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Impact of Climate Change on Agricultural Production by Farmers in Taraba State, Nigeria

Jifin D. Tsojon
Agricultural Education Department, College of Education, Zing Taraba State, Nigeria

Abstract

The purpose of the study was to determine the impact of climate change on agricultural production by farmers in Taraba State, Nigeria. A survey research design was adopted for the study. Five research questions guided the study. The study was conducted in Taraba State, Nigeria. The population of the study was all farmers in Taraba State. The sample for the study was 290 farmers who were drawn by multi-stage sampling technique. The instrument for data collection was a structured questionnaire tagged "climate change and agriculture production questionnaire" (CCAPQ). The instrument was validated by three experts. After trial testing a Cronbach Alpha reliability coefficient of 0.89 was obtained indicating that the instrument was reliable to elicit data for the study. Two hundred and ninety copies of the questionnaire were administered on the respondents with the help of three research assistants which facilitated 100% retrieval of the questionnaire. The data collected were analyzed using percentage to answer research question 1 and mean and standard deviation was used to answer research questions 2 to 5. The results revealed that majority of the farmers were not aware and have no knowledge of climate change but have been experiencing the impact of climate change as it affected their agricultural production. The study also showed that the impact of climate change has also affected the education of the families of the farmers. The farmers adapted only the few mitigation strategies they know. The study recommended, among others, that State and Federal Governments should organize seminars and workshops for farmers and for the extension agents also who can educate the farmers in the rural areas to improve their level of awareness and knowledge on climate change in Taraba State, Nigeria.

Keywords: *Climate change, Agriculture, Farmers, Impact, Mitigation strategies*

Corresponding Author: Jifin D. Tsojon

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Background to the Study

Climate is the average weather condition of a place over a long period of time. It refers to the regular pattern of weather condition of a particular place for about 40 years (Obiora and Madukwe, 2011). Climate is not static, that is, it changes with time. This usually results in a clear and permanent impact on the ecosystem. These elements of climate change have been affecting agricultural production of farmers. The variability of these elements of climate constitutes climate change. International Panel for Climate Change (IPCC) (2007) and Adebayo (2011) posits that climate change refers to statistically significant variation in either mean state of climate or in its variability, persisting for an extended period which could be in decades or more. Adebayo added that climate change involves a shift of climatic condition to a new equilibrium position with values of climatic elements changing significantly. In this study, Climate change is the variation of elements of climate such as rainfall, temperature, and wind among others that change significantly over decades affecting agricultural production by farmers. Climate change is also the distinct change in measures of climate such as temperature, rainfall, snow or wind patterns lasting for decades or longer (US Environmental protection agency, USEPA, 2009). The report added that in the last decades, there has been a clear consensus among scientists that the World is experiencing a rapid global climate change, much of it attributed to anthropogenic activities. The extent of climate change effects, for example, future temperature increase, is difficult to project with certainty, as scientific knowledge of the processes is incomplete and the socio-economic factors that will influence the magnitude of such increases are difficult to predict.

Climatic change has also been found to occur due to natural variability or as a result of human activities. This means that there are both natural and human factors causing climate change (Adebayo, 2011; Farauta & Apagu, 2011). The natural factor includes terrestrial causes such as the alternation in the orientation of the earth, extra terrestrial causes, such as in solar activities (variability), planetary motion, cloud formation and albedo, Bio-thermostat and ocean current (Bast, 2010). The human causes include the emission of green house gases (GHGs) and aerosols changes in land use and depletion of the ozone layer through various human activities such as industrialization and agriculture and land clearance (Adebayo, 2011). These activities of man induce global warning which is the visible evidence of climate change. Scientists reported that the human induced global warming is caused by increase in green house gas (GHG) emission, particularly carbon dioxide (CO_2) (IPCC, 2001 and FAO, 2008).

Climate change is occurring at an alarming rate and predictions of its impacts have been well reported. Musa and Omokore (2011) submitted that the International Fund for Agricultural Development (IFAD) has reported that about 49 million more people will be at risk of hunger by 2020 and 132 million by 2050 due to climate change; yields from rain fed agriculture may possibly be reduced by up to 50% by 2020 in a number of countries, and between 15% and 37% of land, plants and animal species could become extinct by 2050 as a result of climate change. IFAD (2008) affirms that climate change poses considerable threat to rural farmers and their communities in developing countries, especially those living in the tropics and sub-tropics. Climate change has challenged the poverty reduction

efforts of governments of most countries, with its impacts falling more heavily on the poor than the rich (Skoufias, 2012). The direct impacts of climate variables such as air, temperature, humidity, wind speed and other climate factors influence animal performance such as growth, milk production, wool production and reproduction. Climate change can also affect the quantity and quality of feed stuffs such as pasture, forage and grain and also the severity and distribution of livestock diseases and parasite in agricultural sector (Ayinde, Muchie & Olatunji, 2011). Climate change indices such as flood, drought, soil erosion, high temperature, shortage of water, wind storm, frequent fires, sea rise can also affect the population of farmers through impacts on the necessity and comfort of life such as water, energy, housing, transportation, food, natural ecosystems and health systems (Lal, Alavalapati, & Mercer, 2011).

Agriculture, for decades, has been associated with the production of basic food crops and animals. At present, agriculture in Nigeria and in particular Taraba State, besides farming includes forestry, fruit cultivation, diary, poultry, mushroom, beekeeping and marketing, processing, distribution of agricultural products. The following highlights the importance of agriculture of a nation:

i. provide adequate food for the nation's population,
ii. supplying adequate raw materials to the nation's growing industrial sector,
iii. constituting the major source of employment,
iv. providing market for the product of the industrial sector,
v. contributing to the nation's Gross Domestic Product (GDP),
vi. source of foreign exchange earnings

Statement of the Problem

The change in climate over the years has been having lots of impacts on the communities of the various nations of the world. Nigeria has been having her share of the impacts of climate change. These impacts are felt by the farmers of Nigeria and Taraba State in particular. Climate change is known to be having impacts on agriculture thereby having effects on agricultural production by the farmers. The main trust is to determine the impact of climate change on agricultural production by farmers in Taraba State, Nigeria. The question is how have farmers been coping with the impacts of the climate change all these years? When the answer to this question is found, communities will not drift away from their locations for other places. When the farmers are allowed to move away from their various locations due to the impacts of climate change, the consequence will be communities or households drift from one place to another. This will result in hunger, poor health and poor wellbeing of the farmers' households (Maginness & Stephens 2008 and Lal, Alavalapati & Mercer, 2011).

Other results of rural-urban shift due to detrimental climate change effects include stresses and disturbances such as increased land use change, pollution, wildfire and invasive species (U.S. Global change research programme (USGCRP) 2009). As these shifts continue there will be high pressure on the social amenities in the newly found home, urban area (Rumble, Tubb & Acher, 2008), hence the need for the study to investigate the impact of climate change on agricultural production by farmers in Taraba State, Nigeria.

Purpose of the Study

The purpose of this study is to determine the impact of climate change on agricultural production by farmers in Taraba State, Nigeria. The specific objectives of the study were to:

(i) Ascertain the socio-economic status of farmers in Taraba State, Nigeria.
(ii) Examine the awareness and knowledge of climate change of farmers in Taraba State, Nigeria.
(iii) Identify the impact of climate change on agricultural production by farmers in Taraba State, Nigeria.
(iv) Investigate the adaption of mitigation strategies by farmers on the impact of climate change in Taraba State, Nigeria.
(v) Examine the impact of climate change on farmers' education in Taraba State, Nigeria.

Research Questions

The following research questions guided the study:

(i) What is the socio-economic status of farmers in Taraba State, Nigeria?
(ii) What is the awareness and knowledge level of climate change by farmers in Taraba State, Nigeria?
(iii) What is the impact of climate change on agricultural production by farmers in Taraba State, Nigeria?
(iv) How are farmers adapting the mitigation strategies of impact of climate change in Taraba State, Nigeria?
(v) What is the impact of climate change on the farmers' education in Taraba State, Nigeria?

Methodology

This study adopted a survey research design. The research gathered data from large number respondents. The purpose was to gather information about variables from a representative sample of the population. Its scope is concerned with the practices that prevail, conditions or relationship that exist, belief or points of view, processes that are going on, influences that are being felt and trends that are developing (Denga & Ali, 1998; Uzoagulu,1998; Yalams & Ndomi, 2000 and Emaikwu, 2011).

Data was collected from sampled farmers in Taraba State, Nigeria for the study. Taraba State is located in Northeast Nigeria one of the six geopolitical zones of Nigeria. Northeast Nigeria lies between latitude 8°00' and 12° 00' N of the equator and the longitude 10° 30' and 11° 30' E. The average annual rainfall of the zone ranges between 600mm in the dry months and 1300mm in the wet months. The temperature of Northeast zone ranges between 13° C and 38° C while the vegetation ranges from low forest in Taraba State to Sudan savannah and dry savannah in Yobe State. This description justifies the choice of the Taraba State based on homogeneity in climate, agriculture, vegetation, rainfall, population, education, etc (Emaikwu, 2011).

The population of the study consisted of all the farmers in Taraba State, Nigeria. The farmers' households in communities in Taraba State, Nigeria form the population of the study because of their agrarian characteristics and provided accurate and reliable information for the study. The sample for the study was 290 farmers in Taraba State, Nigeria. The sample is the proportion of the population of farmers in Taraba State Nigeria that was selected for the study to make inferences about the population. To avoid biases respondents were randomly selected in the multi-stage technique to give every farmer equal and independent chances of being selected for the study.

The study employed the multi-stage random sampling technique to draw sample for the study. Multi-stage sampling technique involves sampling in stages to obtain the required sample size from a very large population for the study. A multi-stage sampling technique is a technique where sample is drawn in stages from a population. Depending on the necessity, there may be three, four or more stages. (Emaikwu, 2011; Idowu, Banwo & Akerele, 2011 and Asogwa, Umeh & Okwoche, 2012). The stages could take the form of some randomly or purposively selected states in the first stage, some LGAs selected in these States, which is the second stage. The third stage could be some political constituencies from these LGAs and finally some wards also randomly selected from which the respondents are finally drawn either randomly or purposively.

This study was conducted in Taraba State of Nigeria. Seven (7) LGAs were randomly selected from the sixteen LGAs of Taraba State, which was the first stage. In the second stage 22 extension blocks were purposively selected from these seven LGAs and in the third stage 290 farmers were randomly selected from these extension blocks to form the sample for the study. Based on the foregoing, 290 farmers served as sample for the study. The instrument that was used for data collection was a structured questionnaire named; climate change and agricultural production questionnaire (CCAPQ). The instrument was developed by the researcher based on the relevant literature reviewed. The instrument was a structured questionnaire on a 4-point rating scale of strongly agree (SA), agree (A), disagree (D) and strongly disagree (SD). Values assigned to them were: SA = 4, A = 3, D = 2 and SD = 1.The mean of these values were used for analysis. That is, (4+3+2+1)/4 = 10/4 =2.50. The questionnaire was divided into five sections. This was based on the specific objectives which sought for responses that addressed each of the specific objectives of the study.

The instrument (questionnaire) that was used to elicit data for the study was subjected to both face and content validity. The instrument was submitted to a panel of three experts to vet the items in the instrument for clarity, relevance and suitability for collecting data for the study. The comments of the panel of experts were used to improve the quality of the instrument prior to pilot testing, thereby strengthening the study (Yalams & Ndomi, 2000 & Emaikwu, 2011).

The reliability of the instrument (CCAPQ) was determined by trial testing outside the study area. The result of trial testing yielded a reliability of 0.89, indicating that the instrument was reliable for eliciting data for the study. The questionnaire was

administered on the respondents (farmers) in the area of the study by the researcher with the help of three research assistants in the state. The sampled farmers were reached through personal contact which facilitated 100% retrieval of the questionnaire. A total of 290 copies of the questionnaire were administered on the sampled respondents in the study area. The analysis of data for answering the research question 1 was frequency and percentage while for research questions 2-5 was the descriptive statistics, mean and standard deviation. The decision to agree or disagree was that any questionnaire item with a mean value of 2.50 to 4.00 was considered agree while those items with mean value less than 2.50 was considered disagree. The standard deviation was used to describe the dispersion or closeness of the item to the mean and to each other.

Results

The results of the study were presented in the tables below.

Table 1: Socio-economic characteristic of farmers

What is the Socio-economic characteristic of Farmers?	Frequency	%
Educational level		
No formal Education	151	52.0
Secondary School	111	38.3
Tertiary education	28	9.7
Location		
Rural	246	84.8
Urban	44	15.2
Farming experience		
1-10 years	31	10.7
11-20 years	107	36.9
21-30years	129	44.5
> 30 years	23	7.9
Farm size		
< 1ha	186	64.2
1-3ha	67	23.1
4-6ha	23	7.9
> 6ha	14	4.8
Source of income		
Personal	181	62.4
Family friends	63	21.7
Cooperatives	27	9.3
Bank	19	6.6
Income per annum (₦) from agric. Prod.		
< 20,000	30	10.4
20,000-40,000	55	19.0
41,000-60,000	121	41.7
61,000-100,000	63	21.7
> 100,000	21	7.2

Table 1 revealed that majority (52%) of the farmers had no formal education implying that most of the respondents are illiterate. Most the farmers (84.8%) are rural dwellers with 44.5% of them having between 21-30 years of farming experience. Majority of the farmers

(64.2%) of the respondents had less than one hectare (1ha) of farm land for their agricultural activities. Their sources of income for farming activities was through personal effort (62.2%) while 41.7% of them earn between 41,000 – 60000 per annum from their agricultural activities.

Table 2: Awareness and Knowledge of Climate Change by Farmers

S/N	How do you agree to the awareness & knowledge of climate change?	$\bar{x}$	SD	Remark
1.	I am aware of climate change.	2.12	0.46	Disagree
2.	I have knowledge in climate change.	1.81	0.78	Disagree
3.	Climate change causes erratic rainfall pattern.	2.31	0.71	Disagree
4.	It causes high rate of weeds.	3.11	0.78	Agree
5.	It causes draught.	3.17	0.75	Agree
6.	It decreases soil moisture.	3.22	0.82	Agree
7.	It decreases crop yields.	3.06	0.88	Agree
8.	Climate change causes high rate of pests and disease incidence.	2.01	0.73	Disagree
9.	It causes rise in temperature.	1.91	0.96	Disagree
10.	It causes flooding of farmland.	1.82	0.92	Disagree
11.	It causes soil erosion.	1.29	1.06	Disagree
12.	Climate change causes heavy winds.	1.97	1.02	Disagree

Data from Table 2 showed that 5 items were rated agree with mean rating between 3.06 and 3.22 while the remaining 8 items were rated disagree with mean rating ranging from 1.29 to 2.31 below the cutoff point of 2.50. This implies that majority of the respondents were not aware and have no knowledge of climate change.

Table 3: Impacts of Climate Change on Agricultural production

S/N	How do you agree to these impacts of climate change on Agricultural production?	$\bar{x}$	SD	Remark
1.	Changes in Agricultural pattern.	3.51	0.65	Agree
2.	Pests infestation of crops.	3.42	0.65	Agree
3.	Choking of crops by weeds.	2.89	0.93	Agree
4.	Crop failure and poor harvest.	3.19	0.79	Agree
5.	Farmers incur more costs on Agricultural activities.	3.16	0.87	Agree
6.	Drying up and rotting of farm produce.	3.00	0.99	Agree
7.	Delays planting dates which affect yields.	3.33	0.76	Agree
8.	Animal growth, reproduction, and milk production are negatively affected.	2.97	1.07	Agree
9.	Pasture, forage and other animal feeds are negatively affected.	3.00	0.89	Agree
10.	Diseases and parasites spread quickly.	3.22	0.72	Agree
11.	Reduces animal rate of eating and grazing.	3.10	1.07	Agree
12.	Increases animal mortality.	3.00	0.77	Agree
13.	Reduction in livestock quality and quantity.	3.05	1.05	Agree
14.	Reduction in fish harvest.	3.02	1.00	Agree
15.	Displacement of farmers.	3.23	0.81	Agree

Table 3 revealed that all the 15 items were rated agree by the respondents with mean rating between 2.87 and 3.35 above 2.50 cutoff point. The implication is that the respondents have been experiencing these impacts of climate change in their agricultural production.

Table 4: Adaption of Mitigation strategies of Impact of Climate Change by farmers

S/N	How do you agree to this Adaption of mitigation strategies of impact of climate change?	$\bar{x}$	SD	Remark
1.	Migration of farming family	3.16	0.98	Agree
2.	Rain harvest.	2.22	0.82	Disagree
3.	Cultivation of different types of crops and wild plants.	1.88	0.82	Disagree
4.	Integration of livestock farming system.	3.22	0.76	Agree
5.	Switching crop varieties (Crop rotation).	3.41	0.64	Agree
6.	Changing crop varieties (Fast maturing).	3.41	0.67	Agree
7.	Changing planting dates.	2.32	0.60	Disagree
8.	Mulching.	3.14	0.88	Agree
9.	Irrigation.	3.32	0.75	Agree
10.	Planting draught tolerant crops.	3.41	0.61	Agree
11.	Intercropping practices.	3.08	0.72	Agree
12.	Zero tillage practice.	2.89	0.92	Agree
13.	Use of different means of livelihood.	2.81	1.02	Agree

Data in Table 4 showed that 3 of the items were rated disagree with mean rating from 1.88 to 2.32 below 2.50 while the remaining 10 items were rated 2.81 to 3.41 above the cutoff point of 2.50. This implies that most of the farmers adapted the mitigation strategies without necessarily being aware and having knowledge of climate change.

Table 5: Impacts of Climate Change on Farmers' education

S/N	How do you agree to these impacts of climate change on farmers' education?	$\bar{x}$	SD	Remark
1.	Farmers loose time for schooling as they trek long distance in search of water.	3.62	0.63	Agree
2.	Children drop out of school as a result of food scarcity as they cannot go to school with empty stomach.	3.38	0.72	Agree
3.	Children who go to school do not learn well as they might be hungry.	3.54	0.56	Agree
4.	Famers migrations make children loose education right.	3.43	0.73	Agree
5.	Children are taken out of school to work to raise income for the farming family.	3.19	0.92	Agree
6.	Flooding, collapse of houses, roads, bridges prevent children the right to education.	3.19	0.78	Agree
7.	Schools used as houses for victims of such disasters remain closed for learning for the length of time the victims are in the school.	3.24	0.64	Agree
8.	Water borne diseases, increase temperature, air pollution and poor food quality results in sick farmers' households' thus poor school attendance.	3.49	0.78	Agree

Table 5 revealed that all the 8 items were rated agree by the respondents with mean rating between 3.19 and 3.62 above the cutoff point of 2.50. The implication is that climate change has been having negative impact on the education of the respondents' household.

Discussion

In table 1, it was found from the study that most of the respondents do not have education above the secondary school level and are found mostly in the rural areas of Taraba State. This means that most of the respondents are not well educated and are domicile in non urban areas of the state. This implies that the farmers may not be aware and knowledgeable of climate change. The farming experiences of the respondents range from 11 to 30 years of practical farming. The farm size of the respondents is between less than 1ha to 3ha. The years of experience and farm size of the farmers have shown high likelihood of the impact of climate change than those with less experience. The farmers responded that their sources of income for farming were from personal efforts (62.4%) and family friends (21.7%) with annual income from farming activities between 41,000 to 100,000. The implication is that majority of the farmers do not have adequate sources of raising resources for their farming activities with annual income of not more than 100,000 per annum.

The result on Table 2 revealed that the farmers were neither aware nor knowledgeable on 8 items listed but had some level of awareness and knowledge on the remaining 4 items presented. Some of the items that the farmers were not aware and had knowledge include; I am aware of climate change, I have knowledge on climate change, Climate change causes erratic rainfall patter, It causes rise in temperature, It causes soil erosion among others. This study is in consonance with the finding of Rosegrant, Ewing, Yohe, Burton Huq and Valmonte-Santos (2008) who maintained that climate change brings about seasonal changes in rainfall and temperature which impact on agro-climatic conditions, altering growing seasons, pests, weeds and disease population.

In Table 3, it showed that the respondents were experiencing the impact of climate change as it was seen in their agricultural production. The farmers experienced changes in agricultural pattern, pests' infestations on their crops, crop failure and poor harvest, high cost of agricultural activities, slow annual growth, reproduction and milk production, reduced animal rate of eating and grazing, reduction in fish harvest among others. The study is in agreement with those of International Institute for Sustainable Development (2000), Kean, Page, Kergna and Kennan (2009) Ladan (2014) who found that climate change brings about poor yield in agriculture, flooding affecting crop production, increase of disease and pests population.

The result on Table 4 revealed that farmers adapted some strategies they know in mitigating climate change based on their level of awareness. The strategies the respondents adapted include migration of farming families, integration of livestock farming system, switching crop varieties (crop rotation), changing crop varieties (fast maturing varieties), irrigation, zero tillage among others. This study is supported by the researches of Kurnkulasuriya and Rosenthal (2003), Enate (2014) Saul (2015) who indicated in their findings that farmers adapted the following strategies in mitigating the impact of climate change: choice of crop varieties, change in planting date, irrigation, crop research, change in tillage practices, migration of farming families, among others.

In Table 5, it was found that climate change affected the education of the farmers' family. The impact of climate change on the education of the respondents' family include: loose of time for schooling as they trek long distances in search of water, children drop out of school as a result of food scarcity as they cannot go to school with empty stomach, farmers migrations make children loose education right, schools used as houses for victims of climate change disasters remain closed for learning for the length of time the victims are in the school among others. This study is in agreement with the finding of Adowu, Ayoola, Opele and Ikenwe (2011), Ladan (2014) and Saul (2015) who found that the education of farmers' families were affected by the impact of climate change in the following ways: children could not learn properly because they go to schools on empty stomach, the schools were taken over by the victims of disaster (flooding) as result of climate change.

Conclusion and Recommendations

The study provided explicit insight on the impact of climate change on agricultural production by farmers in Taraba State, Nigeria. The study revealed that farmers in Taraba State were experiencing the impact of climate change on their agricultural production. The findings showed that climate change had impact on socio-economic characteristics of the farmers, level of awareness and knowledge of climate change, agricultural production and the education of the farmers' families negatively. It was recommended that:

1. The Government of Taraba State and indeed Nigeria should improve on the socio-economic characteristics of farmers to enable them combat the impact of climate change on agricultural production to improve on food security of the nation, Nigeria.
2. The Government should organized on regular bases conferences, seminars and workshops for farmers in Taraba State to raise the level of awareness and knowledge of farmers on the impact of climate change.
3. Training and re-training of extension agents should be carried out on regular bases to equip the farmers with the knowledge of climate change so that they can transfer same to the rural farmers whom they are always in contact with to improve the farmers' agricultural production.

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