



ASSESSMENT OF THE PERCEPTION OF CLIMATE VARIABILITY AND ITS EFFECT ON FOOD CROP PRODUCTION IN BAMA LOCAL GOVERNMENT AREA OF BORNO STATE, NIGERIA

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ABSTRACT

The study assessed food crop farmer's perception of climate variability and its effects on food crop production in Bama LGA Borno State, Nigeria. Multi stage sampling was used in drawing 100 respondents for this study. Information was collected using structured questionnaires. Both descriptive and inferential statistics were used to analyze the data. Descriptive statistics used includes frequencies, means and percentages. The inferential statistics used was multiple regressions model. The result revealed that majority of 71% were male and dominated food crop production, 76% were also married. Furthermore, 56% had 5-8 household members. 20% had tertiary education, while 43% had primary education. The result revealed that 45% had 5-8ha of land for food crop production. An overwhelming majority of 90% perceived those gases released from factories/industries and auto mobile ranked 1st as responsible for causing climate variability. 87% ranked deforestation as 2nd cause of climate variability, while 10% ranked traditional neglect as the 12th and least cause of climate variability. For the effect of climate variability on food crop production, majority of 95% ranked decrease in crop yield as the 1st effect of climate variability, 94% ranked reduced income from crop yield as the 2nd effect of climate variability. The least perceived effect of climate variability was reduced cover crop which was ranked by 50% of the respondents in 14th place. The result of factors influencing the perceived effect of climate variability was positive and significant at $P \leq 0.05$ and $P \leq 0.01$, respectively. The coefficient of gender was positive and significant at 5% which implies that every male had higher chance of being affected by the effect of climate variability than their female counter part. The study recommended more campaign on climate variability for rural farmers. Also, government, non-governmental organizations and policy makers should create an avenue where more female farmers could participate and have access to arable land.

Keywords: Perception, Climate Variability, Perception, Adaptation, Food crop production and Assessment.

INTRODUCTION

Climate variability has been defined by the Intergovernmental Panel on Climate variability (IPCC) as the statistically significant variations that persist for an extended period of typically decades or longer, it includes shift in the frequency and magnitude of sporadic weather events as well as the slow continuous rise in global mean temperature. According to IPCC (2007a), climate variability manifest in a number of ways, which includes; changes in average climatic conditions leading to some regions becoming drier or wetter on average; rainfall events may become more erratic in some region; changes in the frequency and magnitude of extreme weather events and changes in sea levels. Fraser (2008) defined climate variability as significant variation in weather pattern occurring over a period of time ranging



from decades to millions of years. In a related opinion, Olusola *et al.* (2008); Mohammed *et al.* (2014) described climate variability as long-time significant change in the average weather that a given region experiences. Average weather may include average temperature, precipitation and wind pattern. Climate change may also refer to the change in average weather condition, i.e., more or fewer extreme weather events (Karl, 2009). Based on the given definitions, climate change can be seen as a long-term change in the elements that define weather. These elements include; temperature, rainfall in terms of volume, regional distribution and wind. Climate change is said to have occurred when there is relatively permanent change in weather elements.

Climate variability is caused by factors such as biotic process, disparity in solar radiation received by earth, plate tectonics and volcanic eruptions. Certain human activities (deforestation and industrialization) have been identified as significant causes of climate change often referred to as global warming (IPCC, 2007b). As a result of the changes in climate, the concentration of greenhouse gases such as Methane (CH₄), Nitrous Oxide (N₂O), Carbon Dioxide (CO₂), Chlorocarbon (CCs) and Sulphur Dioxide (SO₂) in the atmosphere keeps increasing. The increase in the concentration of these gases contributes to global climate change (Mohammed *et al.*, 2013; Audu, 2003). IPCC (2007b) explains that although the length of time climate variability takes to manifest matters, the level of deviation from normal and its impacts on the ecology are quite evident.

Agriculture is affected by climate variability in several ways. This is partly informed by the fact that most of the agricultural activities are directly dependent on weather (Rosenzweig and Liverman, 1992). Some of the ways through which climate change affects agriculture include depletion of soil water, distortion in carbon and nitrogen cycles, reduced food crop growth and development, reduced feed and water availability for livestock and increase incidences of pests and diseases. The effects of these could manifest in the form of increased heat stress and increased evapo-transpiration rate. Climate variability could also affect livestock production through reduced performance in terms of feed intake, body weight gain, and general productivity including reproduction (Mu and McCarl, 2011). Climate plays the dominant roles in agriculture having a direct impact on the productivity of physical production factors; soil moisture and fertility (Smith and Skinner, 2002). Adverse climate effects can influence farming outputs at any stage from cultivation through the final harvest. Even if there is sufficient rain, its irregularity can negatively affect yields adversely if rains fail to arrive during the crucial growing stage of the food crops (Molua and Lambi, 2007).

Droughts are endemic and rainfall tend to have been in decline and temperature increasing in Nigeria since 1960 (NIMET, 2013). Every part of Nigeria suffers from one form of environmental problem or the other in varying degrees. The northern part of Nigeria (savannah) of the country is being blown away by wind while in the southern part (forest) is being washed away into the ocean by erosion. Recognizing that Nigeria is confronted by major environmental problem, one of the most important is drought which is an insidious hazard of nature that originates from the deficiency of precipitation over a long period of time (Emeka, 2009). Farmers in Borno State are facing increasing food insecurity, from erratic rainfall, marginal soil fertility, infestation of pests and diseases and a non-conducive policy environment (international institute of tropical agriculture (IITA, 2009). The recent food crisis in Nigeria is among other reminders of the continuity of the vulnerability of the region on the impact of climate condition. Consequently, this is due to weak institutional capacity, limited engagement in the environmental and adaptation issues and lack of validation of local knowledge. Accordingly, there is need to gain as much information as possible and learn position of indigenous farmers knowledge and their needs.



Perception is a process of one's ultimate experience of the world and involves further processing of sensory input. Sensation and perception are impossible to separate, because they are part of one continuous process (David, 2007). Perception strongly affects how farmers deal with climate-induced risks and opportunities, and the precise nature of the behavioral responses to the perception will shape adaptation options (Adger *et al.* 2009). Perception of climate change among rural communities is driven by multiple forces. Different household and farm factors influence whether and to what extent farmers perceive climate change and its impact on agriculture (Deressa *et al.* 2008). Perception affects or influences the ways farmers have the understanding of climate variability. This understanding goes to determine the factors influencing the use of indigenous adaptation strategy by farmers. It is in view of the above that this study assessed the factors influencing farmers' perception and the utilization of indigenous climate change adaptation strategies in the study area.

The concern of climate variability in Nigeria is heightened given the linkage of agriculture with poverty. It is anticipated that adverse impact of climate variability on the agricultural sector will exacerbate the incidence of rural poverty. Climate variability has the capacity to affect African agriculture in a range of ways which overall leads to reduction in productivity. Over 80% of Nigeria's population depend on rain fed agriculture and fishing as their primary occupation leading to high risk of food production system being adversely affected by the variability in timing and amount of rainfall (Odjogo, 2008). Interactions between climatic, environmental, economic, political, institutional, social, educational and technological processes all add up to affect production. The findings of this study will be relevant to the small-scale agrarian communities, the researchers, NGOs, policy makers, government and international organization for information and policy making. Because Africa is generally acknowledged to be the continent most vulnerable to climate change and variability. There is an urgent need for documentation and advocacy on farmers' perception of climate change and indigenous adaptation strategies employed to adapt to the variability of climate change; this cannot be successfully achieved without any evidence. Such study will therefore promote evidence-based information/ knowledge/advocacy.

With appropriate documentation of the perception of climate variability and effect on food crop production, production will be enhanced and thus vulnerability to climate variability will be minimized. Although, there were other studies on climate variability and climate change (Mudi *et al.*, 2008; Bulama, 2014) but none of these studies focused on the perception of climate variability and its effect on food crop production in Bama LGA of Borno state Nigeria. The main objective of this study is to identify ways in which farmers perceived climate variability and how such perception enhance food crop production. The specific objectives were to:

- i. Determine the socio-economic characteristics of food crop farmers in Bama LGA of Borno State;
- ii. To ascertain the perceived causes of climate variability among food crop farmers in the study area;
- iii. To examine food crop farmers perceived effect of climate variability on food crop production; and
- iv. Determine the socioeconomic factors influencing the perceived effect of climate variability in the study area.



MATERIALS AND METHODS

The Study Area

Borno State is located in the north eastern Nigeria and covers an area of 69,435 square kilometers (KM²) (Borno State Ministry of Land and Survey, 2010). Borno State lies between latitude 12° 08' 60.00" N longitude; 12° 53' 59.99" E It shares borders with Adamawa State to the south, Yobe State to the west and Gombe State to the south west. It also shares international border with the Republic of Niger to the north, Chad to the north east and Cameroun to the east. Bama Local Government Area lies within the tropic hence, a tropical temperature is experienced with a fairly wide seasonal range of temperature. It can be described as a semiarid environment. The climatic regime consists of a simple dry season followed by a short-wet season. The raining season lasts between 3-4 months with a record of 300-700mm per annum and with lots of sunshine due to the little cloud cover. The rain fall is not only low but also scanty and erratic in distribution and the variability over time and space is high because of the latitude location. The area has relatively high temperature throughout the year with temperature of up to 44°C in March and April (BOSADP Annual Report, 2007) the coldest lays between December and January (the harmattan period).

The greater part of Bama Local Government (LGA) Area consist of clay soil and small proportion of sandy soil on which grains thrive to blooming luxuriance. Greater part of the population is engaged in agriculture, Major crops grown in the area are sorghum, millet beans and groundnut. The area is also blessed with gum-Arabic and livestock such as cattle, sheep, goat, poultry and vegetable crops like onions, carrots, tomatoes, pepper, garden eggs are cultivated during the dry season.

Sampling Procedure

The sampling procedure involve multistage random sampling. The first stage involved purposive selection of three wards (that are free from intensity of insurgency) which are (Shehuri, Mairi, and Hausari). The second stage involved proportionate random selection of the respondents based on the number of populations in the sampling fame.

Method of Data Collection

The data for the study was obtained mainly from primary sources. The primary data was collected from food crop farmers through administered structured questionnaires. Trained enumerators assisted in administering the questionnaire. Secondary information was obtained from Journals, relevant websites, conference proceedings and BOSADP publication

Analytical Techniques

Descriptive statistics such as frequencies means and percentages were used to achieve specific objectives i, ii, and iii while multiple regression was be used to obtain objective iv. The multiple regression model is explicitly expressed as;

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3, \dots \dots \dots \beta_{10} x_{10} + e \quad \dots(1)$$

where;

Y = effect of climate variability on food crop production

X = Independent variables

β_0 = Constant

β_1 - 10 = Estimated coefficient

e = error term

X₁ = Age (years)

X₂ = Sex – Male (1), Female (0)

X₃ = Marital Status (Married = 1, 0 not married)

X₄ = Farm Income (₦)

X₅ = Farm Size (ha)



X_6 = Educational Status

X_7 = Household Size (Number of household members)

X_8 = Access to Extension Contact (No access = 0 and have access = 1)

X_9 = Farming Experience (Years spent in food crop production)

X_{10} = Access to Credit (No access = 0 and have access = 1)

e = error term

RESULTS AND DISCUSSION

Socio economic Characteristics of Food Crop Farmers

From Table 2, the results revealed that majority of the respondents were male (71%). The implication of the finding found that majority of the food crop farmers in the study area were dominated by male. In addition, this finding further explained that males are more likely to perceived climate variability and its effects than their female counterpart. Table 1.0 also shows that majority of those involved in food crop production in Bama LGA were between the ages of 31-40 years (42.0%). The implication of this result revealed that those involved were youths full of energy, zeal and enthusiasm. It also implies that the respondents are dynamic and can adopt and adapt to any agricultural innovation. Few of the respondents were between the ages of 51-60 and 60 above who participated less in food crop production.

Table 2 also shows that majority of those who participated were married. The implication is that married farmers have more responsibility connected to family care (Hospital bills, school fees, feeding etc.) hence have more level of seriousness. In addition, their family role as providers has the tendency of making them attune to vital issues such as climate variability and its consequences. The results in Table 2 discovered that 56% of the respondents were having household size 5-8, out of which 45% had less than 5 ha of land for crop production. That means that those with high number of household size and small farm size were more likely to notice and bear the brunt of climate change variability and its effects on food crop production in the study area.

The results also found out that significant majority of 43% had primary education. It implies that the level of education in the study area was very low. This will have negative effect on understanding Agricultural packages. In addition, this could possibly influence their perception on the effect of climate variability such as erosion, food insecurity, flooding, reduced cover crop, etc. The study shows that majority of the respondents (54%) personally owned their land. Farm lands were owned either through inheritance, buying or allocation from government. This could help in maximizing profit as compared to those who rent the land or hired it for food crop production.



Table 2: Socio-economic variables

Variables	Frequency	Percentage
Sex		
Male	71	71.0%
Female	29	29.0%
Age		
Less than 20 years	2	2.0%
21-30	11	11.0%
31-40	42	42.0%
41-50	24	24.0%
51-60	12	12.0%
60 years and above	9	9.0%
Marital status		
Married	76	76.0%
Single	12	12.0%
Divorced	3	3.0%
Widow	4	4.0%
Widower	5	5.0%
Household size		
less than 5	10	10.0%
5—8	56	56.0%
9—11	23	23.0%
12—14	7	7.0%
15 and above	4	4.0%
number of years in education		
Non formal education	23	23.0%
Primary education	43	43.0%
Secondary	14	14.0%
Tertiary	20	20.0%
Farm size(ha)		
less than 5	45	45.0%
5—8	23	23.0%
9—12	12	12.0%
13—16	16	16.0%
17 and above	4	4.0%
Ownership of farm land		
Hired/Rented	14	14.0%
Personal	54	54.0%
Family	32	32.0%
Annual income		
Less than 50,000	13	13.0%
50,000-70,000	24	24.0%
71,000-100,000	40	40.0%
101,000 and above	23	23.0%

Source; Field Survey (2021)

Table 2 also showed that annual income of 40% of the respondents derived from food crop production was 71,000 – 100,000 Nigerian naira as annual income. This justified that majority were small scale farmers at subsistence level. And by extension, the respondents could have a poor understanding of the overall effect of variability in climate given their subsistent level of farming.



The information on farming experience is revealed in table 1.0. Farming experience is determined by number of years one spent in active food crop production. The results found that majority of 39% had 13 and above years in crop production. This justified that majority have adequate years to know the changes in climate as well as the variability and consequence that came with it.

Table 2 revealed respondents' membership to farmer's organization. Membership to farmer organization is a fulcrum where farmers derived various agricultural information on either pest control, improved seeds or access to information. Majority of 68% were members of farmer organization. This could be an important avenue where farmers could get information on climate change and climate change variability. Access to extension services is an important avenue where farmers can get guidance, technical information from someone via extension agent. The results in Table 2 discovered that overwhelming majority of 81% had access to extension services. The implication of the finding is that majority have adequate technical guidance to determine the climate, climate variability, climate change and effects it has on food crop production.

Agricultural credit is designed to help farmers in day-to-day agricultural production. Table 2 revealed that 77% had no access to agricultural credit. This clearly justified the low income of the respondent where the majority received 71,000 – 100,000 naira. Table 2 discovered that majority of 81% of the respondents had access to information on climate change variability. This could be attributed to the high level of access to extension services and high membership to farmer organizations.

Table 2: Socio-economic Variables Cont'd.

Variables	Frequency	Percentage
Farming Experience		
Less than 4	12	12.0%
4—8	25	25.0%
9—12	24	24.0%
13 and above	39	39.0%
Yes	68	68.0%
No	32	32.0%
Access to Extension Services		
Yes	81	81.0%
No	19	19.0%
Access to Agricultural Credit		
Yes	23	23.0%
No	77	77.0%
Access to Source of Climate Change Information		
Yes	81	81.0%
No	19	19.0%

Source: Field Survey (2021)

Perceived Causes of Climate Variability

Table 3 results revealed that the most serious perceived cause of climate variability was gases released from factories, industries and automobile. This was ranked in 1st place by 90% of the respondents. This concurrently meant that high access to extension services and access to information influenced the respondent's knowledge base. It made them understand that gases released from factories, industries and automobile can cause climate variability. The



respondents subsequently perceived that deforestation, burning of fossil fuel and overgrazing could alter and cause climate change. These were ranked in 2nd and 3rd place by 87% and 84% of the participants respectively. The least among the perceived cause of climate variability were existence of super natural powers and traditional neglect.

Table 3: Perceived causes of climate variability

Causes of climate change	Frequency	Percentage	Rank
Gases released from factories/ industries and automobile.	90	90.0%	1st
Deforestation	87	87.0%	2nd
Burning of fossil fuel	84	84.0%	3rd
Overgrazing by cattle and animals	76	76%	4th
Burning of bush for firewood	70	70.0%	5th
Quranic/ Biblical manifestation	55	55.0%	6th
Use of organic fertilizer on soil during cropping	52	52%	7th
Continuous cropping	45	45.0%	8th
People disobeying God/ gods	37	37.0%	9th
Unnecessary setting bush in fire	34	34.0%	10th
Supernatural power	31	31.0%	11th
Traditional neglect	10	10.0	12th

Source: Field Survey (2021)

Perceived Effects of Climate Variability

Table 4 showed Perceived effect of climate variability on food crop production. Farmer's perception of climate variability. The analysis shows that 95% cited reduced income, reduced crop yield and erosion ranked 1st, 2nd, and 3rd respectively. The respondents perceived that the first noticeable perceived effect of climate variability decrease in crop yield. This implies that climate variability affects the yield a farmer can receive. Farmers perhaps indicated decreased in yield because it affects food availability and utilization. The annual income from food crop farming is the second noticeable effect as perceived, because it has direct link with food availability, accessibility and utilization among the communities in the study area. Among the least of the perceived effect of climate variability as perceived by the respondents were famine, loss of farm activities, increased evapotranspiration and reduced cover crop. The implication is that despite the fact that the climate has consequences in the study area, famine was not significant, secondly, the able-bodied youth did not lose agricultural jobs. This justified that, Agricultural activity did not seize as a result of climate variability. Increased evapotranspiration did not wash away the cover crops.



Table 4: Perceived Effects of Climate Variability

Perceived effects of climate variability	Frequency	Percentage	Rank
Decreased in crop yield	95	95.0%	1st
Reduced income from crop yield	94	94.0%	2nd
Erosion	89	89.0%	3rd
Food insecurity	88	88.0%	4th
Increased disease infestation	86	86.0%	5th
Decreased Soil Fertility	80	80.0%	6th
Flooding	79	79.0%	7th
Reduced vegetable/pasture	77	77.0%	8th
Malnutrition	76	76.0%	9th
Drought	76	76.0%	10th
Famine	68	68.0%	11th
Loss of farm activities	65	65.0%	12th
Increased evapotranspiration	56	56.0%	13th
Reduced cover crop	50	50.0%	14th

Source: Field Survey, (2021)

Socio-economic Factors Influencing the Perceived Effect of Climate Variability

Multiple regression was used to determined socioeconomic factors influencing the perceived effect of climate variability. The exhibit an R-square of 0.75 which means about 75.0% of the variation in dependent variable was explained by independent variables, this shows that the model fit the data. The results are presented in Table 5. The results from the Table 4.0 revealed that the coefficient of gender was positive and significant at 5% which implies that a respondent being male has higher chance of perceived effect of climate variability than female counter part. The coefficient of age 0.3064 was positive and significant at 1% level which shows that age has a positive relationship with perceived effect of climate variability. A study conducted by (Nzeadibe, *et al.*, 2011) in Kyuso District, Kenya showed that age of the household head, influenced the possibility of a farmer to perceive effect of climate variability. Another notable and significant variable is the coefficient of marital status which has a positive and significant relationship between perceived effects of climate variability at 1%. A respondent being married has a lot of responsibility to carter for his/her family and such scrutiny can lead to more knowledge on effect of climate variability. Household size is one of the significant variables in influencing the perceived effect of climate variability. The coefficient was positive and significant at 1% implying that the larger the household size the higher the chances of the household detecting the effect of climate variability. The coefficient of years of education was positive and significant at 1% in relationship to perceived effect of climate variability. Despite the low levels of education of the majority of farmers, they perceived effect of climate variability. Based on their local knowledge and farming experience (Uzor *et al.*, 2015, Vodouhê *et al.*, 2010; Vose *et al.*, 2012).



Table 5: Factors influencing the perceived effect of climate variability

Variables	Coefficient	Std. Err.	T-value
Sex	1.0797	0.4390	2.5**
Age	0.3064	0.0172	17.8***
Marital status	0.3767	0.0606	6.2***
Household size	0.2844	0.1010	2.8***
Years of education	0.0199	0.0014	13.9***
Farm size	0.4735	0.1421	3.3***
Ownership of farmland	0.0724	0.0074	9.7***
Annual income	0.0345	0.0019	18.3***
Farming experience	0.0246	0.0052	4.7***
Membership of organization	0.0232	0.0056	4.2***
Access extension services	0.1544	0.0151	10.2***
Access Agricultural credit	0.2280	0.0160	14.3***
Access Source of information on climate	0.0059	0.0143	0.4
Cons	3.4864	0.6912	5.0***
R ²	0.75		

Note: **, *** are significant at 5% and 1%, respectively.

Source: Field Survey (2021).

CONCLUSION AND RECOMMENDATIONS

This research reveals that the socio-economic characteristics of the respondents were: male dominated food crop farming and there were in their economic active age and also majorities were married. Majority had between 5 – 8 house hold members. The farm sizes they operated resulted in their low farm income. Furthermore, farming experience access to extension services and access to credit positively influenced the perception of the respondents towards climate variability. The major causes of climate variability as perceived by the respondents were: gasses from factories/industries, and auto mobile. This study revealed that perceived effect of climate variability by the respondents were decrease in crop yield, reduced income from crop yield, erosion and increased disease infestation. The data for this study were obtained mainly from primary sources and secondary. The primary data were collected from food crop farmers through administration of structured questionnaires. Trained enumerators assisted in administering the questionnaire. Secondary information was obtained from Journals, relevant websites, conference proceedings and BOSADP publications. The result concluded that male dominated food crop production and understanding of climate variability than the female counterpart.

Base on the finding of this study, the following recommendation were made;

1. There was dominance of male counterpart in food crop production. The government, non-governmental organization NGO, international non-governmental organization, policy makers should create an avenue where female farmers could participate and have access to arable land.
2. Government, Agricultural institution, ministries of finance and central bank of Nigeria (CBN) should create source of finance to help boost food crop farming in the study area.
3. Gases released from industries/factories where sited as major cause of climate variability by the respondents. Government should create a law to minimize the emission of such gases.
4. Awareness/Education on the issue of climate change needs to be expanded to increase women's level of awareness.



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