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FARMERS' PERCEPTIONS ON CLIMATE VARIABILITY AND CROP PRODUCTIVITY IN BILLIRI LOCAL GOVERNMENT AREA OF GOMBE STATE

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ABSTRACT
This study evaluates farmers' perception on the impact of climate variability on cereals crops in Billiri. The study examines the causes, impacts and coping strategies of climate variability. Stratified random sampling technique was employed to determine one hundred and forty five (145) respondents. The secondary data (Rainfall) was obtained from Gombe State Agricultural Development Programme (GSADP) Ladongor station for the period of Forty (40) years. Descriptive statistics was used to analyze the data. Majority of the respondent are between the Ages of 20-49 which show they are within the active and productive age and male gender form the highest percentage of 74%. Most of the respondent has post-primary certificate. The farmers were of the opinion that temperature, dry spell and drought were increasing while soil moisture and rainfall were decreasing. The perceived impacts are poor crop yield, insufficient food supply and increase crop diseases. The respondents intensify crop diversification, planting ahead of rain (torbi), cover cropping, planting deeper than usual and planting of tolerant or improved seed variety as copping strategies. The highest amount of rainfall was observed in 1989 while the lowest amount was in 1987. The study recommended that extension worker should provide farmers with the current scientific weather information and government should provide soft loan to the farmers to expand their scale of production and to build their capacity, knowledge and response in other to enhance their resilience towards climate variability.

Keywords: Farmers, Rainfall, Trend, Impact, Copping Strategies

INTRODUCTION

Climatic resource is the back born of every agricultural process and rainfall is the primary source of moisture for crop production in Nigeria. Climatic fluctuation is putting Nigeria's agriculture system under serious threat and stress (Ayinde *et al*., 2011). The rainfall of 400mm-1200mm is the requirement for the production of cereals (Rice, Maize, Sorghum and Millets), any variation in the rainfall or temperature may result to crop failure. The major challenges/hindrance in crop production in the study area is the variation of climatic variable most especially rainfall because of it significant role in the production of cereals which is the major crop produced by the inhabitance of the study area (Tunde, 2011). The major problems associated with the production of cereals particularly rice include drought, flooding, extreme temperatures and changes in rainfall patterns (Ajetumobi *et al.*, 2010).

Farmers perceived climate variability as; increasing temperature, increased in length of hot period, decreased length of cold, decreased in availability of ground water, increase in wind intensity and frequency of draught in the northern Nigeria (Bose et al, 2014) and (Daba, 2017) farmers perceived climate change in terms of changes in rainfall and temperature, increase in drought condition, crop pests and diseases. Farmers perception of effects of climate change on rice is hinged on irregular rainfall pattern that encourages weed growth, and excess water encourages fungal diseases spread which lowers rice yield (Onyegbula, 2017).

Akinseye (2014) revealed that the rainfall received in the month of June and September during the growing season are the two powerful predictor of crop yield while monthly rainfall and average temperature of growing seasons reflect an multiplicity impacts on crop growth, development, flowering, seed production and maturity. Impacts of climate variability in rural areas include reduced in crop yield, increase in crop pest and disease and soil erosion and reduced seedling, delayed in seedling and delayed in maturity (Daba, 2017).

The impact of climate change on farms are changes in onset and cessation of farming season, less rainfall, higher temperature; extremities of weather events such as high sun intensity, heavy winds; and increase in farming problems, in particular, reduction in crop yields and loss of soil fertility (Kaletapwa, *et al.*, 2011). The main impacts of climate variability and change are changes in rainfall patterns and temperature which affect agriculture having a significant reduction in food security, water security, decrease in fish, and increase in vector-borne diseases (African Partnership Forum [APF], 2007). The effects of climate change in rural areas include poor crop yields reduced soil fertility, increase flood, poverty and food shortage (Egbe *et al.*, 2014).

The adaptation strategies to climate variability and change in the rural cross river include; reduction in timber and non - timber product exploitation, reduction in bush burning, engaging in alternative occupations like bike transportation, food vendor and establishment of boreholes as sources of drinking water. Others are adoption of shorter fallow periods, home-stead farming, afforestation efforts, reduced destruction of available watershed and dependence on forest resources and prayers to God for intervention (Egbe, *et al.,* 2014). Farmers have adopted a variety of adaptation strategies including soil conservation, change in planting date, agro forestry product, improve crop seedlings, and irrigation (Bose *et al*., 2014). The adaptation strategies to climate change in northern Nigeria include multiple cropping, intensive manure application, and use of wetland/fadama, use of resistant varieties, processing to minimize post-harvest loss, and reforestation (Kaletapwa *et al.,* 2011).

The aim of this study is to examine the impact of the prevailing rainfall variation on the production of cereal crops ;(maize, rice, sorghum and millet) grown in Billiri Local Government Area of Gombe State and the farmers ability to cope or combat with the rainfall variability in their production.

Study Area

Billiri is located between Long $9^{0}51'53''$N and Lat. 11^{0} 13'31'' E it has an area of 737 km² with a population of 202,144 (Census, 2006). The dominate tribe in Billiri LGA is Tangale. The predominate geologic unit in Billiri is Sandstone, Siltstone, Shake, Coal and Iron stone while Porphyritic Granite and Coarse Porphyritic Biotite has little percent, the dominants soils types in Billiri is the Luvisols and Vertisols followed with Leptosols, Cambisols and Luvisols while Regosols and Cambisols has little (Mayomi *et al.* 2018). The topography of the study area is predominately plains because 61.72% of it land is plain, the highest point in Billiri is 882m above sea level and the major drainage channel is River Panda and it two main tributaries are River Chabbal and River Gada Uku (Lasale) having some little streams (Mayomi *et al.* 2018). The climate of the study area belong to the Koppen's Aw climate with two distinct seasons, rainy seasons and dry seasons or summer and winter seasons. The rains start around April/May and end around October/November and it has an average of rainfall of 42.4mm. Farming is the primary activities of the inhabitance of the study area.

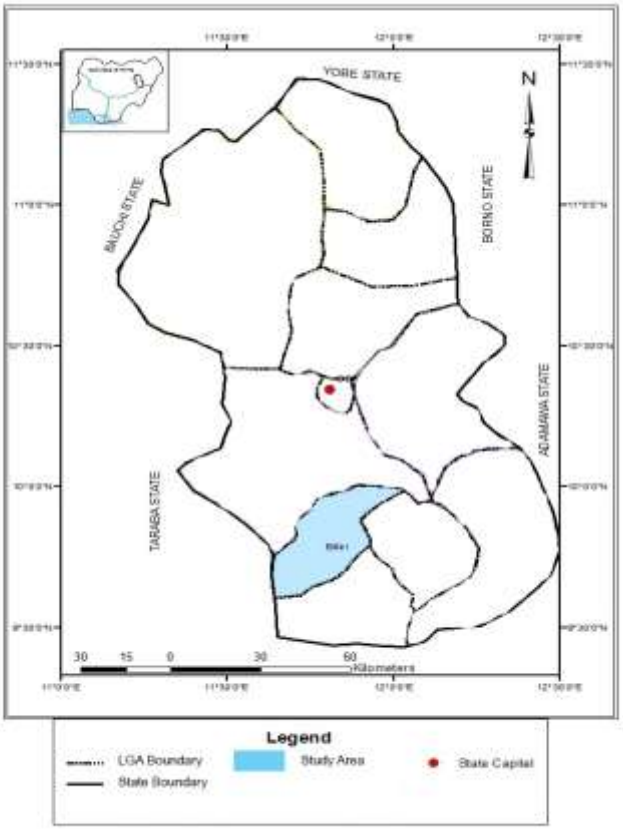

Fig. 1: Map of Gombe State showing the Study Area
Source: *Gombe State Ministry of Land any Survey Gombe (2012)*

MATERIALS AND METHODS

The data for this study was generated from both primary and secondary data source. The primary data was collected through the use of questioners to the determine the farmers' perception on impact and coping strategy to climate variability while The secondary data (Rainfall) was obtained from Gombe State Agricultural Development Programme (GSADP) Ladongor station for the period of Forty (40) years. Only respondent that are up to thirty years and above were administered the questioners. In selecting the sample size, 50% of the villages and the respondent whom are the beneficiary of the Noman Zamani (NZ) from Area II Village Extension Area (VEA) of the (GSADP) were purposively selected. Then, random sampling was used to select villages in which questionnaire will be administered. This formed the sample size of six (6) villages out of the eleven (11) villages. Because of the disparity in population distribution among the selected villages benefiting NZ and the need for adequate representation, Cochran (1977), proportional technique formula was used to determine the number of respondent in each selected villages as indicated in table 1.

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

where Nh = Population

N = Sample size

n = Total number of respondents

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

Table 1. Sample Population

Area II VEAs of the GSADP	**50% of VEA**	**Name of the Sample Village**	**Members of SCAP**	**Sample Population**
Lakwakka, Lasale, Sansani, Amuta, Ladongor, Lapinde, Lawiltu, Tangin, Laushi Dagi, Fai, Pisswokko	6	Lakwakka	34	19
		Sansani	74	41
		Fai	31	17
		Lawiltu	52	29
		Tangin	25	14
		Pisswokko	43	25
Total			**259**	**145**

Source: NZ (2017)

Descriptive statistics was used ascertain the farmers' perception on the climatic variability, impact and coping strategies and time series was equally used to determine the rainfall pattern in the study area. The result obtained was presented on Charts and tables. Statistical package for social science (SPSS) was used to carry out the analysis.

RESULTS AND DISCUSSION

Socio-Demographic Characteristics of the Respondent

The results presented in Table 2 indicate the socio-economic characteristic of the respondent, ages 40-49 have the highest percentage of 54% followed by age 50 – 59 with 27% which shows that active farming age fall between these range which is in agreement with the findings of (Burton, 2000) and (Arimi, 2014). While ages 50 and above indicated decline in farming activities. Considering sex, 74.5% are male while 26.5% where female, these implies that male are the predominate group among the farmers in the study area, this finding support the report of (GSADP, 2014) which shows that most farming activities is carrying out by male in most northern Nigeria.

Educational qualification of the respondent shows most of the farmers obtained senior secondary school certificate with about 37.2% followed by non-formal education with 22.1% and the least are those with junior secondary school with about 4.8%. This finding is not in agreement with the work of (Yila, 2000) who stated that the people of the locality are highly educated compare with other part of the state in general.

Table. 2 Socio-demographic Characteristics of the Respondents

Age	Frequency	Percentage
30 – 39	16	11
40 – 49	78	54
50 – 59	39	27
60 >	12	8
Sex		
Male	38	26
Female	107	74
Education		
Non Formal Education	32	22.1
Primary	18	12.3
Junior Secondary School	7	4.8
Senior Secondary School	54	37.2
Tertiary	34	23.6

Source: Fieldwork, 2017

Perceptional Impact of Climate Variability by Cereals Farmers in Billiri

The respondents in the study area show that there is an increasing incidence of drought 67.9%, dry spell 82.8%, temperature 82.8% and heat waves 60.7 while a decreasing incidence of rainfall 47.8, flood 76.6% and soil moisture 70% Table 3. Dry spell affect the growth, maturity and yield of cereals crops as presented in plate 1, none of the respondent report that there is no change in any of the climatic variables over the years, this implies that climate is changing in the study area.

Table 3. Farmers Perception on Climate Variability

Perceptions	Frequency	Percentage
Drought		
Increased	98	67.9
Decreased	25	17.2
No change	22	15.2
Flood		
Increased	24	16.6
Decreased	111	76.6
No change	10	6.9
Rainfall		
Increased	65	44.8
Decreased	69	47.8
No change	11	7.6
Soil moisture		
Increased	40	28
Decreased	102	70
No change	3	2
Heat Wave		
Increased	88	60.7
Decreased	54	37.2
No change	3	2.1
Dry Spell Days		
Increased	114	82.8
Decreased	12	8.3
No change	13	9.0
Temperature		
Increased	120	82.8
Decreased	12	8.3
No change	13	9.0
Totals	**145**	**100**

Source: Fieldwork, 2017

Plate: Impact of Dry Spell on Maize farm
Source: Fieldwork (2017)

Impact of climate variability on crop production

The impact of climate variability on crop production in the study area reveals that the farmers agreed that there is an increase incidence of crop diseases, poor yield and insufficient food supply in their homes and they equally disagree that it does not affect their production cycle and flood incidence Fig 2. The implication of this result is that the livelihood of the farmers is affected since they cannot be able produce as it is expected.

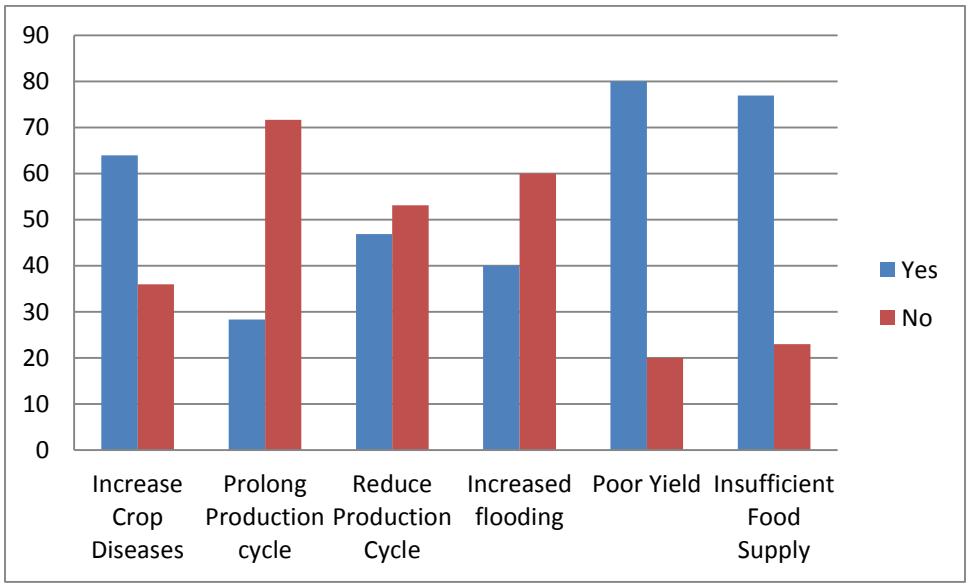

Fig. 2: Impact of climate variability on crop production **Source**: Fieldwork, 2017

Farmers Coping Strategies to Climate Variability in Billiri

The result of this findings shows that farmers adapt/ device ways of coping or combating climate change Fig 3.shows different and preferable ways local farmers adopt to this climatic variability. Most farmers in the locality use crop diversification followed by planting ahead of rain, cover cropping, planting deeper than usual and tolerant seed variety. The result is in agreement with the findings of (Ademola and Bello, 2014) who stated that the farmers in northern part of Nigeria should adapt mulching, used of improve seeds that can adopt the climatic change of the place, and early planting utilizing the first rain for crop production. Planting of drought resistant/improve variety of seed should have been the best option for the study area since their major impacts are increase in temperature, dry spell, drought and decrease in soil moisture.

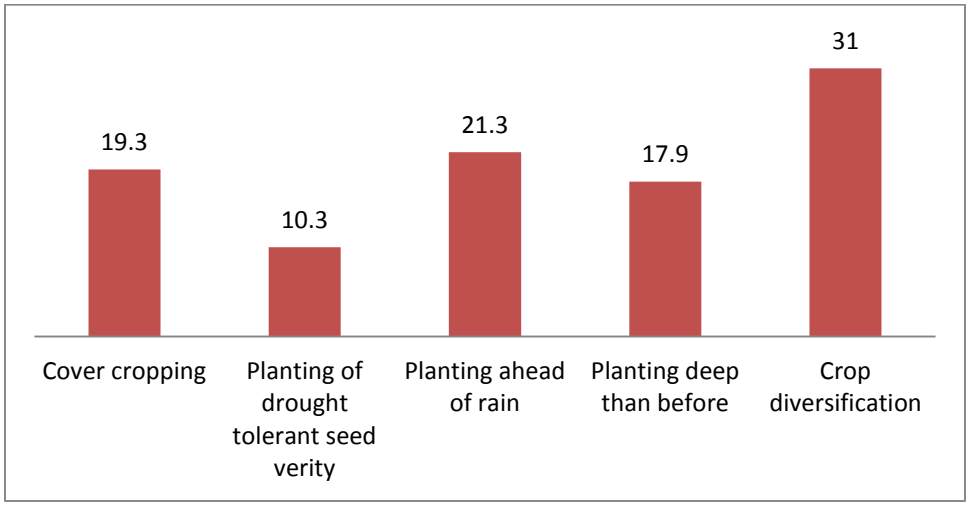

Fig. 3: Farmers coping strategies **Source**: Fieldwork, 2017

Rainfall Variability in Billiri

The rainfall data obtained from GSADP station reveals that throughout the period of forty years there has been constant fluctuation of annual rainfall totals in the area (Figure 4). The year 1989 has the highest volume of 1407.9mm and 1987 has the lowest volume of 363.8mm of rainfall while the range of the rainfall is 1044.1mm which is very wide, and the average rainfall is 787.4mm. The implication of this result is that the farmers in the study area are not sure of the volume of rainfall they will receive therefore they cannot be able to know what type of plant to grow and when to plant due to consistence variation of rainfall volume.

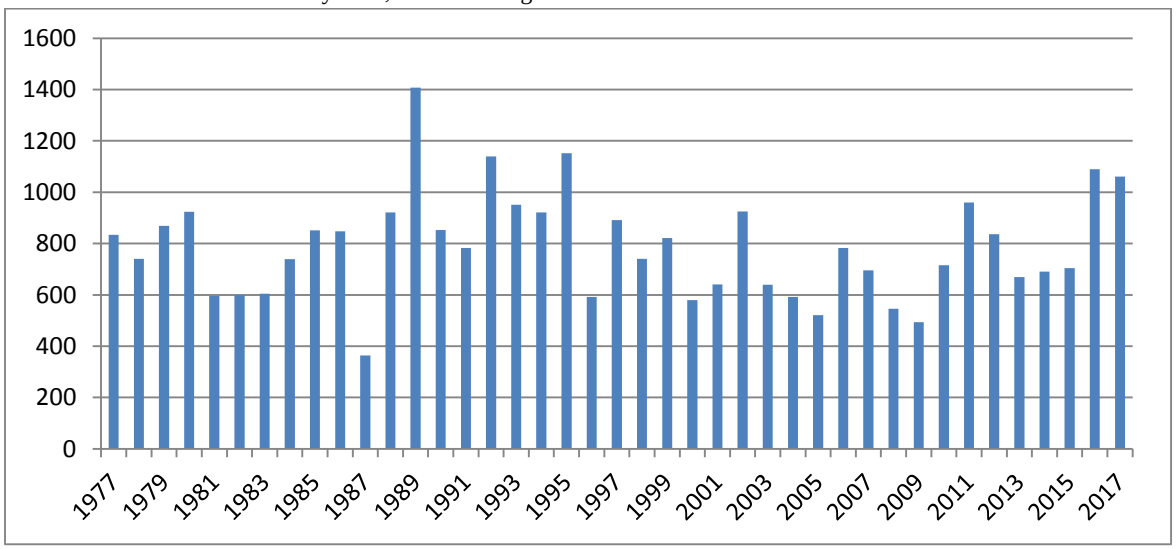

Fig. 4: Rainfall Total in Billiri from 1977-2017

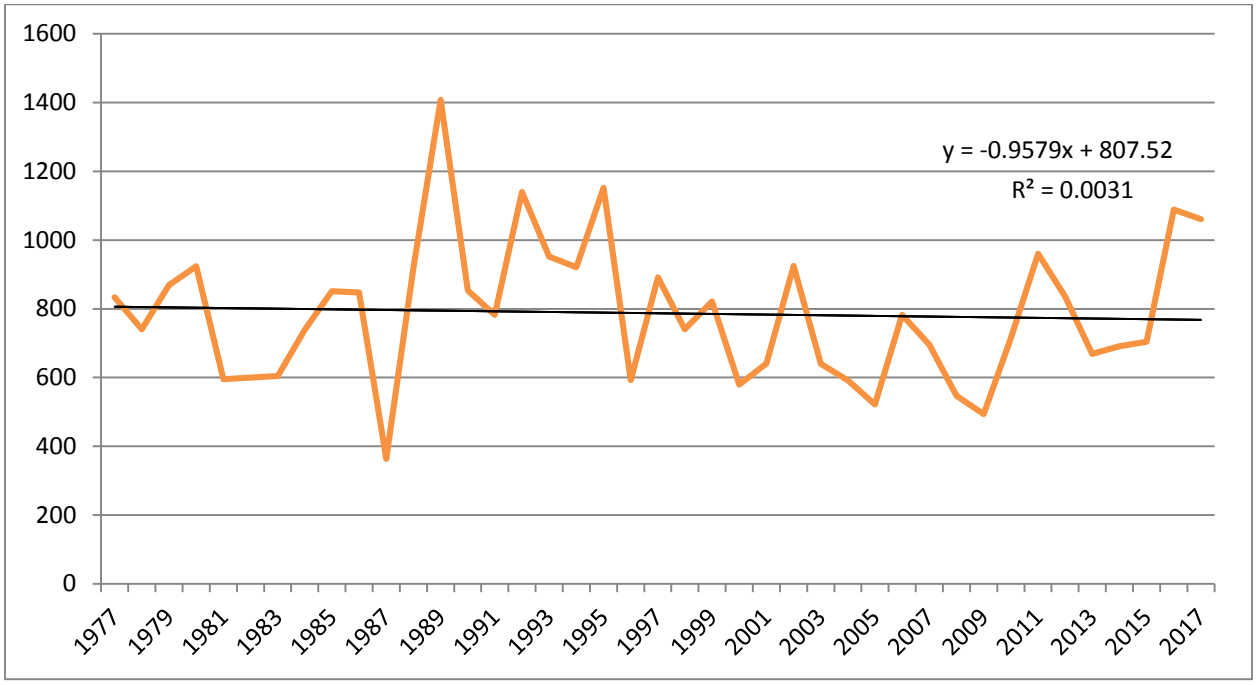

Fig. 5: Trent of Rainfall in Billiri

The rainfall pattern of Billiri LGA has been fluctuating over time. The data on volume of rainfall from 1977 – 2017 obtained from GSADP shows a decreasing trend (Fig.5). This contrasts with Abdulrahim (2012) revealed an increasing trend of rainfall in Sokoto. The mean value of volume of rainfall and its standard deviation over the period are 794.13mm and 212.752mm, this imply that there is high inter- annual variability in volume of rainfall value over the years in the study area. The correlation coefficient of the rainfall totals and the time is 0.0031 which implies a week correlation with a negative relationship between rainfall totals and the time, there is a wide range of deviation between the mean and standard deviation of the rainfall volume in the study area (Table 4). The implication of this result will have a negative effect on crop production in Billiri.

Table 4: Analysis Rainy Day Data of Billiri from 1977 -2016.

Statistics	**Values**
Mean	42.400
Std. Deviation	8.6641
Minimum	27.00
Maximum	60.00
Correlation	0.0031

Conclusion

Majority of the farmers in the study area admit that radio is their major source of information about climate variability and had positively influenced their farming activities. The perceived impact are increase in temperature, dry spell, drought, heat waves, decrease in rainfall and soil moisture while the observed impact are increase incidence of crop diseases, poor yield and insufficient food supply in their homes and an unstable rainfall patterns. The farmers used crop diversification, planting ahead of rain, cover cropping, planting deeper than usual and tolerant/improved seed variety as copping strategies. The farmers lack the resources to expand the scale of their production and other copping strategies due to insufficient information on weather and climate.

The study recommended that extension worker should provide current scientific weather information to the farmers, government should provide soft loan to the farmers to expand their scale of production and community leaders are to form farmers clubs so that the can build their capacity against any form of challenge facing their farm practices.

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