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Effect of Climate Variation on Cassava Production in Yakurr Local Government Area, Cross River State, Nigeria

[1]Oniah, M. O. and [2]Edem, T. O.
Department of Agricultural Economics and Extension,
University of Cross River State, Obubra Campus, Obubra, Nigeria.

***Corresponding Author Email:** oniahmon@yahoo.com

ABSTRACT

This study was carried out to examine the influence of climatic variation on cassava production in Yakurr local Government Area of Cross River State, Nigeria. The study were described the socio-economic characteristics of the cassava farmers in the study area, identified major climatic factors influencing cassava production in the study area, examined the perceptions of cassava farmers on the effects of climatic variations on cassava production, and identified coping strategies adopted by the cassava farmers to improve on cassava production in the study area. A random sampling technique was used to select 117 cassava farmers. Data were collected with the use of a questionnaire and were analyzed using frequencies, percentages, mean and chi-square (X^2). The study found out that 58.12% were male with a mean age of 38 years and were married (46.15%). 56.41% had a household size of 1-6 persons, more than 88% had attained formal education, and 41.88% had 11 to 15 years of farming experience. The mean farm size of the farmers was 1.4 hectares with a mean annual income of ₦115,28 per hectare. About 42.74% were members of cooperative societies. Major climatic elements that affected cassava production were temperature, rainfall, sunshine, relative humidity and wind. The chi-square results showed that there was a perceived significant ($p<0.05$) influence of climatic variation on cassava production in the study area. The major problems of climatic variation were irregular rainfall pattern, rotting of cassava tubers and drought. It is recommended that improved cassava varieties resistant to extreme weather conditions be adopted by the cassava farmers as coping measures on climate variation effects on cassava production in the area.

KEY WORDS: Climate change effect, cassava production, coping strategies

INTRODUCTION: Cassava (Manihot esculenta) is a native of South America and is extensively cultivated as an annual crop in tropical and sub-tropical environments for its edible starchy tuber as a root. Cassava is one of the most important staple food crops after rice and maize in Africa and is a source of energy all year round. Over 90% of Nigeria's rural households on a daily basis consume cassava product in one way or the other. Therefore, cassava is an important factor in food security, as it helps in poverty alleviation (IPCC,2011). However, in recent times, climate change (extreme temperatures, flooding, drought, and increased salinity of water) has become a global issue with increasing intensity due to its significant challenge, particularly in developing countries like Nigeria (IPCC,2011). According to the Intergovernmental panel on climate change, IPCC (2004), African countries are the most vulnerable to the impact of climate change due to a lack of economic, development, and institutional capacity. Ajetombi and Abiodun (2010) attributed these to widespread poverty caused by slash and burn agriculture, greenhouse gas emissions, firewood burning, and farm residues.

Climate change has a significant effect on agriculture productivity, especially in rain-fed agriculture production systems (IPCC, 2011). Though the threat of climate change is universal, agricultural production activities are generally more vulnerable than other sectors. The vulnerability of the Nigerian agricultural sector due to climate variation is of particular interest to policy makers because agriculture is a key sector in the economy, accounting for between 60 and 70% of the labour force and GDP contribution. The extent of climate variability's role in Nigeria's agricultural productivity is still under research, but the decline in major crop production since the 1970s drought is considered the first evidence of climate variation in agricultural production. The Inter-governmental Panel on climate variation (IPCC) has projected that if greenhouse gas emission continues to rise, the mean global temperature will increase from 1.4 - 5.8^{O}c by the end of the 21st century (IPCC, 2011).

Despite efforts by past government on some agricultural programs (Operation Feed the Nation (OFN), the Green Revolution, River Basin Development Authority to mention but a few) aimed at revitalizing the agricultural sector, there's a persistent challenge in the supply of certain staple foods including cassava products in Nigeria. Given the fact that agriculture depends largely on the climate and other environmental factors, any change in climate is bound to constrain the sector and other socio-economic activities. These constraints may be positive or negative. Presently, negative seasonal variations and changes brought on by climate change pose a threat to cassava production globally (FAO, 2022). Without a high level of awareness on variability in climate change, there may be a loss in Nigeria's GDP by 2050, thereby, compromising the attainment of 2025 Millennium Development Goals and objectives in food self-sufficiency. Oniah (2019) observed that climatic variations influenced the output of sweet potato in Cross River State, Nigeria. Also, Oniah, Kuye and Ettah (2017) noted that yam farmers experienced declined in yield of yam output in Obubra Local Government Area as a result of changes in climatic patterns which also led to the reduction in the farm income of the farmers.

Over the years, many researches has been on soil fertility and the agronomic parameters that may improve cassava production, but little has been done on climate variation and change in the cassava production industry in Yakurr Local Government Area. Given the above, there is a need to identify some major climatic factors that affect cassava production and the coping strategies adopted by the farmers to mitigate the influence of climate variation in cassava production in the area. Specifically the study described the socio-economic characteristics of cassava producers in the study area; identified the major climate variations on cassava production and assess farmers perceptions of climate elements on cassava production in the study area.

METHODOLOGY: The research work was carried out in Yakurr Local Government Area. Yakurr is one of the six Local Government Areas in the Central Senatorial District of Cross River state, Nigeria. Yakurr has thirteen wards: Assiga, Inyima, Afrekpe/Epenti, Ajere, Ntan, Mkpani/ Agoi, Abanakpai, nkpolo/ukpawen, Bikobiko, Ikpakapit, Ijiman, Ijom, and Idomi. The study area has a population of about 78, 402 inhabitants and located between latitudes 5^{0}10$^{`}$N and 6$^{0}$51$^{`}$N of the Equator and longitudes 4^{0}40$^{`}$E and 8$^{0}$32$^{`}$E of the Greenish meridian (National Population Commission, NPC, 2006). The area has an annual rainfall distribution ranging from 1,200mm to 1, 324mm, with an annual temperature of between 25^{0}C- 31^{0}C. Farming is the major occupation of the people in the area. Crop like cassava, yam, maize, rice and plantain are grown for consumption and for sales.

The study employed random sampling technique to select respondents from all the thirteen (13) wards of the study area. Hence all the communities in the study area cultivate cassava. Using a proportionality factor of 10%, respondents were randomly selected from the list of registered cassava farmers obtained from the FADAMA extension agents in charge of the study area. This was summarized in table 1 below.

Table 1: Selection of respondents for the study

Wards	Sample frame	Sample size

Assiga	110	11
Inyima	90	9
Afrekpe	80	8
Ajere	70	7
Ntan	90	9
Mkpani/Agoi	90	9
Abanakpai	110	11
Nkpolo/ukpawen	100	10
Bikobiko	80	8
Ikpakapit	70	7
Ijiman	110	11
Ijom	90	9
Idomi	80	8
13	1,170	117

Source: Field data, 2022

Data used for this study were generated principally from primary sources. These were collected with the aid of a questionnaire. Information were collected on: socio-economic characteristics of the cassava farmers (age, sex, marital status, annual income, farming experience, educational level and household size), major climatic elements that influence cassava production, perceptions of the respondents on the influence of climatic variables of cassava production and the various adaptation measures employ by the farmers to mitigate climatic variations in the study area. Some information were collected from relevant reviews of literature, FADAMA reports, Cross River Geographical Information Agency (CRGIA) and the Ministry of Agriculture reports.

Descriptive statistic such as frequency distribution, percentages, means and Chi-square analysis were used to achieve the objectives of the study. The chi-square (x^2) model is expressed thus $X^2 = \frac{\Sigma^k (O - E)^2}{E}$

where: X^2 = Chi square, O = Observed value, E = Expected value, K = Category of observation.

RESULTS AND DISCUSSION

Socio-economic characteristics of cassava farmers in Yakurr LGA.

Table 2: Socio-economic characteristics of cassava farmers in the study area

Variables	Frequency	Percentages (%)	Mean (average)
Gender			
Male	68	58.12	
Female	49	41.88	
Age (years)			
21-30	23	19.66	
31-40	27	23.08	
41-50	31	26.49	38 years
51-60	30	25.64	
61 and above	6	5.13	
Marital status			
Single	29	24.79	
Married	54	46.15	
Divorced	17	14.53	
Widowed	17	14.53	
Household size			

1-6	30	25.64	
7-10	66	56.41	8 persons
11 and above	21	17.95	
Educational level			
Never attended school	14	11.97	
Primary school	25	21.36	
Secondary school	55	47.01	
Tertiary school	23	19.66	
Farming experience			
1-5	12	10.26	
6-10	30	25.65	11 years
11-15	49	41.88	
16 and above	26	22.3	

Source: Field survey, 2022

Table 2 shows that majority, 58.12% of the farmers were male, while 41.88% were female, implying that males are involved in cassava farming than their female counterparts. The high percentage of male cassava farmers obtained in this study agreed with the findings of Kuye and Edem (2019) who reported that males (56.6%) were more involved in cassava production than women in Nigeria. The variable of age on Table 2 shows that about 49.57% were within the age brackets of 31-50 years of age. This implies that the cassava farmers are in their economically active age of farming. The mean age of the farmers was 38 years. This finding is in agreement with Ezekiel, Olawuyi, Ganiyu, Ojedokun and Adeyemo (2012), who observed that farmers within 31 and 50 years are productive.

The results presented in table 2 shows that about 46.15% of the cassava farmers in the study area were married. This may reduce the cost of hired labour if the farmers engage their families especially adults in the activities on the farm. The study of Samuel, Caleb and Ogonna (2019) also showed that in Cross River State and Imo State of Nigeria, married people are more involved in cassava production.

The results on household size revealed that 56.41% of the respondents had a household size of 7-10 persons. The mean household size of the farmers was eight (8) persons per family, implying that the cassava farmers in the study area had a reasonably large size that can be utilized as family labour in cassava production. A larger family with higher number of adult children would enable small-scale cassava-based farmers to have enough labour to work in the farm (Kuye and Edem, 2019). As shown on Table 2, the result on the variable of educational level shows that majority 47.01% had secondary school education. By this result, the farmers can read and write since they have attained formal education. This education affords a cassava farmer the opportunity to understand the changes that may occur in their cassava farmlands. In line with this finding, Kuye (2019) who opined that since the cassava farmers in South-South, Nigeria were moderately educated, they will be able to understand the operations in their cassava enterprise. Table 2 also shows that in the variable of farming experience, 41.88% had a farming experience of 11-15 years, while 10.26% had a farming experience of 1-5 years. The average years of experience in cassava farming was 11 years. With a higher level of farm experience, it is expected that a cassava farmer could better understand the cultivation process and observe any changes that might occur as a result of climate variation.

Influences of climatic variation on cassava production

Table 3: Response of cassava farmers to climate variation in the study area

Response	Frequency	Percentages (%)
Yes	83	70.94
No	34	29.06

Total	117	100

Source: Field survey, 2022

The results presented in table 3 shows that 70.94% of the respondents agreed that they perceived some influences of climate variation in their cassava farms, while 29.06% did not observe any influences of climatic variation on their cassava farms. This result implies that the cassava farmers in the study area have a level of awareness on the phenomenon of climate change and as such could clearly point out the influences of climate variations on their cassava farm. Concordantly, Defang, Manu, Bime, Tabi and Defang (2014) observed that farmers in Cameroon were very much aware of the negative influences of climate variation on their production levels.

Table 4: Major climatic elements influencing cassava production in the study area

Climate element	Very severe	Severe	Moderately severe	Not severe	Mean	Remark
Temperature	34	23	42	18	2.62	Severe
Rainfall	48	32	27	10	3.04	Very Severe
Sunshine	45	43	18	11	3.01	Very severe
Relative humidity	21	52	24	20	2.63	Severe
Wind	32	22	43	20	2.56	Severe

Source: Field survey, 2022

Mean $\leq$ 2.5 = Severe

Mean $\geq$ 2.5 = Very severe

Table 4 reveals that there are five (5) major climatic elements influencing cassava production in the study area. The table shows that the most severe elements that influenced cassava production were rainfall (3.04) and sunshine (3.01). This is as a result of the fact that excess rainfall and sunshine will lead to rotting of the tubers and wilting of the stems of cassava while low sunshine will hamper on vegetative growth of cassava stems. Studies of Ezekiel *et al.*, (2012) reported that high sun intensity results in high evaporation and evapotranspiration which reduces the water content of the soil and plant, subsequently affecting the level of production of the plant. Other climatic elements include temperature (2.62), wind (2.56) and relative humidity (2.63). Confirming the results obtained in this study, Oyeneke and Madukwe (2010) observed that precipitation (rainfall), soil moisture and sunshine are the major climatic factors affecting cassava production in Nigeria. Oniah (2023) studies also reported temperature (3.01), rainfall (3.08), wind (3.23) and sunshine hours (2.57) as the major climatic factors affecting cocoa production in Central Agricultural Zone of Cross River State, Nigeria

Table 5: Chi-square (X^2) analysis of the perceptions of cassava farmers on climate variation in the study area

Variables	Observed (O)	Expected (E)	O-E	$(O-E)^2$	$(O-E)^2/E$
Decline in yield	34	117	-83	6889	58.88
Increase in yield	18	117	-99	9801	83.77
Reduction in income	8	117	-109	11881	101.54
Pests and diseases attack	45	117	-72	5184	44.31
None of the above	6	117	-111	12321	105.31
All of the above	6	117	-111	12321	105.31
			X^2		**499.12**

Source: Field survey, 2022.

Table 5 presents the chi-square (X^2) analysis results for the perceptions of cassava farmers to the influences of climatic variation in the study area. The results showed that the calculated value was 499.12 while the tabulated value at 5% ($p<0.05$) and df of (6-1 = 5) of 11.070. This implies that the calculated value is greater than the tabulated value and as such there are perceived influences of climatic variation on cassava production in the study area. This result agrees with that of Mbanasor, Nwachkwu, Agwu and Onwusiribe (2015) who reported a significant influences of climate variations on agricultural productivity in Nigeria. It however, disagrees with the findings of Ezekiel *et al.* (2012) who reported an insignificant effect of climatic variations on cassava production.

Problems caused by climatic variation in the study area

Table 6: Major problems caused by climatic variation in the study area

S/no	Problems	N	%
1	Irregular rainfall pattern, resulting to shift in planting dates	26	22.22
2	Flooding and erosion of farmlands	22	18.81
3	Rotting of cassava tubers due to excessive heat from sunshine	19	16.24
4	High wind storm leading to breaking of cassava stems	14	11.97
5	Low soil moisture leading to poor sprouting of cassava stems	12	10.26
6	Early cessation of rainfall resulting to low yield	9	7.69
7	Late cessation of rainfall leading to rotting of cassava tubers	6	5.12
8	Water-logging in soils leading to cassava tuber rotting	4	3.42
9	High temperature from sunshine leading to stem and leaves	3	2.56
10	Heavy rainfall causing poor growth and yield of cassava	2	1.71
	Total	**117**	**100**

Source: Field survey, 2022.

Table 6 shows the various problems arising from the effects of climatic variation on cassava production in the study area. The result shows that the major problem was irregular rainfall pattern (1st), which results to changes in the planting dates for cassava. Other problems include flooding and erosion (2nd), rotting of cassava tubers (3rd), high wind storms leading to breakage of cassava stems (4th) and low soil moisture (5th). Also, early cessation of rainfall (6th), late cessation of rainfall (7th), water-logging in soils (8th), high temperature from excessive sunshine (9th) and heavy rainfall (10th) all leading to detrimental effects on cassava production in the study area. According to the Integrated Regional Information Networks (IRIN), increased drought and floods due to higher temperature has led to greater crop yield losses in Nigeria (IRIN, 2013). This result is in line with the findings of Olusegun and Olaniran (2010) and Ezekiel, Olawuyi, Ganiyu, Ojedokun and Adeyemo. (2012) who reported that major problems arising from climatic variation in cassava production include erosion and flooding, water logging, heavy rainfall and high temperatures resulting to significant changes in crop growth and yield.

Strategies adopted by cassava farmers to mitigate climate variation in the study area

In order to determine the adaptation strategies adopted by cassava farmers in adjusting to the impacts of climate change on cassava production in the study area, descriptive statistics was adopted. The results are presented in table 7.

Table 7: Strategies adopted by cassava farmers to mitigate climate variation in the study area

S/no	Strategies	N	%
1	Planting of cassava varieties resistant to climate effect	24	20.51
2	Application of fertilizer to improve soil fertility	23	19.66
3	Inter-cropping cassava with other crops	18	15.38
4	Planting trees in farmland to reduce wind damage	14	11.97

5	Increasing the size of ridges/heaps for planting cassava	12	10.27
6	Planting of early maturing cassava varieties	10	8.55
7	Proper drainage of the farm to control water-logging	6	5.12
8	Late planting of cassava stems	5	4.27
9	Planting of high-yielding cassava varieties	3	2.56
10	Use of mulch materials to reduce the temperature heat	2	1.71
		117	100

Source: Field survey, 2022.

The result on Table 7 shows that among the strategies that have been adopted by the cassava farmers in the study area to tackle the effects of climate variation are planting of cassava varieties resistant to climate change (20.51%), application of fertilizer to improve on soil fertility (19.66%), and inter-cropping cassava with other crops (15.38%) and planting trees in farmland (11.97%), were the major adaptation methods adopted. Improved cassava varieties resitant to climate change have been proven to be efficient in terms of yield, quality, and resistance to pests and diseases (FAO, 2022). Farmers diversified their crops in order to spread the risks and challenges presented by changes in weather condition. Planting cassava in ridges/heaps was practiced by 10.27%, 8.55% practiced planting early maturing varieties, 5.12% practiced late planting of stems, and 4.27% practiced late planting of cassava stems as climate change adaptation strategies in other to overcome these harsh weather conditions. Also, planting of high-yielding cassava varieties was adopted by a very low percentage (2.56%) of the farmers followed by use of mulch materials which was practiced by negligible proportion (1.71%) of the farmers which is relatively very poor as well. Correspondingly, Kalu and Mbanasor (2020) in their studies reported that use of improved crop variety (92.81%), mixed cropping (79.86%), crop diversification (77.1%), multiple planting dates (72.1%), fertilizer application (60.7%), irrigation practices (45.7%), planting of trees (27.1%) were adaptation strategies practiced by the farmers to mitigate climate change. Cassava farmers in Ebonyi State adapted planting improved cassava varieties (95.9%), planting different crops (96.9%), and diversification (94.9%) as adaption methods (Osuji, Igberi and Ehirim (2023).

Table 7: Chi-square test result

Chi-square ($\mathbf{X^2}$) calculated	499.12
Chi-square ($\mathbf{X^2}$) tabulated	11.070

Note: If X^2 calculated is greater than the X^2 tabulated value, accept the alternate, otherwise reject.

Test of hypothesis: Testing the null hypothesis that "there is no significant relationship on the effect of climate variability and cassava yield in the study area" using the Chi-square test. The results presented in table 8 revealed that the calculated value of 499.12 was greater than the tabulated value of 11.070, at 5% level of probability, in which case the null hypothesis is rejected and its alternative form accepted, implying that there is a significant relationship between climate variability and cassava yield as perceived by the cassava farmers in the study area.

CONCLUSION: Based on the results obtained in this study, it is concluded that the cassava farmers are generally small-scale farmers and they are affected by the effect of climate changes in cassava production in the study area. The Chi- square result showed that the calculated value was 499.12 while the tabulated value at ($p<0.05$) was 11.070 indicating that the cassava farmers perceived effect of climatic variation on cassava production in the study area. The study recommends that, awareness creation on climatic threats be given to cassava farmers on how to tackle the effects of climatic variations. Cassava farmers should be encouraged to plant improved cassava varieties resistant to climate threats in the study area.

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