrigation farmers in the study area as its respondents. After rigorous consultations with the personnel from KTARDA and irrigation society officials lists of farmers that fit the demand of this study were compiled. Fifteen percent of the sample frame was selected via simple random sampling method giving rise to 200 respondents. Table 1 shows the distribution of the respondents according to zones in the study area.

Table 1: Sample Size

Zone	Population	Sample (15%)
Ajiwa (I)	702	105
Dutsinma (III)	630	95
Total	1,332	200

Method of Data Collection

Primary data was used in this study. First, there was a reconnaissance survey where focus group discussions (FGDs) were conducted. Then, a structured questionnaire was designed, pilot-tested, tested for reliability and validity, and administered by well-trained enumerators that were conversant with Hausa (the local language) under the supervision of the researcher. Information was collected on farmers' socio-economic characteristics, adaptation strategies they employed and availability and accessibility of food in their households.

Method of Data Analysis

Data collected was analyzed using Statistical Package for Social Sciences (SPSS®) 21. Descriptive and inferential statistics were used to achieve the objectives. Descriptive statistics used include frequency distribution, mean and percentages.



The United States Department of Agriculture approach to food security measurement will be used for this study. It involves asking respondents a series of questions on observed changes in consumption patterns, behaviours and experiences known to characterize households having difficulty meeting their food needs (United States Department of Agriculture [USDA], 2000; Fakayode *et al.*, 2009). The responses come in affirmative (yes) or negative (no) form. If the response to a particular question is “yes”, the respondent is further asked to tell how frequently such incidence happens. While, a “no” response is recorded under the column “never”.

Afterwards, mean score will be found to place households on the food security continuum/scale ranging from 0 to 100 with households having lower scores being more food secured than those with higher score on the scale. Households will then be categorized as presented in Table 2.

Table 2: Food security status stratification

0 – 25	26-50	51-70	76-100
	Food insecure		
Food secures	Food insecure without hunger	Food insecure with hunger “moderate”	“severe”

Source: Adapted from USDA (2000)

An ordinal logit regression model was employed thus:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e$$

where;

Y = food security status (1= food insecure with severe hunger, 2 = food insecure with moderate hunger, 3 = food insecure without hunger and 4 = food secure).

a = constant

b_{1-n} = regression coefficients

X₁ = number of adaptation strategies used by the household

X₂ = amount of credit accessed (naira)

X₃ = extension contact (number of visits in a production cycle)

X₄ = household size (number of people)

X₅ = farming experience (years)

X₆ = educational attainment (years of schooling)

e = error term.

RESULTS AND DISCUSSION

Climate change adaptation strategies employed by the respondents.

As the farmers exist in their rural societies, changes are inevitable phenomena and as these changes occur farmers adapt and readjust in order to cope and survive. Among the prominent changes affecting farmers and their environment is the issue of climate change. Respondents have identified the strategies they employ in adapting to and mitigating the adverse effects of climate change on their irrigation production. As shown in Figure 2, mixed cropping was noted as the most important adaptation strategy used, as it was identified by a total of 194 respondents (97%). This could be attributed to the fact that different crops have different climatic requirements. Hence, several crops on a plot reduce the risk of complete loss due to unfavourable climatic conditions. This is in line with the findings of (Shemdoe, 2011) where farmers in Tanzania employed mixed cropping and crop diversification among other

strategies to cope with climate change. Other important strategies in the study area include change in date of sowing which was identified by 184 respondents (92%), seed selection to ensure that only viable materials are sown (86.5%) and prayers and supplication (73%).

Farmers in the study area, as in most rural societies, are religious and spiritual people. Hence, they seek spiritual intervention to ameliorate problems threatening their wellbeing. For instance, during periods of dry spell and droughts all members of the affected community including men, women, children and livestock movement to the outskirts of the village for a special prayer in the Islamic tradition known as *salatul-istisqa'a*. They also practice *Rokon ruwa*; where old women dressed in their husbands' attire go round town chanting songs, seeking forgiveness from God while children follow them clapping and drumming. In the same vein, in Sierra Leone, important indigenous climate change adaptation technologies/strategies include performance of ancestral ceremony/spiritual invocation (Morlai *et al.*, 2011). Other strategies employed such as traditional (*Shadouf*) irrigation system instead fuel-powered systems (66%), afforestation (64.5%), household fuel conservation (38.5%) and minimum tillage (34%) could help in minimizing greenhouse effect through use of clean energy sources and enhancing carbon and overall mitigation of climate change (Adesina *et al.*, 1999).

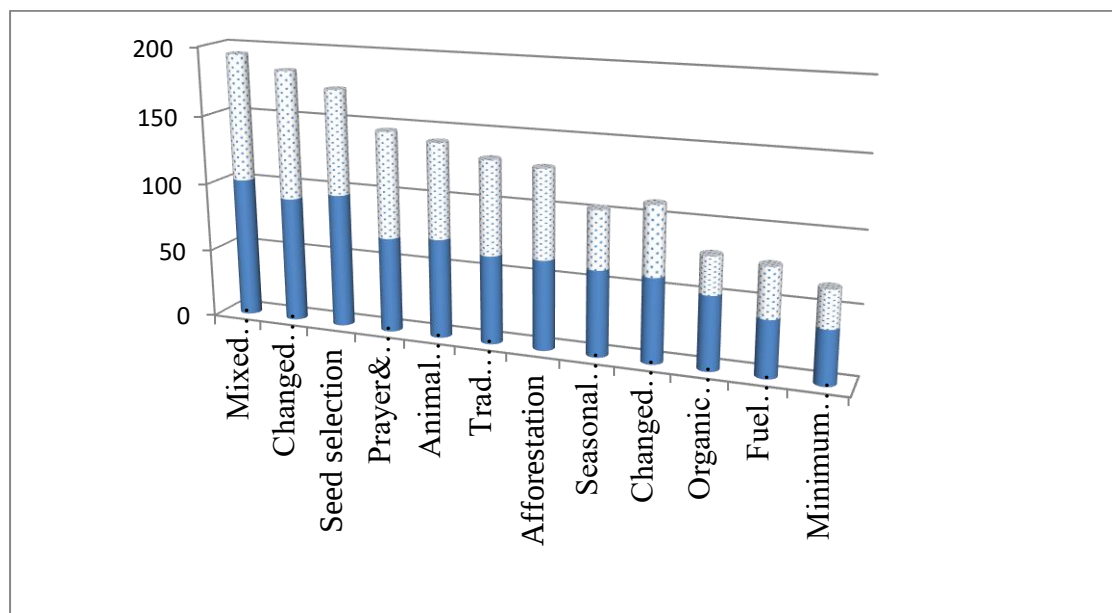


Figure 2: Frequency of Adaptation Strategies Used by the Respondents

The Effect of Climate Change Adaptation Strategies on Food Security

Table 3 shows the food security status of the respondents' households. It indicates that only 43 respondents (21.5%) are food secure. However, 82 respondents (41%) fall in the category of "food insecure without hunger", while 66 (33%) are "food insecure with moderate hunger" and 9 (4.5%) are "food insecure with severe hunger". An overwhelming majority (78.5%) of the households studied are in various degrees of food insecurity. The trend of food insecurity in Nigeria is worrisome. The proportion of food insecure in Nigeria people was reported to be about 18% in 1996, over 40% in 2005 and over 65% in 2008 (Busayo, 2011; Mohammed, 2008). About 325 million people in Sub-Saharan Africa are living on less than \$1 per day; there is a strong belief that most of the smallholder Nigerian farmers are inclusive. Since they live below the poverty line, they are plunged into a vicious cycle of poverty, inadequate information, environmental degradation, illiteracy and, of course, hunger.



Table 3: Showing distribution of respondents according to their food security status

Level of food security	Frequency	Percentage	Cumulative Percentage
Food insecure with severe hunger	9	4.5	4.5
Food insecure with moderate hunger	66	33.0	37.5
Food insecure without hunger	82	41.0	78.5
Food secured	43	21.5	100.0
Total	200	100.0	

Results from an ordinal logit regression analysis (Table 4) have shown that, the use of identified adaptation strategies against climate change (CSI) significantly affects and is positively related to likelihood of food security situation of the respondents' households. To this end use of climate change adaptation strategies positively influences the food security statuses of households at 5% level of statistical significance ($p < 0.05$). This implies that households that use more adaptation strategies are more likely to be food secured than households with use less strategies.

It was also found extension visit was positively related food security and significant at 5%. Consequently, households that received more extension visits were more food secured than those that received less.

Table 4: Some factors affecting the level of food security of the respondents

Variables	Coefficient	Standard Error	Z	P> z
Adaptation strategy	0.0007254*	0.0003075	2.36	0.018
Credit	-1.25E-06	2.38E-06	-0.53	0.599
Extension visits	0.296286*	0.1402459	2.11	0.035
Household size	0.0093355	0.0225555	0.41	0.679
Farming experience	- 0.0142306	0.0157859	-0.9	0.367
Years of education	0.0134154	0.0254929	0.53	0.599

Dependent variable: Food security, * = significant at 5% level of probability

CONCLUSION AND RECOMMENDATIONS

It is evident that rural irrigation farmers in the study area are among the victims of the global danger of climate change. This fact is also reflected in the prevalence of food insecurity (with varying degrees of severity) in the study area. Fortunately, they are able employ various climate change adaptation strategies which have sustained them and their households over time. The study has found that the use of such adaptation strategies was shown to be significant in achieving household food security in the area under study. It is therefore, recommended that households combine more of the adaptation strategies for enhanced food security.

REFERENCES

- Adesina, F. O., Siyambola, W. O., Oketola, F. O., Pelemo, D. A., Ojo, L. O. and Adegbugbe, A. O. (1999). Potentials of agroforestry for climate change mitigation in Nigeria: Some preliminary estimates. *Glob. Ecol. Biogeogr.*, 8:163–173.
- Busayo, O. C. (2011). *Climate change and food insecurity burden on women in Nigeria*. Retrieved November 28, 2012, from <http://www.globalpressinstitute.org/global-news/africa/nigeria/climate-changeand-food-insecurity-burden-women-nigeria>.



- Fakayode, S. B., M. A. Y. Rahji, O. A. Oni and M. O. Adeyemi (2009). An Assessment of Food Security Situations of Farm Households in Nigeria: A USDA Approach. *The Social Sciences*, 4 (1): 24-29.
- Fayiga, A. and Adedoyin S. F. (2011). Environmental sociology: definitions and conceptual issues. In: Adedoyin, S. F., (ed) *Rural, agricultural and environmental sociology in Nigeria*. A publication of the Nigerian Rural Sociological Association. Andkolad Publishers Nigeria Limited, Ile-Ife, Nigeria, p32.
- Intergovernmental Panel on Climate Change [IPCC] (2001). *Impact, adaptation and vulnerability*. Contribution of working group II of the IPCC to the third assessment report of the IPCC. Cambridge University Press. London.
- Intergovernmental Panel on Climate Change [IPCC] (2007). Tide gauge measurements and satellite imagery suggest that sea level has risen. *Recent climate change – sea level changes, climate, science*. The fourth assessment report of the IPCC. Cambridge university press. London.
- Mohammed, I. (2008). Road Map to Attaining Food Security in Nigeria. *Nigerian Tribune*, Monday, 5th May.
- Morlai, T. A., Mansaray, K. and Vandy, G. (2011). Enhancing agricultural yields by smallholder farmers through integrated climate change adaptation programme in Sierra Leone. *Research Paper*, African Technology Policy Studies Network (ATPS), Nairobi, Kenya.
- National Population Commission (2006). *Report of national population census*. Nigeria.
- Nelson, G. C., M. W. Rosegrant, J. Koo, R. Robertson, T. Sulser, T. Zhu, C. Ringler. (2009). *Climate change: Impact on agriculture and costs of adaptation*. International Food Policy Research Institute. Washington, D.C.
- Nelson G. C. M. W. Rosegrant, J. Koo, R. Robertson, T. Sulser, T. Zhu, C. Ringler. (2010). *Food security, farming and climate change to 2050: Scenarios, results, policy options*. International Food Policy Research Institute (IFPRI) research monograph, Washington, D.C.
- Nyong, A., Adesina, F. and Elasha, B. O. (2007). The value of Indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. *Journal of Mitigation and Adaptation Strategies for Global Change* 12:787-797. Retrieved September 02, 2012, from <http://www.springerlink.com>.
- Shemdoe, R. S. (2011). Tracking Effective Indigenous Adaptation Strategies on Impacts of Climate Variability on Food Security and Health of Subsistence Farmers in Tanzania. *Research Paper*, African Technology Policy Studies Network (ATPS). Nairobi, Kenya.
- Umar, S. and Musa, M. W. (2015). Determinants of the use of Indigenous Coping Strategies against Climate Change among Smallholder Farmers in Katsina State , Nigeria. *Journal of Agriculture and Ecology Research International*, 3(1)(1), 24–32.
- United Nations (1998). *Framework convention on climate change, article 1*. Retrieved May 9, 2013 from http://unfccc.int/essential_background/convention/background/items/2536.php
- United Nations (2007). United Nations special rapporteur on the right to food. Retrieved May 9, 2013 from <http://www.righttofood.org/>.
- United States Department of Agriculture (2000). *Guide to Measuring Household Food Security*. Retrieved May 9, 2013 from <http://www.econ.org/briefing/foodsecurity>.