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## **Perception of Climate Change by Smallholder Maize Farmers in Gombe State, Nigeria**

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### **Authors' contributions**

*This work was carried out in collaboration between both authors. Author DSM designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author YB managed the analyses of the study. Both authors read and approved the final manuscript.*

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### **ABSTRACT**

This study assessed the awareness and impact of climate change by smallholder maize farmers in Gombe state. Both primary and secondary sources of data were used. List of registered farmers was obtained from Gombe State Agricultural Development Programme (GSADP). The primary data were collected through the use of interview schedules. Descriptive statistics were used for the analysis. The result reveals that Most 43.2% of the respondent were between ages 40-49, 87.5% were male, 84.3% were married, 65.7% had 30-35 years of farming experience and only 38.8% belong to farmers association. Majority 85.6 % of the farmers were fully aware about the changing climate and 57.3% of the farmers obtained their information about climate change through radio because it is the most available and reliable means of communication to the farmers and length of farming experience influenced awareness of changing climate. About 62.9% of the respondent reported that decrease in rainfall reduce crop yield, 59.4% said increase in temperature damage their crops and 50% said increase in wind speed breaks their plants. The impact observed on farm were flood, soil erosion, prolonged dry spell and reduced crop yield were rated high based on likert scale. The study recommends that extension works and community groups should enlighten the farmers on the impact of changing climate and farmers are advised to come up with early warning system on how to cope with the changing climate.

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## 1. INTRODUCTION

Climate change awareness involves creating knowledge, understanding, values, attitude, skills and abilities among individuals and social groups towards the issues of climate change for attaining a better environment. Awareness about climate change will go a long way in solving most of the problem attached to it. Most of the campaigns about climate change were not addressing the target population that was why its impact was not meeting its set objectives. Climate change awareness was highest at the federal level, these dropped sharply at the state and local government levels, where real action is needed [1]. Farmers are aware of the differences between the past climate and the present climate according to the change in climate variables (rainfall pattern, temperature, sunshine and wind), but not with the name climate change [2].

Climate change had caused a shift in the seasonal variability of weather and climate and thus a shift in the normal timing and length of wet and dry seasons and increase in the seasonal fluctuation of the water bodies. Rainfall variability refers to variations in the mean state and other statistics (such as standard deviations and the occurrence of extremes) of rainfall on all spatial and temporal scales beyond that of individual precipitation events [3].

In Nigeria, changing rainfall patterns have been observed by [4], [5] and [3] which is observed decline in rainfall intensity in Nigeria. There are observable reductions in precipitation in northern parts of Nigeria, [6]. The most significant climatic variation in the north eastern region of Nigeria since 1960s had been the persistent decline in rainfall which had reduced agricultural productivity in the region, [7]. Farmers in Gombe state had observed changes in rainfall trends and number of rainy days which are attributed to climate change [8].

Agriculture in Nigeria is adversely impacted by increased variability in the timing and amount of rainfall, Water deficits depress crop and livestock production and hence affect food security, reduction of arable lands, while the sea incursion is reducing the arable land of the coastal plain, the desert encroachment with its associated sand dune is depriving farmers of their

agricultural farmlands and grazing rangelands [9].

In Nigeria, some areas like the Niger Delta regions receive more rainfall, while some areas in the Northern regions are receiving less rainfall, the length of the growing seasons are changing, ecological zones are shifting and rainfall is becoming more unpredictable and unreliable Brett, [10]. Maize farmers in Gombe state are finding it difficult to produce the quantity they use to produce due to constant changes in the behaviors of the climatic variables which resulted to the losing of livelihood by many farmers. It is based on this background that this study seeks to assess farmers' awareness about climate change and its impact on their farm production with the following objectives:

- i. Identify the socio-economic characteristics of the respondents;
- ii. Assess the awareness of farmers on the changes in climatic variables.
- iii. Determine the impact of climate change in the study area.

## 2. METHODOLOGY

Gombe State is located between Latitude. 9°30' and 12° N and Longitude. 8°45' and 11°45'E. It shares boundaries with Yobe state to the north, Borno and Adamawa states to the east, Bauchi state to the west and Taraba State to the south. The data used for this study were from primary and secondary sources. The primary data were collected through the use of interview schedule. List of registered farmers from Village Extension Area (VEA) of Gombe State Agricultural Development Program (GSADP) was used to select the number of the farming family in each community for the interview. Maize crop yield data from GSADP and rainfall totals from Upper Benue River Basin Development Authority (UBRBDA) Dadin-kowa station. Three Local Government Areas (LGA) were systematically selected based on the three Agro-climatic zones of the state.

Stratified, random and purposive sampling technique was employed to administer the questionnaire to those that have been farming for the period of thirty (30) years and above because of their experience. According to National Conservation Foundation (NCF, 2008) [11]

**Table 1. Sampling frame for the study**

LGA	Selected VEA	Number of registered farmers	Determine sample size	Sample size
Billiri	Sansani	1069	33	21
	Todi	1807	55	36
Kwami	Malleri	2074	64	41
	Kwami	3621	110	72
Nafada	Jigawa	2422	74	48
	Nafada	1561	48	31
<b>Total</b>		<b>12554</b>	<b>384</b>	<b>249</b>

Source: Gombe State Agricultural Development Program (GSADP, 2015)

Gombe state was divided in to three agro-ecological zone namely Southern Guinea Savanna (SGS), Northern Guinea Savanna (NGS) and Sudan Savanna (SS) where one LGA was selected from each agro-ecological zone. Billiri LGA was selected from (SGS), Kwami LGA from (NGS) and Nafada LGA from Sudan Savanna (SS). Krejcie and Morgan (1970) table of sampling population was used where 384 was determined as the sample size. Cochran [12] formula for the determination and distribution of sample size was used, the formula is as follows:

$$N = \frac{Nh \times n}{P}$$

Where Nh = Population

N = Sample size

n = Total number of respondents

P = Total population of the selected communities within the study area.

Three hundred and eight four (384) questionnaires was randomly distributed among those that had been farming for thirty (30) years and above. But only two hundred and forty nine (249) questionnaires were return from the respondents therefore, only the returned questionnaires were used for the study (Table 1).

## 2.1 Data Analysis

Both qualitative and quantitative technique (mixed method) was used for this analysis where descriptive statistics was used to analyse the socio – economic status of the respondents and their awareness while Likert type scale was used to analyse the impact on farm, the Likert type measuring instrument is represented by the formula:

$$\bar{X} = \frac{\sum fx}{\sum f} \quad (1)$$

Where  $\bar{X}$  = mean score

$\sum$  = Summation Sign

F = Frequency

Three (3) different scaling statements were used namely; high (3), moderate (2) and low (1). The mean of the scaling statement was 2 which is the weight mean of the weight mean of the statement. Decision Rule: Any mean value greater or equal to 2 is high; any mean value less than 2 is low.

$$\frac{3+2+1}{3} = \frac{6}{3} = 2$$

Statistical package for social sciences (SPSS) (version 19) was used for data analyses.

## 3. RESULTS AND DISCUSSION

### 3.1 Socio Characteristics of the Respondent

Respondents studied varied based on their age, sex, marital status and formal educational exposure. The distribution of the farmers based on the demographic characteristics of age, sex, marital status and formal educational exposure is presented in (Table 2).

One hundred and eighty four (108) of the respondents studied who constituted 43.2% of the study population were from age group of 40-49 while respondents who were of the ages 70 and above constitute only 2.8% of the study population this implies that majority of the farmers were from the productive age. About 87.6% of the respondent were male while 12.4% were female and majority of the respondents studied 84.3% were married. This result is in line with findings of [13] who reported more male farmers 60% than female famers 40% in Umuahia South.

### 3.2 Educational Qualification of the Respondents

Based on Respondent educational exposure, 48.2% were not exposed to formal education and 25.3% had primary education. Those who had secondary and tertiary educational exposure constitute 16.8% and 9.6% respectively. This is an indication that almost half of the respondents were educated and educated respondents tend to be aware about climate change, more efficient in production and ready to accept new strategies when compared with the other half respondents that were illiterates who rely on their experience (Table 2). This result is in agreement with the findings of [13] who reported that education influence awareness of farmers.

### 3.3 Number of Farmlands, Farming Experience, Farmers Club and Extension Services

About 40.9% of the respondent owned one (1) farmland, 45.4% owned two (2) farmlands and only 13.6% owned (3-5) farmlands, by implication majority of the respondents had two (2) farm land. Years of farming experience equipped respondents with adaptation strategies to cope with different climatic conditions in their production. About 65.7% of the respondents had (30-35) years of farming experience, while 9.2% had over 40 years of farming experience. About 38.8% of the respondents belong to Farmers Association while 61.2% of the respondents did not belong to farmers club, this results contradicts the findings of [2] who reported majority of the farmers belong to farmers organisation.

Results of respondent patronise extension services where 85.6% experience extension service while farmers whom did not patronise the extension services constituted 14.4%. Since majority of the respondent access extension service therefore adaptation to climate change among respondents will not be a challenge.

### 3.4 Awareness and Source of Information about Climate Change

Awareness about changes in climatic variables is important in coping or adapting to climate change. Awareness of climate change is the first step in mitigating the impact of climate change through adaptation. Rising awareness is an important component in building capacity of the population in combating the menace of climate

change, because adaptation may not be possible without effective awareness.

Majority of the respondents who constitute 85.6 % (Table 3) were aware that the climate is changing. Only thirty six (36) who constitute 14.4% were not aware, which implies that majority of the farmers were aware of climate change, because of their level of awareness it will be easy for them to identify effect of climate change in their farming system, this result concord with the findings of [13] who reported that majority of the farmers in Umuahia South were aware of climate change, [14] and [15] reported that farmers aware of climate variability and change also [16] reported that Majority of the farmers in Adamawa state are aware of climate change and submitted that climate change has affected their farming activities in recent years.

Respondents obtained information about climate change from various sources, namely: radio, television, newspapers, extension services, research institute, co-operative, fellow respondents and religion gathering. One hundred and forty three (143) who constitute 57.3% of the farmers obtained information about climate change through radio while two (2) constitute 0.8% of the respondents obtained their information from co – operative societies, (Table 3) presents the details of the findings of the major sources of climate change awareness; this implies that radio played an important role in creating awareness about climate change which is in line with the finding of [17] who reported that radio is the fastest means of reaching all farmers than any other means of communication. Since it is easy to communicate to farmers through radio, adaptation strategies can also be communicated to them through radio.

### 3.5 Observed Impact of Climate Change by Farmers

Majority 62.9% of the respondents reported that reduction in rainfall have reduce their crop yield while only 11.6% said it reduces grass for their animals. About 59.4% of the respondents reported that increase in temperature is responsible for damaging farm produces while 32.4% reported that it wilted their crops, only 8.0% reported that it kills their livestock's. These results agree with the finding of [18] who reported that high temperature reduce crop yield in the northern Nigeria. From these results it is evident that climate change have affected agriculture in the studied areas as presented on (Table 4).

**Table 2. Characteristics of the respondents n = (249)**

<b>Characteristics</b>	<b>Frequency</b>	<b>Percentage %</b>
<b>Age (Years)</b>		
40-49	108	43.2
50-59	76	30.4
60-69	58	23.2
70+	7	2.8
<b>Sex</b>		
Male	218	87.5
Female	31	12.4
<b>Marital Status</b>		
Married	210	84.3
Widowed	26	10.4
Single	13	5.2
<b>Educational</b>		
Non Formal Education	120	48
Primary	63	25.3
Secondary	42	16.8
Tertiary	24	9.6
<b>Number of Farm Land</b>		
1	102	40.9
2	113	45.4
3-5	34	13.6
<b>Farming Experience (Years)</b>		
30- 35	164	65.7
36 -40	62	24.8
40 +	23	9.2
<b>Farmers Clubs</b>		
Belong	97	38.8
Not Belong	152	61.2
<b>Access to Extension Service</b>		
Access	213	85.3
Not Access	36	14.7
<b>Total</b>	<b>249</b>	<b>100</b>

Source: Fieldwork 2016

**Table 3. Awareness and source of information about climate change**

<b>Variables</b>	<b>Frequency</b>	<b>Percentage %</b>
<b>Awareness of Climate Change</b>		
Aware	213	85.5
Not Aware	36	14.5
<b>Source of Information about Climate Change</b>		
Radio	143	57.1
Television	5	2
News Paper	6	2.4
Extension Service	27	10.8
Research Institute	7	2.8
Co -Operative	2	0.8
Fellow Farmers	47	18.8
Religion Gathering	12	4.8
<b>Total</b>	<b>249</b>	<b>100</b>

Source: Fieldwork 2016

**Table 4. Observed impact of climate change by farmers n= 249**

Variables	Frequency	Percentage %
<b>Effect of low Rainfall on Farm</b>		
Reduce crop yield	157	62.9
Reduce water for livestock	63	25.2
Reduce grass/ biomass	29	11.6
<b>Effect of high Temperature on Farm</b>		
Wilting of crop	81	32.4
Damage farm produce	148	59.4
Death of livestock	20	8.0
<b>Effect of wind</b>		
Breaking of plants	125	50.2
Blowing off the flowers	79	31.7
Top soil Erosion	45	18
<b>Total</b>	<b>249</b>	<b>100</b>

Source: Fieldwork, 2016

**Table 5. Impact of climate change on farm**

Variables	High	Moderate	Low	Mean	Decision
Floods	178	60	11	2.6	High
Prolonged dry spells	127	98	24	2.4	High
Severe wind storm	62	112	75	1.9	Low
Incidence of pest and disease	73	147	29	2.1	High
Incidence of weed infestation	43	89	117	1.7	Low
Decrease in soil fertility	43	137	69	1.8	Low
Poor yield	50	142	57	2.0	High
Increased cost of production	114	101	34	2.3	High
Erosion	199	31	19	2.7	High

Source: Fieldwork, 2016



**Plate 1. Gully erosion on a maize farm in Billiri**

Source: Fieldwork, 2016

About half (50.2%) of the respondents reported that wind speed breaks their plants while 18.0% of the respondent reported that top soil erosion affects their farms as a result of increased wind

speed. This implies that change in wind speed had a negative impact on farms because it affects the direct means of livelihood of the respondents.

### 3.6 Impact of Climate Change on Farm

The most common impact of climate change observed in the studied areas was presented on (Table 5) where Floods, prolonged dry spells, incidence of pest and disease outbreak, poor yield, erosion (Plate 1) this result was not in agreement with the findings of [13] who reported that flood and erosion were rated low while increase cost of production were rated high while severe wind storm, increase rate of weed infestation and decrease soil fertility were rated low as it was determined by the scale. The numbers of high impacts were higher than the low impacts as it is from the decision rule, therefore this results means that it affects the livelihood of the farmers.

### 4. CONCLUSION

In conclusion, about 43.2% of the respondent were between ages 40 -49, 87.6% were male and 84.3% were married. Majority of the respondent 48.2% were not exposed to formal education and 45.4% owned two (2) farmlands. The farmers were fully aware of the changes in climatic variables and awareness may be a key to adaptation. Base on crosstabing results length of farming experience and formal education does not influence awareness of climate change. Climate change has a negative impact on the livelihood of the respondents such as crop failure, wilting of crops, damaging their crops, killing their animals as a result of increase in temperature while decreasing rainfall manifest through food shortage increase, starvation and many of the respondent lost their basic means of livelihood due to the menace of climate change is in line with the findings of [19].

### 5. RECOMMENDATION

The study came up with following recommendations in order to create room for adaptation to climate change in the state:

- i. Extension works and community groups should educate farmers with information on Climate Change and its impact.
- ii. Farmers are advice to come up with early warning system on how to handle issue regarding the changing the climate in their faming activities.
- iii. Farmers are encourage to practice irrigation in order for them to supplement their livelihood when rain fed agriculture fails.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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