Implication of Climate Change and Food Security Status on Rural Farmers in Kura Kano State North–Western Nigeria

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Abstract This paper explores the food security context and the socio-economic consequences of climate change on rural farmers in Kura local government, Kano state, Nigeria. The purpose of the study was to ascertain the food security status of the rural farmers in the study area. Socio- economic consequences were ascertained. Agro forestry will serve as a win-win solution to the difficult decision between reforestation and agricultural land use; hence it increases the storage of carbon and may also increase agricultural productivity. Lottery sampling procedure was used in the selection of local government, communities and farmers for the research study. Structured questionnaire were used to obtain the data for the study. Food security index was used to ascertain the level food insecurity among the rural farmers in the communities. Descriptive statistics as a tool for analysis was used to analyze the data obtained. 98.5% of the respondent was married with dependants and low annual income of # 80,000 and below. Most farmers experienced loss of investment on farm lands, lives and income respectively. This study reveals that rural farmers suffered serious hardship they cannot produce what to feeds their families for at least six month in a year (food insecure). They also suffered ill health, such as malaria, water born diseases and skin infections among others. The study recommends that policy makers should encourage more recognition of food security in the state, support for adaptation activities in rural areas, enhance the role of civil societies and adaptation and mitigation.

Keywords Climate change · Food security · Rural · Nigeria · Farmers

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1 Introduction

Climate change has effects on agriculture because an agricultural activity depends on climate condition. That effect threatens our ability to advance global food security. Agroforestry, is the growing of trees in agricultural landscapes, has the potential to achieve sustainable agriculture in smallholder farming. Various Agroforestry practices are suitable for adaptation of agroecosystem to climate change. In view of t that Agro forestry will serve as a win-win solution to the difficult decision between reforestation and agricultural land use, hence it increases the storage of carbon and may also increase agricultural productivity. Agro forestry will serve as a potential mitigation strategy.

It is important to point out that the global climate or the climate of any part of the world has never been static. Climate fluctuations and climate change impinge on human affairs in diverse and many ways, climate determines the ability of man to feed him through its influence on agricultural production.

Agriculture is an important occupation and operation that provide income, employment and food to Nigeria thereby enhancing food security in the country, but in a situation of climate change, Agriculture in northern Nigeria as in other northern parts of west Africa, would evidently be impacted (IPCC 2007). This is applicable to Kano state where most rural communities engaged in farming and crop production for their livelihoods and attainment of food security.

There is a growing consensus in the scientific literature that in the coming decades the world will witness higher temperatures and changing precipitation levels. The effects of this will lead to low/poor agricultural products. Evidence has shown that climate change has already affecting crop yields in many countries (IPCC 2007; Deressa et al. 2008; BNRCC 2008).

Food security, livelihoods, and poverty in rural communities in northern Nigeria are determined by the agricultural production of the individuals and communities. Also rainfall and temperature rate dictate the amount of agricultural production, annually. Agriculture everywhere in the country, being dependent on rainfall, will be adversely impacted by increased variability in timing and amount of rainfall.

Production of grain crops like maize, guinea corn, millet and rice can be depressed. The openness of the region to high temperature also affects the level of soil fertility (Adogi 2008). The state of agriculture in Nigeria in recent times shows a continuous decline in exportation and increase in importation of agricultural products into the country. The share of Nigeria's agricultural products in total exports plummeted from over 70% in the 1960s to less than 2% in 2010 (Adogi 2008).

The major contribution to the decline has been liked with the negative effects of climate change on crop production in sub-Saharan Africa (Okunnola and Ikuomola 2010). It is predicted that the majority of Nigerian and African countries will have novel climates over at least half of their current crop year by 2050 (IPCC 2007).

2 Agriculture and Climate Change

Though the extent and nature of the effect of climate change on agriculture has not yet been accurately forecast; its impact so far on diverse farming regions of the world has been profound (McClean, et al. 2005; FOA 2007; Revkin 2008). Water sources have become unpredictable; with excess, little or no rainfall and flooding and inundation in coastal areas (Brown 2006; Dore 2005; Hopkin 2005).

3 Food Security and Climate Change

According to the FAO, food insecurity exist when people are not able to secure access to an adequate and safe diet which constrains them from leading an active and health life today. In addition, those who are currently food secure may become vulnerable to food security in the future. Potential impact of climate change on food security includes both direct nutritional effects (changes in consumption quantities and composition) and lively livelihood effects (change in employment opportunities and cost of acquiring adequate nutrition). Climate change can affect each of these dimensions FAO(2002).

4 Food Security in Changing Climate

Food security (is) a situation that exists when all people at all times, have physical social and economic access to sufficient, safe and nutritious food that meets their dietary need and food preference for an active and healthy life FAO(2002). Climate change has already caused and will continue to cause change in global temperature and precipitation pattern as well as changes in soil processes and properties (Meehl et al. 2007). This has lead to considerable concern that climate change could compromise food security, which would lead to an overall decline in human health.

5 Implication of Climate Change and Food Security in Nigeria

Countries in sub-saharan Africa, including Nigeria are likely to suffer the most because of their geographical location, low incomes, low institutional capacity as well as their greater reliance on climate—sensitive renewal natural resources sector like agriculture (Ebon 2009). Climate change is threatening agricultural sector because food production is affected when there is a change on the climate.

Once effects occur on agriculture it will equally has an effects on people who depend on agriculture as a means of livelihood. According to IPCC 2007, BNRCC 2008. Rough estimates is of the view that for the next 50 years or so, climate change may likely have serious threat to meeting global food needs than other constrains on agricultural system.

The number of people without food to eat on regular basis is increasing in a geometric progression. Over 60% of the world's undernourished people live in Asia and a quarter in Africa (FAO 2002). Climate change phenomenon affects agriculture in many ways, such as unreliability in the onset of the farming season, due to changes in rainfall characteristics; this can result to an unusual sequence of planting and replanting which may lead to food shortage due to harvest failure (Okoh et al. 2011).

6 Significant of the Study

Most climate change impacts research studies have been focusing on human perception on climate change while implication of climate change and food security status remains a poorly investigated area in research. At the same time cultivation of indigenous foods found growing in the forests that are important locally but have, to date, been under-researched by the scientific community. Climate change is recognized as one of the major worldwide challenges facing men and his environment and has become one of the areas of urgent concern and focus.

Agro forestry is one of the potential options which can be us or practice to mitigate the impacts of climate change and therefore there is need to conduct a research on the implication of climate change and food security status in our communities.

7 Aim and Objectives of the Study

The main aim of this research is to explore the food security context and socio-economic consequences of climate change on rural farmers in Kura local government area, Kano state from which the following specific objectives were derived:

(a) To determine the relationship between climate change and food security in the study area.
(b) To examine the food security status of rural farmers in Kura emanating from climate change using food security index.
(c) To examine the impacts of climate change event on food security of the farmers in the local government.

8 Method and Material

This study was carried out in Kura local government area Kano state, Nigeria. The area was selected because agriculture is the major economic activities in the area. The study area is located at the southern part of Kano state with a population of 144,601 million people (NPC 2006) with a land mass of 206 km^2, is located between 11° 46′ 12.84″N and longitude 8° 35′ 29.02″E it is about 900 km from the edge of the Sahara desert and 1140 km away from the Atlantic ocean approximately.

The study area shares boundary north and east with Kumbotso local government and west–south it boarders with Madobi and Garun Malan local government area respectively, extreme south–east it boarders with Bunkure local government area. (Fig. 1) The area has three marked temperature regimes; warm, hot and cold with mean annual temperature of 26 and 21 °C main monthly range of maximum temperature in December/January and over 35 °C which is hottest (April/May)wet season start in May and ends October. While November to February is dry cool season with hamattan haze. Vegetation is savanna (grassland) of Sahel Sudan guinea type.

Lottery sampling procedure was used for the selection of the communities and farmers for the research. Six communities were selected to represent the local government area. The measures for selecting the communities include the following:

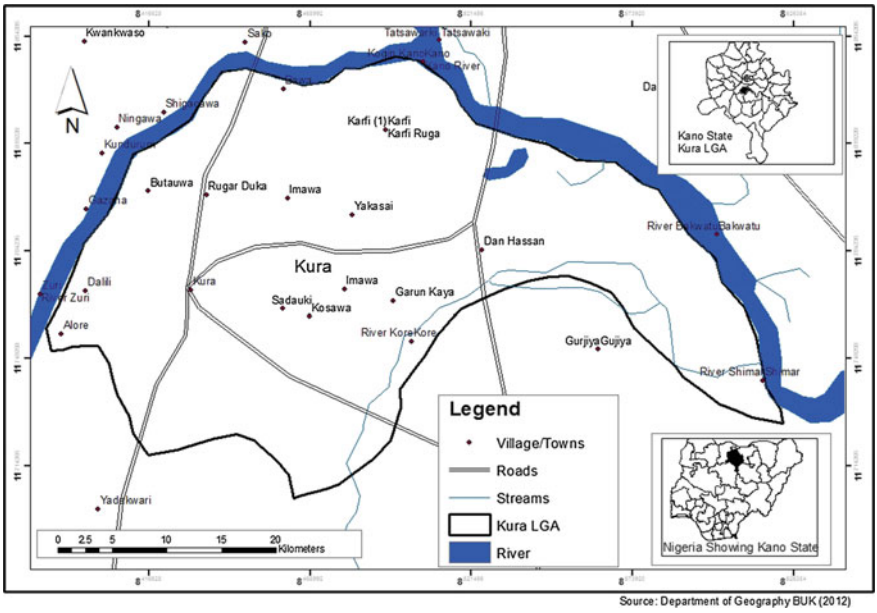

Fig. 1 Map of Kano state showing the study area *Source* Field study 2010

i. Community with a sizable number of farmers with at least ten (10) hectre of cultivable land.
ii. Community with all year round farmers i.e. engaged in farming activities during the dry and wet season.
iii. Agriculture- economy based community.

On view of the above, ***Imawa, Karfi, Gundutse, Bawa, Dukawa, Baure,*** were selected as the study location. A sample of 50 farmers were selected in each community based on snow ball method of one farmer directing the researcher to the next farmer this way a total of 300 sample were collected. The main source of data was through mean of annual temperature and rainfall from January 1991 to December 2013 were collected from Malan Aminu Kano International Airport Nigeria meteorological Agency (MAKIA-NIMET) for the study. The primary data were obtained through observation, discussion, interview and administration of structured questionnaire survey. Information sought was on personal information of respondents including their age, sex, marital status, educational level, additional information were sought based on their involvement in agricultural activities. Descriptive statistics were used to summarize the socio-economic characteristics and to determine the level of food insecurity as well as the food security status among the farmers. The researcher used period of six years in accessing farmers' agricultural activities in the study area from 2007–2012. The data gathered was analyzed using tables, percentages and other statistics techniques relevant for the data collected.

Food security index: food security index was used to determine the level of food in security among rural farmers that have been affected by drought, flood and other climate hazard over the past 40 years. Food security equation used by Felake et al. (2003) and ways of measuring farmers' food security status by Hoddinott (2001) in Emaziye et al. (2013) were adopted for this study. The equation is stated as:

$$C^x = Cj - Yi \quad (1)$$

C^x	food security index of rural farmers
Cj	quantity of food consumed (N = 1–5)
Yi	expected required food to be consumed (N = 5)
If $C^{x=}0$	rural farmer will be said to be a food secure.
If $C^x < 0$	then the rural farmer will be said to be a food insecure

Hoddinott (2001) in Emaziye et al. (2013) outline four ways of measuring household food security status; such as dietary diversity which involves determining the frequency and the number of different foods consumed by an individual over a period of time. Therefore food security index of rural farmers in these study was adopted from Emaziye et al. (2013), based on the total household daily consumption (carbohydrate, vitamins, water, proteins, minerals and fat/oil). A food secured rural farmer is expected to consume all the time categories.

Food insecure category was further categorized in mild food insecure, moderately food insecure and severe food in secure.

$(C^x = C^j - Y^j) = 4 - 5 = -1$ (Mild food insecure)

$(C^x = C^j - Y^j) = 3 - 5 = -2$ (Moderately food insecure)

$(C^x = C^j - Y^j) = 2 - 5 = -3$ (severe food insecure)

9 Correlation

Correlation was used to determine the relationship between calculated climate change variables coefficient of variation and food security of rural farmers in Kura local government.

$$F_s = A_{tcv}T_{cv} + A_{rcv}R_{cv} + A_{ycv}Y_{cv} + e$$

where,

F_s	food security
T_{cv}	temperature coefficient of variation (%)
R_{cv}	rainfall coefficient of variation (%)
Y_{cv}	food production (yield) coefficient of variation (%)
E	error term
A_{tcv}, A_{rcv}, A_{ycv}	Model parameter

Adopted from: Emaziye et al. (2013).

10 Result and Findings

The data on the personal variable of respondents shows 65% of them were within the age 43–53 the remaining were aged 54 above. On the marital status of respondents a total of 200 which represents 66.67% were married, 65% which is 21.6 were divorced, and 35 which represent 11.8% were single. On the educational level of respondents, 120 respondents which is 40% had Qur'anic education, 100 respondents which is 33.33% had primary education, and 80 respondents which is 26.6% had adult education. The respondents mean annual income is N 65,642 (Naira) about $378USD which is less than $1(one dollar) a day which shows a poverty situation of the rural farmers. This might probably due to climate change impact in the state.

In Table 1 above reveal that food security has a significant relationship with climate change variables using Pearson correlation, as temperature and rainfall contributed toward food security it is a well known fact that every crop has rainfall and temperature requirement for it survival as equally observed by the rural farmers in the study area these coincided with the findings of Emaziye et al. (2013).

Table 1 Relationship between climate change variables (temperature and rainfall) and food security in Kura local government

Correlation	Food security (Fs)	Temperature (T_{cv})	Rainfall (R_{cv})
F_s	1.000	–	–
Pearson T_{CV}	–	1.000	1.000
Correlation R_{cv}	–	−000	−000
F_s	–	–	–
Sig. T_{cv}	−000	–	–
(1-tailed) R_{cv}	−000	–	–
F_s	5	5	5
T_{cv}	5	5	5
N R_{cv}	5	5	5

Source field study 2013

Table 2 Respondents food security index

Food security index	Kura local government (n = 300)	Percentage (%)
Food secure	10	3
Mild food insecure	15	5
Moderately food insecure	125	42
Severe food insecure	**150**	**50**
Mean	Severe food insecure	

Source field study 2013

Table 2 above shows how food security index was used to ascertain the level of food security in the study area, and it is reveals that the area falls under severe food insecure with 50% due to shortage of rainfall and 42% moderately food insecure respectively. Based on these findings only 3% were food secured and 5% mild food secure. This was attributed to climate (drought) that resulted to crop failure and loss of investment on farmlands in the study area.

Table 3 above indicated that farmers in the study area experienced a severe impact of losses with 55% because the farmers in the study area depend mostly on climate-sensitive resources for livelihood. This is as a result of climate change event. These findings coincided with statement of Ebon (2009) where he stated that countries in sub Saharan Africa, including Nigeria are likely to suffer the most because of their geographical location.

Limitation and constraint of the paper

- Some of the respondents were illiterate which pose a problem of language barrier. Though the researcher spent time with the respondents trying to translate and interpret the questionnaire for them. However, the research assistants were familiar with local language mainly *Hausa* in order to reduce the limitation.

Table 3 Impact of climate change event on food security

Impact of loss	Kura local government(n = 300)	Percentage (%)
No effect	25	8.33
Low	16	5.33
Moderate	46	15.33
Severe	**165**	**55**
Very severe	48	16

Source field study 2013

- The scope of the study is only limited to Kura local area which is not enough to make generalization about the investigated issue.
- Inadequate finance to cover wider affected area in the region.

11 Conclusion and Recommendation

Climate change poses a serious threat in Nigeria Kura local government inclusive (study area) especially in the area of agriculture. As a result of reduction in precipitation and high temperatures and evatranspiration during droughts period has negatively impacted staple food production in the study area. Thus, a negative impact from climate change in Kura brings about increased poverty, water scarcity and food in security. First we learned that there is a significant relationship between climate change and food security in the study area as rainfall and temperature were contributors. Secondly food security index revealed severe food insecure situation. Thirdly the study revealed severe impact of losses of crops and investment. The study therefore recommends the following for future prospect;

Additional research is needed to further develop local farmers' ability to understand and address issues related to climate change, Agriculture and Agroforestry.
Campaigns' to raise awareness on the role on indigenous species in climate change adaptation.
There is need for development of appropriate policies and institutional infrastructure to catalyze adoption of Agroforestry.

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