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IMPACT OF CLIMATE VARIABILITY ON YAM PRODUCTION IN SHIRORO LOCAL GOVERNMENT AREA, NIGER STATE, NIGERIA.

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ABSTRACT

Climate is described as change as long-term in the statistical distribution of weather pattern over a period of time that ranges from decade to millions of years. Rainfall characteristics in Nigeria have been examined for secular change that is, dominant trend and the results show that there has been a progressive early retreat of rainfall over the whole country spanning up to a half a century now and consistent with this pattern there has also been a significant decline of rainfall frequency. This paper assesses the impact of climate variability on yam yield in Shiroro Local Government Area of Niger State and the adaptive and mitigative measure used for effects of climate variability on yam yield. Qualitative and quantitative research approach was used, rainfall records for 30 years (1988-2018), Yam yield record for 20 years (1998-2018) and structural questionnaire was used. Trend, correlation and descriptive analysis were used. Findings shows that rainfall between 1988 and 2018 have a slightly decreasing trend in the study area and annual yield of yam was observed that 2016 has the highest record of yam yield in the study area with 2923.73 metric tons, followed by 1999 with a 2873.36 metric tons of yam yield. Years 2010 recorded the lowest yield of yield with 2411.45 metric tons. It shows a positively weak relationship thus r = 0.46 (46%). It means that rainfall variations are very crucial to the yield of yam and has a significant value of 304. Different strategies were adopted to cushion the effects of rainfall on yam yield and the most used method is with 83.1% use early maturing crop variety. The paper concludes that rainfall in the study area has been inconsistence (fluctuating). The nature of rainfall in relation to Yam yield for the study period has been making the yields inconsistence (fluctuating). Thereby recommends that there should be climate monitoring stations for every agricultural zones of Nigeria and there should be time to time awareness and enlightment campaign on the causes of climate change in various parts of the country.

Key Words: Climate, Rainfall Variability and Yam yield.

INTRODUCTION

Agriculture is the biggest single industry in many less developed countries of the world (Etim, 2014). It plays a significant role as it contributes to the national food security, national social and economic stability and also to the environmental protection of the nation (Ziervogel, 2014). It provides not only food but also raw materials

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for most manufacturing industries of the country. Most countries, import and export large amounts of agricultural produces which brings about economic development of the world (Diao. 2010).

Crop production is an integral part of agriculture dealing with the cultivation, protection, harvesting and storage of cultivated plants for man's use. It is the sum total of all the activities involved in producing, preparing and processing of agricultural crops (Akanbi *et. al.*, 2004). Agriculture being one of the most weather-dependent of all human activities, is highly vulnerable to climate change; a variability that can have direct impact, or influence on the quantity and quality of agricultural production. The climate of an area is highly correlated to the vegetation and by extension the type of crop that can be cultivated. Nigeria's agriculture therefore depends highly on climate, because temperature, sunlight, water, relative humidity are the main drivers of crop growth and yield (Adejuwon, 2004).

Climate is described as change as long-term in the statistical distribution of weather pattern over a period of time that ranges from decade to millions of years (Adejuwon, 2004). Change in climate and consequent global warming are posing threats to food security in many developing nations including Nigeria because of the climate-dependent nature of agricultural systems and lack of coping capabilities. It is one of the most serious environmental threats facing mankind worldwide. It affects agriculture in several ways, including its direct impact on food production. Climate change, which is attributable to the natural climate cycle and human activities, has adversely affected agricultural productivity in Africa (Ziervogel, 2014).

The rainfall characteristics in Nigeria have been examined for secular change that is, dominant trend notably by Olaniran et al. (Olaniran, 2001) and by Olaniran (2000) and the results show that there has been a progressive early retreat of rainfall over the whole country spanning up to a half a century now and consistent with this pattern there has also been a significant decline of rainfall frequency that is, the number of rain days in September and October which respectively coincide with the end of the rainy season in the northern and southern parts of the country. Furthermore, the combined effect of these declines was found to lead to a significant decrease in annual rain days over the whole country. In effect, except farmers change to early maturing crop varieties, streamline their farming calendars with the changing rainfall regime or have access to irrigation water, the secular changes in rainfall frequency for the country pose serious threat to the maturity of annual crops and consequently to food security for the nation. Hence, the volatility of agricultural output due to rainfall fluctuation can mean a large burden for the low-income farming households (John, 2007).

Yams have had the second highest production level of any food crop in Nigeria in the past 50 years after cassava. Evans school policy analysis and research shows that production and area harvested have grown steadily until 2006 and 2007 respectively, after which production and area harvested have shown a decline. In 2010, the gross agricultural production value for yams was $15,041 million USD and accounted for the largest proportion of any crop in the country. Yams are agronomically, annual rain fed crops which grow for 6-12 months depending on the cultivar, ecology and soil properties in the production area (NRCR, 1998). They serve as staple food in many tropical and even sub-tropical countries. World yam production is about 30 million tons annually with 90% grown in the yam production belts of West Africa (FAO 2002).

Yam production in Nigeria has more than tripled over the past 45 years from 6.7 million tones 1961 to 39.3 million in 2006 (FAO, 2007). This increase in output is attributed more to the large area planted with yam than increase in productivity (Nwosu and Okoli; 2010). Though the cultivated area to yam has increased production, however the growth rate has declined tremendously from the average 27.5% between 1986 and 1990 to 3.5% in the 1996 to 1999 periods (Ekunwe *et. al.*, 2008). This decline in average yield per hectare has been more drastic, - from 14.9% in 1986-1990 to 2.5% between 1996-1999 (CBN, 2002; Agbaje *et al;* 2005 and FAO, 2007).

Shiroro local government area faces the threat of desert encroachment at a very fast rate per year occasioned by fast reduction in the amount of surface water, flora and fauna resources on land (Obioha, 2014). This makes people to exploit more previously undisturbed lands leading to depletion of the forest cover. On the other hand, those in coastal region are vulnerable to incessant floods, destruction of mangrove ecosystems, contamination of water and transmission of water borne diseases, leading to displacement and communal crisis (Odjugo, 2012). The resource poor farmers therefore faced the prospects of tragic crop failures which reduced agricultural productivity, increased hunger, poverty, malnutrition and diseases (Zoellick, 1013). International institute for tropical Agriculture (IITA) has developed various new technologies to produce yams in Africa during dry season (Shiwachi, 2013). The ecological constraints of the savanna zones have been overcome by the spontaneous effort of farmers to pick out the early maturing cultivars that adapt to short rainfall period (Orkwo, 2010).

This research acknowledges that there have been efforts and strategies made by various governments and other Agricultural agencies to improve and manage land resources in various places under study. The input and efforts put into agricultural initiatives by various governments and international agencies have not yielded much dividend in terms of sustainability. In other words, these efforts and strategies have either not been sustained or have failed dismally. The recurrent failure to sustain agricultural initiatives in developing countries and especially in Shiroro has resulted high price of food in the study area. Variations in the rainfall distribution of the past years have greatly affected agricultural activities. Therefore, this paper assess the impact of rainfall variability on yam production in Shiroro Local Government Area of Niger State.

Study Area

Shiroro Local Government Area was created in May 1989. It was formally part of Chanchaga local government area. Kuta, the headquarters of Shiroro Local Government also served as a one-time headquarters of Chanchaga Local Government Area, in 1976. Is located on the downstream of Shiroro dam which is on the Kaduna River near Minna, and it is on longitude 6° 44' 71'' E and latitude 9° 59' 113''N (Imo *et al.*, 2011).

The local government is made up of six districts as shown in the figure 1.1 below namely, Kuta, Galadima-Kogo, Manta, Gussoro, Gurmana, Allawa and Kushaka districts. Shiroro Local Government has an estimated population of 300,000. Gwari language is the major language spoken while other indigenous tribes such as Bassa, Gussoro and Gurmana are also predominant. Other tribes representing the diverse socio-cultural groups are equally found in this area, e.g. the Hausa, Fulani, and Igbo.

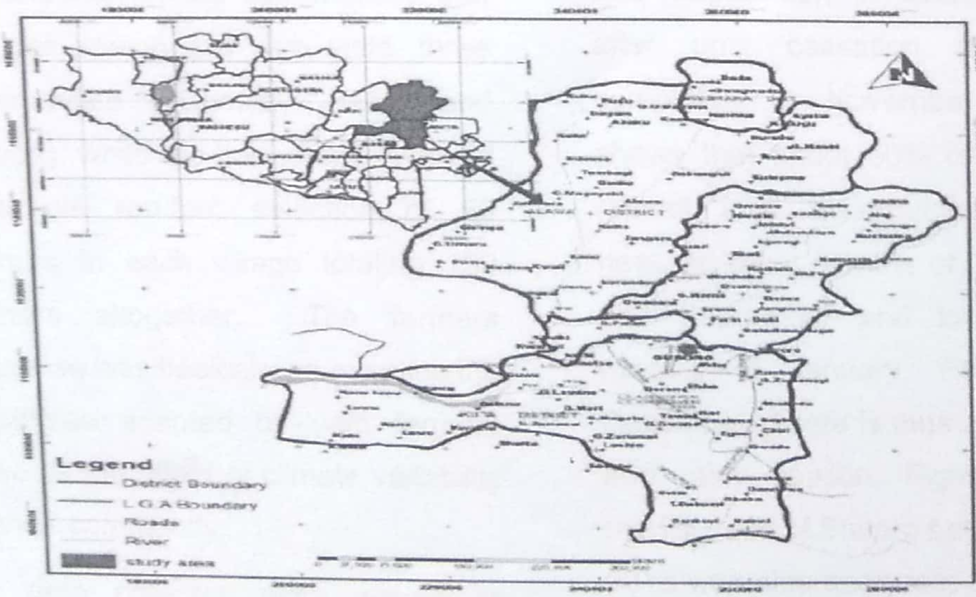

Figure 1: Study Area map

Methodology

Data used in this paper work were generated from both primary and secondary sources. A baseline survey was conducted at Shiroro local government area to determine the extent of yam yield in the area. Annual yield daily of yam production was obtained from Niger State Agricultural Development Programme while the monthly climatic data for 30 years (1988-2018) was collected from NIMET.

Samples were selected using multi-stage sampling technique. The first stage included purposive selection of Yam farmers in Shiroro local government area. This was followed by the selection of the communities that are well known has yam yield, three communities (Gusoro, Kuta and Gwada), while the third stage involved a simple random selection of 50 farmers in each village totaling 150 farmers altogether. The farmers response was basically on examine the strategies adapted by yam farmers towards the effect of climate variability in their community.

All data collected were subject to statistical analysis. Rainfall data was obtained for monthly basis for 30 years (1988 to 2018) and convert to mean annual values using the statistical technique. Time series analysis was used to calculate and linear trends analysis will be used to check the trends in climatic records. The responses from the questionnaire was analyzed statistically using descriptive statistics. Frequency analysis used to analysis the response of the farmers.

Results

Trend in rainfall over Shiroro Local Government Area (1988-2018)

The intra seasonal variation of rainfall over Shiroro shows that rainfall generally begins in March / April.It increases in the months of July, August and September. It decreases there after until cessation takes place completely in November. Figure 2 shows that about 50% of the annual rainfall total accumulates in three heaviest rainy months of July, August and September and lowest in the months of January, February and December. There is thus a marked dry and rainy season. Figure 3 shows rainfall trend of Shiroro between 1988 – 2018 was also analyzed; the deviation of mean annual values of rainfall over thirty (30) years. The deviation of rainfall negative between 1987and 1988. Between 1989 and 1991, the deviations are positive over a period of five years. On decadal basis, the years 1991 and 1994 have the highest deviations while the remaining years have very low deviations.

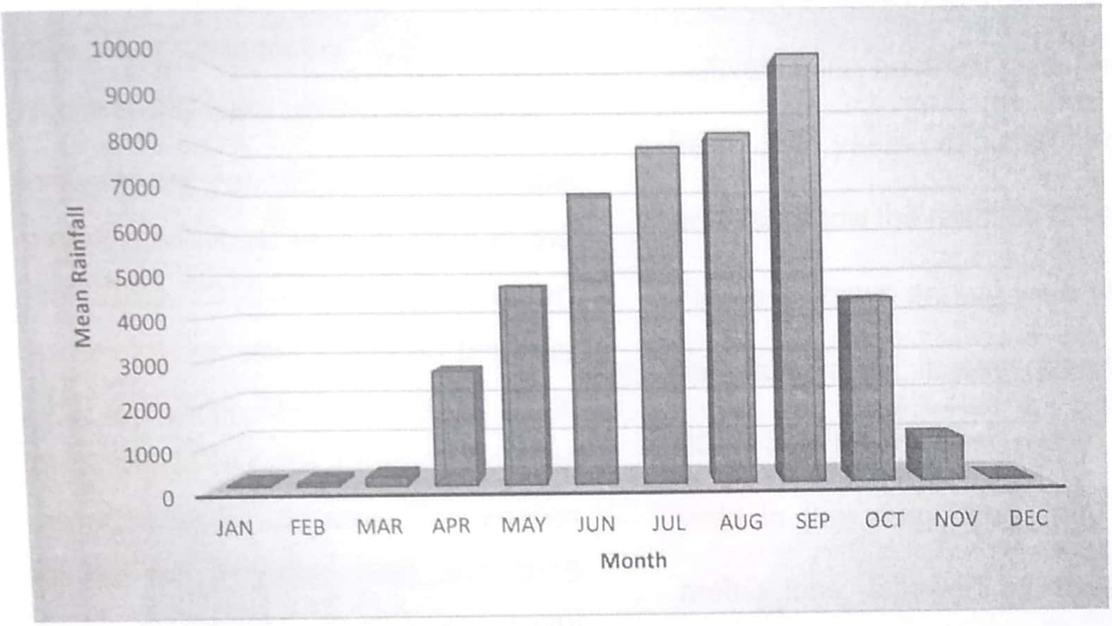

Figure 2: Mean Monthly Rainfall of Shiroro

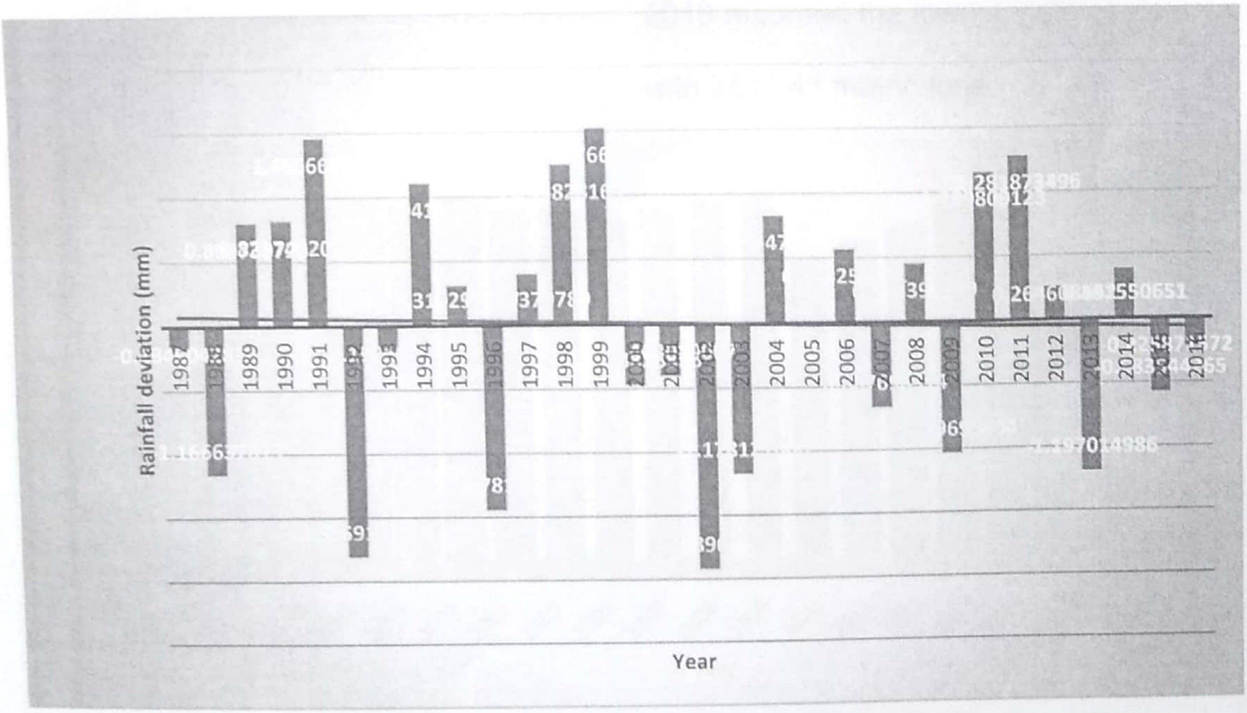

Figure 3: Rainfall deviation

The rainfall deviations increased between 1998 and 1999. On decadal basis, the years 1998, 1999, 2004, and 2006 have positive rainfall deviations while the remaining years have negative and least rainfall deviations.

Between the year 2008 and 2016, the rainfall deviations were positive in the year 2008, 2010 and 2011. However, the deviations were lowest in the year 2012 and 2014. The years 2009, 2013, 2015 and 2016 have a negative rainfall deviation within the area. This implies the rainfall between 1988 and 2018 have a slightly decreasing trend (graphically) in the study area.

Trend Yam yield in Shiroro Local Government Area (1998-2018)

The data on yam yield per tones covers a period of (20) twenty years, the area cultivated in hectare. The variations from the years depicted from this analysis show the reaction of yam yield. Figure 4 shows annual yield of yam in the study area, it was observed that 2016 has the highest record of yam yield in the study area with 2923.73 metric tons, followed by 1999 with a 2873.36 metric tons of yam yield. Years 2010 recorded the lowest yield of yield with 2411.45 metric tons.

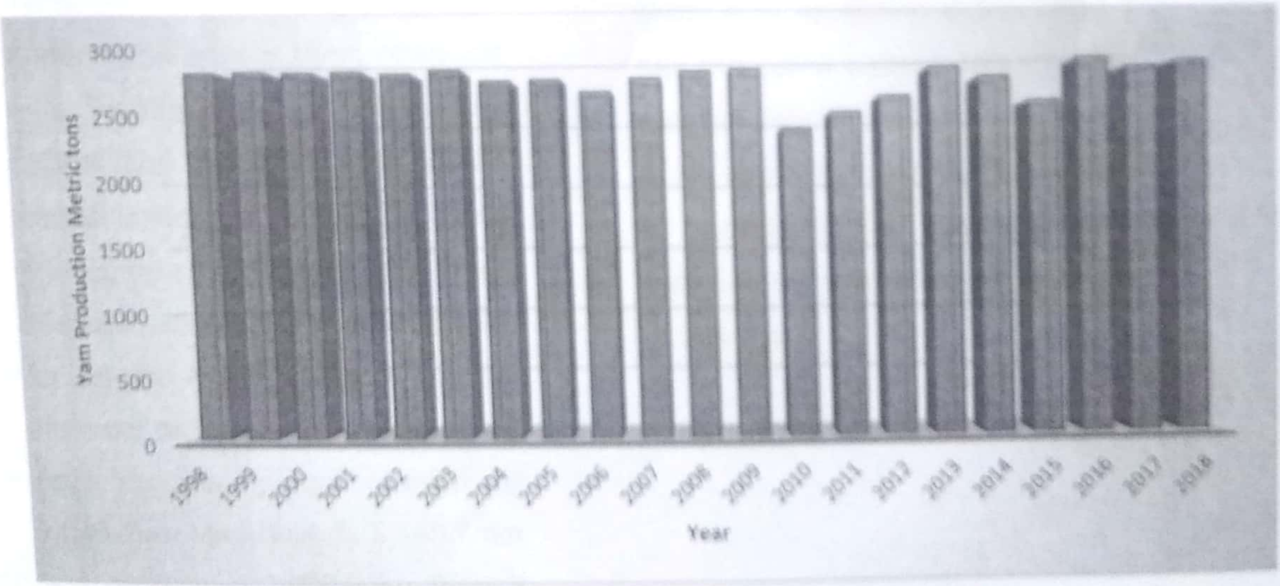

Figure 4: Annual yield of Yam in Shiroro Local Government Area

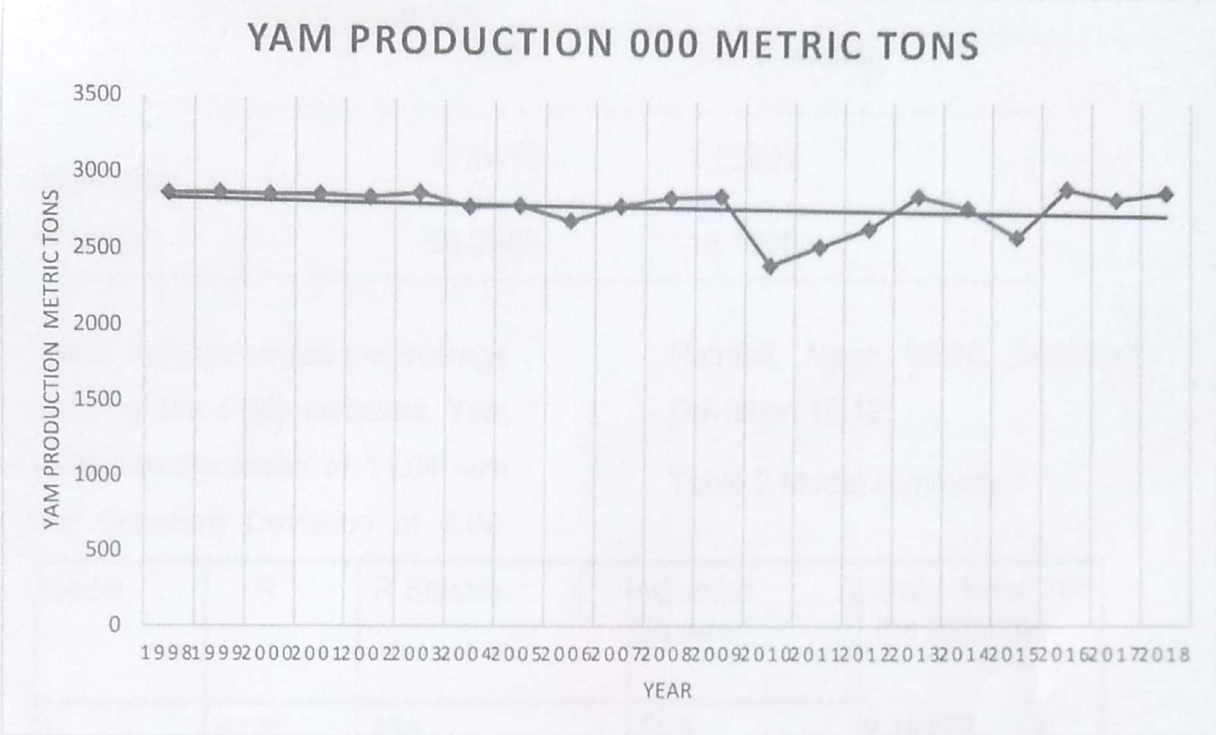

Figure 5: Trends in Yam yield

Relationships between rainfall variability and Yam yield

Aannual rainfall totals and annual mean (in mm) for study area from 1988 to 2018 as is been observed with 1,492.8 (mm) both the total rainfall and the mean, the lowest rainfall is recorded in year 2003 with the record of 761.5 mm. It is been observed that monthly rainfall total for all the years show a gradual increase of rain from April to June, April records a total rainfall of 1,345.mm. May records 2,140.7mm and June has 2,629.9mm then it progresses to the peak in September with sum amount of 4,182.9mm of planting in order to achieve a maximum yield and output. The average monthly rainfall in for the study area as shown in the Table 1 has the same pattern with the total monthly rainfall and the information is the same; but here the differences of rainfall in the study area in between the same months is shown in average.

Table 1: Descriptive Statistics

	Mean	Std. Deviation
Yam yield	11.0412	3.02409
Rainfall	96.2082	18.12001

Table 1 above shows the average mean of the study variables. Yam yield has the mean of 11.04 with the Standard Deviation of 3.02, Rainfall, Mean 96.20, Standard Deviation 18.12.

Table 2 Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.677[a]	.458	.322	2.48972

a.Predictors: (Constant), rainfall.

Table 2 above is the summary of the model which includes, relationships that exist between rainfall and yam yield. This shows a positively weak relationship thus r = 0.46 (46%). It means that rainfall variations are very crucial to the yield of yam in the study area.

Table 3: Dependent Variable: Yam Yield Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	-112.339	97.286		-1.155	.271
Rainfall	.052	.049	.313	1.074	.304

The coefficients in Table 3 are used to test the predictive values of rainfall. It shows that rainfall has a significant value of 304. The coefficients in the table shows that annual output of yam.

Adaptive Measures Practiced by Farmers in the Study Area

Adaptation to the adverse effects of climate variability is a key issue for all society, especially those in sub-Saharan Africa who are often the most vulnerable and least, equipped to defend themselves. Studies have shown that without adaptation, climate change is generally detrimental to the agricultural sector, but with adaptation, vulnerability can be largely reduced. Table 4 is the traditional adaptive practiced by the farmers in the study area. Table 4: adaptive measures practices in the area area to cushion the effects of climate on yam yield. It was observed that 63.1% planted now with early rainfall /onset, 83.1% planted mixed farming practices (possibly for economic purposes) 69.1% practice crop diversification, while 68.3% use early maturing crop variety, 73 process crops against post-harvest pest and moisture changes. 74.2% adjust land preparation based on prevailing condition and 83% adopted practice of planting cover crops to prevent soil erosion and inorganic fertilizer respectively. The practices of water harvesting in the area is low 14.4%. also use of information on climate change is low 33% among the framers. Similarly, use of minimum tillage or zero tillage to minimize GHG contribution is low 28.3%.

Table 4 shows the percentage distribution of respondents adopted different strategies for climate variability adaptation in the study

S/N	Indigenous adaptive measures	% Yes	% No
1	Use of organic manure (measures)	75.6	24.4
2	Use of inorganic fertilizer (measures)	69.5	30.5
3	Use of wind breakers (trees) on the farm	47.8	52.2
4	Planting pest and disease resistant seeds	49.6	50.4
5	Use of acclimated crop varieties	23.3	76.7
6	Staggered seed crop planting	57	43
7	Mixed cropping or crop diversification	69.1	30.9
8	Make of contour build around farmland (more with fadama/irrigation farming)	39.1	60.9
9	Use of minor tillage (zero tillage)	28.3	71.7
10	Varying farmland clearance or preparation date	74.2	25.8
11	Cover cropping (legumes, lemon etc.)	83	17
12	Use of water storage (small scale on farm water harvesting)	4.4	85.6
13	Reforestation /afforestation	37.1	62.9
14	Use of early maturing crop variety	68.3	31.7
15	Mulching of moisture protection practices	54.3	45.7
16	Seed preservation /plant seedling for next planting	78	22
17	Use of weather tolerant/resistant seeds	59.4	40.6
18	Mixed farming practices	83.2	16.8
19	Adjusting planting date	71.2	28.8
20	Planting of crop with early rainfall	63.1	36.9
21	Use of recommended planting distance (wider crop spacing)	41	59
22	Listening to information about climate change	33	67
23	Adjusting harvesting date	73.6	26.4
24	Out migration from climate risk area	28.3	71.7
25	Processing of crops to minimize post harvest pest and disease attack	73	27
26	Indigenous adaptive measures	70	30
27	Inter cropping	63.3	36.7

Source: Field Survey, 2019

Conclusion

The rainfall trend of the study area for the past thirty-one (31) years shows that rainfall amount has been very variable (fluctuating). The lowest rain fall occurred in 2004 which was 473.7mm in total and 1.3mm in average, while the highest rain fall was recorded in 2001 which was 1789.4mm

in total and 4.9mm in average. Indeed 4.9mm (the total of 1789.4mm) as the highest average of rain fall is still very low in agricultural yield even with the short time crops. Most of the respondents are aware of climate change. The farmers got the knowledge of climate change through the knowledge of geography; through ordinary observation of the weather and climate; through media; and through agricultural extension officers. Rainfall of the study area for the period under study and as of these recent years has been inconsistence (fluctuating). The nature of climate in relation to Yam yield for the study period and as of recent years has been making the yields inconsistence (fluctuating). Based on the major findings of this study the following recommendations are put forward toward the issue of rainfall variability on yam yield in Shiroro Local Government Area of Niger State. There should be climate monitoring stations for every agricultural zones of Nigeria and there should be time to time awareness and enlightment campaign on the causes of climate change in various parts of the country.

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