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Analysis of Climate Impacts on Crop Production In Savannah Region of Nigeria

Osabo¹ P., D. Bello¹, A. O. Agwale¹, D. B. Zaknayiba¹, D. P. Sunday²

1.Department of Agricultural Extension and management Nasarawa State College of Agriculture, Lafia.

2.Department of Geography Nasarawa State College of Education, Akwanga.

Abstract

Climate change is a major threat to food production in many regions of the developing world which largely depend on rainfed and labour intensive agricultural production. A lot of studies on climate change and agriculture in Africa and Nigeria have tended to concentrate on mitigation and adaptation of climate change with little efforts in the area of challenges of education on awareness, causes and impacts of climate change especially in the savannah region of Nigeria where the bulk of the food consumed is produced. Two hundred and forty farmers were sampled within two states of Nasarawa and Benue of Nigeria on their awareness, causes and impacts of climate change on crop production. Descriptive and inferential statistical methods were used to analyse the results. The results of the finding revealed that only 20% of the farmers actually have knowledge of climate change, which are mostly based on their sensual awareness of abnormal changing in rainfall pattern, prolonged drought and increased in the level of heat and the effects they have on crop production; and majority of them considered act of God as the major cause of the changing in climate as against scientific factors researchers have observed over the years of human activities of industrialization, urbanization, transportation and agriculture. And the *t*-value results of the findings from the two states are statically the same. This shows that majority of the farmers have very poor knowledge of the subject matter of the awareness, causes, impacts and remedial measures of climate change. The researchers are of the opinion that vigorous public enlightenment campaign from both the government and NGOs to educate the farmers on the awareness, causes, impacts and adaptation option of climate change should be embarked upon to reduce the impacts on crop production in order to sustain food production of the country.

Keyword: Climate change, awareness, impacts, crop production

Introduction

Climate change which referred to long term shift in climate pattern of a specific location, region or planet measurably by changes in features associated with average weather components of temperature, wind patterns and precipitations (Warrick and Barrow, 1991) is a threat to food production in many regions of the developing world which is largely depended on rain fed and labour intensive agricultural production. This is because climate change could lead to reduce soil moisture due to reduced rainfall and shortened growing season, high rate of vector-borne disease due to increasing temperatures, frequent occurrence of weather extremes inform of floods and droughts with their attendant consequences (Umar,2012).Change in climate directly affects agricultural production as agriculture is inherently sensitive to climate conditions of temperature and rainfall.

Available evidences showed that climate change is global, likewise its effects, but the scientific opinion is that countries in the temperate, high and mid-latitude regions are generally likely to enjoy increased agricultural production, whereas countries in tropical and sub tropical regions are likely to suffer agricultural losses as a result of climate change.(Amell.*et al* 2002,Deveruex and Edwards,2004).

The favourable assessment for temperate high latitude regions is based primary on analysis of changes in mean temperature and rainfall. The unfavourable impacts of the developing countries especially those in Africa (Nigeria inclusive) is due to their low level of coping capabilities (Nwafor,2007,Jagtap,2007,Odjugo 2012) due to poverty and low technological development.

Climate change evidence in Nigeria was predicted by intergovernmental panel on climate change (2001) and confirmed by Odjugo (2010) who provided some revealing indicators of climate change of the rising in temperature, which he stated that it is significantly higher than the global mean. Fasona and Omojola (2005) also provided another compelling evidence of the spatial perspective of climate change over Nigeria Landscape which shows that there has been significant reduction in the rainfall. Furthermore, the statistics generated indicated that climate change induced drought and flood have caused significant land degradation in Nigeria. In the works of Odjugo,(2010) and Uguru, (2011) it was evident that since 1901 the temperature trend in Nigeria shows a warmer temperature, fluctuating rainfall distribution pattern and reduced relative humidity. The increase in temperature was gradual until between late 1960s and early 1970s when a sharp rise in air temperature was recorded. Since this period, the increasing trend in the air temperature has been continuous and technically beyond the control of the farmers. On the other hand, the rainfall pattern in Nigeria between 1901 and 2005 reveals a paradigm shift in pattern(onset, cessation, distribution and amount) in the last few decades.

Babatunde,*et al* (2011) in a four year project called building Nigeria's response to climate change (BNRCC) found that the main changes in climate parameters in the savannah region of Nigeria are late onset and early cessation of rainfall and rising temperatures. The implication of these in a region of low rainfall means the farmers would be facing increasing risks during the planting season with reduction in crop yields due to inadequate rains as well as changing implication in the choice of crop to be planted, the date of planting, harvest and post harvest treatment.

With all these available impacts and evidences of climate change in Nigeria, Illiya *et al* (2012) stated that its' full impacts are yet to be fully manifested; which implies that there is the need to explore futuristic consequences of climate change to facilitates the mapping out of appropriate mitigation strategies especially in Nigeria in view of the recent global food crisis and the need to increase and sustain food production to meet

the 2015 target of the Millennium Development Goals (MDGS) of fighting hunger and poverty.

Nasarawa and Benue states popularly known as food Basket of Nigeria, because the highest food production of the country is recorded in these two states. Despite the fact that climate change is attracting serious attention from the academics, media and politicians due to its degree of negative impacts especially in developing nation like Nigeria, yet little research has been focused in the study area where the bulk of the food consumed in the country is produced. Most studies on climate change and agriculture in Africa and Nigeria have tended to concentrate on mitigation and adaptation (Adejuwon 2006, Stige 2006, FAO,2007, Ajetomobi *et al.*,2010).There have been little or no work in the area of challenges of education, awareness, impacts and remedial measures of climate change especially in the study area. This paper therefore is intended to address these aspects, more so, that Rukevwe,(2008) as reported by Odjugo (2012) that much emphasis has been devoted to the science of climate change but the education of the people on the causes and impacts is lacking. Pam,(2007) also reveals that while the concept of climate change is fully known to majority of those in the atmospheric science, it might not be so for many educated individuals in other disciplines and uneducated ones.

Methodology

The Study Area.

The study area has a central location in the middle belt region of Nigeria. Lies roughly

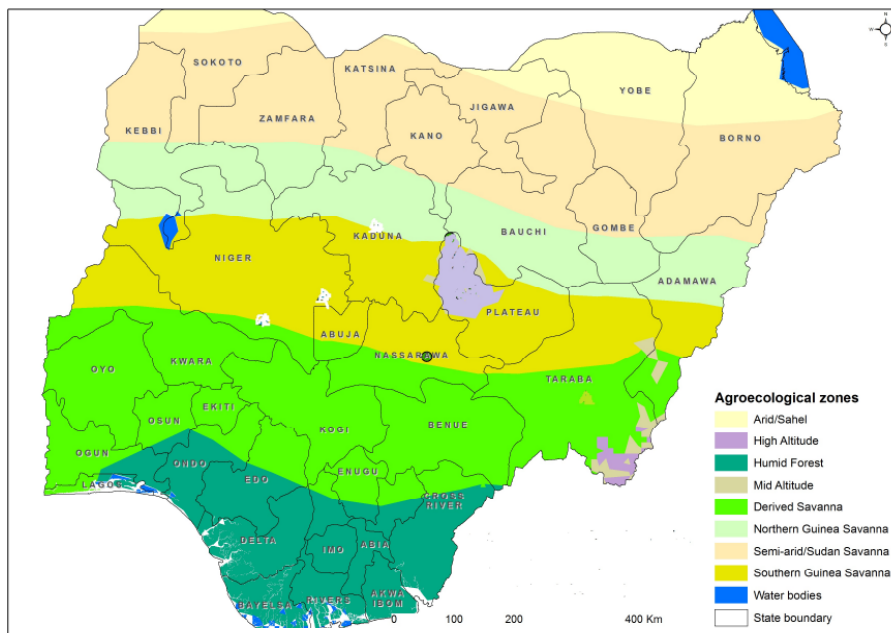


Fig 1. Map of Nigeria showing savanna region

between latitude 6° to 8° North of the equator and longitude 6° to 10° East of Greenwich meridian, Benue state (BSN Gizatte 1992) and latitude 7° to 9° North of Equator and longitude 7° to 9° East of Greenwich meridian,

Nasarawa State (Marcus *et al*,2007)

The area of study is found within the tropical sub-humid climate belt, with a marked seasonal variation in rainfall and temperature distribution. Dry season as from November to March and rainy season from April to October with mean annual rainfall range of 110 to about 2000mm (Rahman,2007).Temperatures are generally high during the day, particularly between the months of March to April. The mean monthly temperature in the region range between 20 to 40^oc in most of towns within the states. The vegetation type of the study area is largely characterised of southern Guinea savannah and some elements of Northern guinea savannah (Fig1).

Agriculture is the main source of livelihood of the inhabitants and they produce varieties of cash such as yam, maize, beniseed (sesame) melon and cassava.

Sampling Technique

The study adapted a multistage sampling technique due to complexity of the population distribution of the respondents which requires more than one sampling technique to select the required sample. The first stage involved purposive selection of two local Government areas (LGA) that are known for active participation in crop production from each of the two states from the list of LGAs in the states. The two LGAs selected in Nasarawa State were Doma and Akwanga ,Guma and Ohimini LGAs from Benue State . Two farming communities were chosen from each of the LGAs selected. Finally, thrity (30) farmers were selected from the list of farmers in each farming community which were obtained from the extension agents working in those communities, hence a total sample size of two hundred and forty farmers were selected for the study.

Structural and validated questionnaire was used to generate the data. The information gathered include the socio economic characteristics of the respondents, awareness level of the respondents about climate change, causes, effects and adaptation measures of the farmers. The data were collected with the help of field assistance which were recruited and trained by the researchers.

Data analysis technique

Descriptive and inferential statistical methods of data analysis were used to analyse the data collected

Descriptive method used were percentage and means while inferential method used was 4 point rating scales of very much, much ,not much and not at all.

The means of the rating scale data were analysed thus, $\text{mean} = \frac{\text{VM} \times 4 + \text{M} \times 3 + \text{NM} \times 2 + \text{NA} \times 1}{\text{total number of questionnaire administered}}$

<u>Response categories</u>	<u>Ordinal values</u>	<u>Real limit values</u>
Very much (VM)	=4	3.50-4.00
Much (M)	=3	2.50-3.49
Not much (NM)	=2	1.50-2.49
No at all (NA)	=1	1.00-1.49

t-value was used to test the difference between the two means.

The results were further presented in tables, followed by detailed discussion.

Results and Discussion

It was observed that the socio-economic characteristics of the respondents' of age distribution, educational status, year of farming experience and length of stay in the study area have influence on their views about discussion of climate change phenomenon which requires longer living period within a particular place.

Table 1: Socio-economic characteristics of the respondents

<i>Gender of household heads</i>	Frequency	Percentage (%)
Male	178	74.17
Female	62	25.83
Total	240	100
<i>Educational status</i>		
Tertiary institutions	16	6.67
Secondary school education	48	20.00
Primary school education	112	46.67
No formal education	64	26.66
Total	240	100
<i>Years in farming</i>		
0-10	14	5.83
11-20	23	9.58
21-30	28	11.67
31-49	130	54.17
40-50	39	16.25
Above 50	06	2.50
Total	240	100
<i>Length of stayed (years)</i>		
Above 50	11	4.58
40-49	71	29.58
30-39	128	53.33
20-29	26	10.83
Below 20	04	1.67

Source: field survey 2014

Thirty four percent (34%) of the respondents were between the ages of 31-40 years, 48% were between 41 to 50 years and 10% of them were above 50 years of age. This shows that the respondents had reliable age to appreciate changing in the weather condition. The educational status of the respondents in the table shows that 73% of them are literate to some extent to provide answers to issues related to climate change, the table also further revealed that about 85% and 81% of the respondents have stayed in the study area and had farming experience for over 30 years, which were enough period of time and experience to provide some information about changing in weather and climate conditions of an area.

Table 2: Awareness level of the respondents on climate change

Level of awareness	NS	%	BN	%	X%	t-value
High	7	5.83	6	5.00	5.42	0.59
Moderate	19	15.85	15	12.50	14.17	2.36
Low	44	36.67	48	40.00	38.34	-8.01
No	50	41.67	51	42.50	42.09	-6.60
Total	120	100	120	100		

***p<0.05 Source: field survey 2014 NS=Nasarawa State ; BN = Benue State

The respondents were asked to state their awareness level of climate change. As presented in Table 2, an average of about 80% of the respondents indicated that they have low (38%) and No (42%) knowledge of climate change. The response of the respondents concurred with the work of Odjugo (2012) which discovered that only 22% of the respondents in Nigeria have much knowledge of climate change and only 9% of them are from rural areas, which he concluded that information on climate change in the grassroots or rural areas is poor. He further stated that it is not good for Nigeria's economy as the rural areas holds the agricultural strength of the country.

Those who are aware of climate change were asked to indicate their sources of information about climate change, majority of them (96.67%) got to know of change in climate mainly through their personal observation, followed by Radio (82%), extension agents (74%) farmers' cooperatives and television. This revelation shows the important of these channels of communication in information dissemination, hence should be patronized in passing information about climate change to farmers.

When asked, what were their perceived causes of climate change.73% of them attributed the change in climate to the Act of God and only few of them mentioned those factors researchers have observed over the years about the global causes of climate change as indicated in the work of Odjugo (2012) of industrialisation, urbanization, transportation and agriculture that release greenhouse gases into

atmosphere. The perception of the respondents about the causes of Climate change is clearly an indication of their poor knowledge of climate change. To further confirm the respondents' level of awareness about climate change, the respondents were asked to indicate their indices of climate change.

Table 3: Perceived indices of climate change awareness among farmers

Perceived indices	NS	%	BN	%	X	t-value
Decrease rainfall amount	61	50.8	5.8	48.3	49.6	4.74***
Unpredictable rainfall	98	81.7	82	68.3	75	9.48***
Changes in rainfall pattern	107	89.2	112	93.3	91.3	-2.90***
Increase in temperature (heat)	99	82.5	109	90.8	86.6	-5.87***
Delay in arrival	101	84.2	114	95.0	89.6	-4.67***
Changes in harmattan conditions	54	45.0	66	55.0	50	-7.07***
Decrease in icefall during rainfall	51	42.5	43	35.8	39.2	4.74***
Unusual heavy rainfall	40	33.3	51	42.5	37.9	-6.51***
Prolonged drought	43	35.8	71	59.2	47.5	-16.55***
Drying ponds/streams	12	10	21	17.5	13.8	-5.30***
Increase in post harvest waste	10	8.3	31	25.8	17.1	-12.37***
Increase flooding/erosion	67	55.8	44	36.7	46.3	13.51***

***P<0.05 Source: Field survey 2014 **Multiple responses were allowed

Table 3 showed perceived indices of change in climate among farmers. Prominent among the indices stated were changing in rainfall pattern, delay in arrival, unpredictable and decreased in rainfall amount. Increase in temperature and changes in harmattan conditions were also stated which culminated into prolonged drought, increased in flooding/erosion and also decreased in icefall during rainfall and drying ponds and streams due to increased in temperature. Even though Odjugo (2012) observed that Nigerian understanding about climate change is actually poor, since majority of them can not say what Climate Change actually means, and that their understanding is limited to their sensual awareness of abnormal increase in the level of heat and the effects it has on farm yields in rain-fed agricultural economy, the indices of climate change stated by the respondents are in line with other researchers in Nigeria who revealed that temperature is increasing with frequency and intensity of unusual and extreme weather event such as erratic rainfall pattern, floods and drought (Molega;2006. Umoh, 2007, Odjugo 2010, Uguru, 2011).

Impact of Climate Change On Crop Production

Viewing the high level of vulnerability of Nigeria farmers' to the effect of climate change as observed by earlier researchers (Ayinde,2010) where funding to agricultural

research has been comparatively low (Nigeria,s House Committee on Agriculture,2005) the current spread of agricultural information and training are poorest(Enete and Amusa, 2011) and where domestic economics depend heavily on rain-fed agriculture (Apata,2008) and available literature which suggest that climate change is already having significant negative impacts in Nigeria and these impacts are expected to increase in the future .The farmers in the study areas were asked to state the intensity of the indices of climate change on their crop production using four point rate scales of very much, much, not much and not at all.

Table 4: perceived intensity impact of climate change by the respondents

Perceived impact	Intensity		X	T value	
	NS	BN			
Decrease rainfall amount	2.81	2.73	2.77	0.57	**
Unusual heavy rainfall	2.77	2.62	2.70	0.11	**
Unexpected rainfall	2.44	2.60	2.52	-0.11	**
Changes in rainfall pattern	3.79	3.84	3.82	-0.04	***
Increased cases of flooding	3.00	2.42	2.71	0.41	**
Decreased soil moisture	2.62	2.71	2.67	-0.06	**
Prolonged drought	3.40	3.87	3.54	-0.20	***
High temperature and heat	3.20	3.87	3.54	-0.47	***
Heavy winds	2.11	2.25	2.18	-0.10	*
Increase in pests and diseases problem	2.51	2.73	2.62	-0.16	**
Extinction of some crop species	2.49	2.63	2.56	-0.10	**
Reduction in crop yield	2.51	2.56	2.54	-0.04	**
Poor quality of storage of farm produces as a result of heat	2.42	2.67	2.55	-0.18	**
Increasing drying up of seedling after germination	2.52	2.72	2.62	-0.14	**
Heat stress on crops leading to burning	2.99	3.41	3.20	-0.30	**
Increased soil erosion resulting from unusual heavy rain	3.10	2.94	3.02	0.11	**
Stunted growth of crops	2.14	1.53	1.88	0.43	*
Increased health problems	2.00	2.41	2.21	-0.29	*

Very much *** Much ** Not much*

Table 4 presented some perceived intensity of the impacts of climate change on crop production from the perception of farmers in the study area.

Three (3) out of the eighteen (18) identified impacts of climate change on crop production had mean values that fell within 3.50-4.00. These are changes in rainfall pattern (3.82) prolonged drought (3.54) and high temperature (3.54) on a 4- point rating scale. This implies that these three effects of climate change were perceived as having very serious impact on crop production in the study area.

The result in the table showed further that twelve (12) out of the eighteen (18) identified impact of climate change on crop production had mean values that range between 2.52-3.20 which fell within the real limit of number 2.50-3.49 indicating that the twelve impacts are already having serious impact on crop production in the area

These variables with their corresponding mean values on a 4-point rating scale include. Heat stress on crop (3.40) increase soil erosion (3.02) decrease rainfall amount (2.77) increase cases of flooding (2.71) unusual heavy rainfall (2.70) decreased soil moisture (2.67) increased in pest and disease (2.62) drying of seedlings (2.62) extinction of some crop species (2.56) poor quality of storage (2.55) reduced yield (2.54) unexpected rainfall (2.52)

Results presented in Table4 also showed that, the remaining (03) identified impacts of climate change on crop production had mean values that ranged between 1.88 to 2.21 which fell within the read limit of Number 1.50 to 2.49 indicating less serious effects of the climate change impact on crop in the area. These variables include increase health problem (2.21) heavy winds (2.18) and stunted growth of crops (1.88).The t-value results presented in the table showed that all the perceived impacts of climate change on crop production from the respondents of the two states (Benue and Nasarawa) were between -0.47 to 0.57 which is lower than the critical value of 6.314 at $p < 0.05$. This implies that the intensity of the impacts of climate change on crop production are radically the same within the two states.

The impacts of Climate Change identified by the respondents (farmers) especially the three outstanding impacts of changing rainfall pattern, prolonged drought and increasing temperature were actually a reflection of their farming occupation which earlier researchers have observed as the actual climate change problems affecting crop production and these identified impacts are having scientific backing, because the performance of crop production is depended on a large number of climatic factor. The most important climatic factors include endowment of soils, rainfall, temperature and relative humidity, which play an important role in the realisation of higher or lower crop yields. Mark et al (2008) highlighted some of the direct impacts of climate change on agricultural systems to include seasonal changes in rainfall and temperature, which include uttering growing seasons, planting and harvesting calendars, water availability, pest, weed and disease population. In the savannah which is the study areas, rainfall can be singled out as the most important factors influencing crop cultivation as it is the main supplier of soil moisture to crops, even though soil moisture do not depend on rainfall alone but also on various factors such as the evapo-transpiration and surface run-off

The respondents in the study area enumerated some methods they use to remedy the impacts of climate change Such as planting of fast maturing crop varieties and planting of different varieties of crops, minimum or zero tillage not to exposing soils to loss of nutrients, early or late planting of crops, increase mulching of crops to conserve

moisture and reduce heat as well as staking of crawling crops such as yam to avoid burns.

The adaptation methods identified by the respondents are in line with earlier researchers suggestions (Onyereke,2010, Enete and Amusa,2010 and Ogbonna *et al*,2007) such as use of new crop varieties that are suited to drought, crop diversification, changing planting dates, radical departure from reliance on rain-fed food production to irrigation farming and growing of cover crops like potatoes and melon to protect soils from erosion .Even though Yohe *et al* (2007) observed that in any given context, the identified adaptations may be constrained by factors such as their expense, lack of knowledge on how to implement them and countervailing beliefs and cultural practices; notwithstanding these impediments, farmers at risk of climate change can be provided with external help. Possibilities include the provision of technical information, advice or guidance, the provision of weather and seasonal climate forecast and warnings, drought or flood relief and insurance or other forms of financial assistance and risk spreading.

Conclusion and Recommendations.

The study revealed that the socio-economics characteristics of the respondents of age, educational status, years of stay in the study area and farming experience have influence on their views about climate change discussion and analysis which requires longer living period within the study area. Majority of the respondents (80%) do not have much knowledge about climate change and 97% of them who claimed to have knowledge of climate change got to know it through personal observation and 82% from Radio and many of them (73%) attributed climate change to Act of God, instead of the scientific factors of industrialization, urbanization, transportation and agriculture that release green house gases into the atmosphere as earlier researchers have observed .From their personal observation they were aware that the climate is changing in terms of increase in temperature, changing in rainfall pattern, prolonged drought and delay in rainfall, which to them have negative impact on their crop production. But enumerated some methods of remedying the effects through planting of fast maturing crop varieties and planting of different varieties of crops; increase mulching to conserve soil moisture and to reduce heat and also staking of crawling crops.

Recommendations

1. Public enlightenment on climate change using media like Radio, television, printed materials should be encouraged .Such enlightenment should be in simple language of the audience
2. Seminars and workshops on climate change should be organised more frequently by various levels of government.

3. Indigenous knowledge and practices should be integrated into formal climate change mitigation and adaptation strategies.
4. Farmers should have regular information on current issues related to climate change and agriculture.
5. Better equipped weather station should be established to provide accurate and timely weather forecast and predictions to farmers in order to prevent weather related disasters.

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