FUDMA Journal of Agriculture and Agricultural Technology
ISSN: 2504-9496
Vol. 10 No. 3, September 2024: Pp.167-172

https://doi.org/10.33003/jaat.2024.1003.19

EFFECTS OF WEATHER VARIABILITY ON YAM PRODUCTIVITY AMONG FARMERS IN DELTA STATE, NIGERIA

Giweze, E.A.,[1] Oyita, G.E.,[2] Ofuoku, A.U.[3] & Ebewore, S.O.[4]

1-2, Department of Agricultural Extension and Rural Development, Dennis Osadebay University, Asaba, Delta State, Nigeria
3-4, Department of Agricultural Extension, Delta State University, Abraka, Delta State, Nigeria
Alex.giweze@dou.edu.ng/https://orcid.org/0000-0002-1372-197x/08037946731

ABSTRACT

This study investigates the effects of weather variability on yam productivity among farmers in Delta State, Nigeria. The objectives of this study were to: examine the weather trend from 2019 to 2023; determine the effect of temperature on yam productivity in the study area and determine the effect of rainfall on yam productivity in the study. All data were gathered through the use of secondary data on weather variability and yam productivity for five years (2019 to 2023) from publications of the Nigerian Institute of Meteorology (NIMET) and Ministry of Agriculture Asaba, Delta State, Nigeria. Data were analyzed using trend analysis and Pearson Product Moment Correlation. Results revealed that the trend of the rainfall is that of increase within the five-year period. From 2,450 mm in 2019, the rainfall increased to 2,893 mm in 2023. Temperature in 2019 was 25.8°C, and increased up to 26.5°C in 2023. The rising temperature and increasing rainfall threatens agricultural productivity in the State. Correlation result on effects of temperature on yam productivity shows statistically significant negative correlation between temperature and yam productivity, with a Pearson correlation coefficient of -0.587 and a p-value of 0.002. This indicates that as temperature rises, yam productivity decreases. Correlation result on effects of rainfall on yam productivity shows a statistically significant negative correlation, with a Pearson correlation coefficient of -0.685 and a p-value of 0.002. This indicates that as rainfall increases, yam productivity decrease. Weather variability were as a result of climate change

KEYWORDS: Weather variability, Yam productivity, Temperature, Rainfall.

INTRODUCTION

Agriculture has been the main stay of the Nigeria economy. It is the major source of employment in rural areas (Olatinwo, Yusuf and Bamidele, 2023). Food serves as a basic necessity for human survival, wellbeing and productivity. In African countries, agricultural segment is the highest employer of labour. However, agricultural productivity is highly influenced by many variables. Weather is among the numerous variables influencing agricultural productivity.

Weather variability has been experienced by countless communities over a long period of time, climate change aggravates its measure and effects on agriculture, especially yam productivity. Till date, there have been challenges in properly assessing the risks posed by weather variability (Druckenmiller, 2023). As weather patterns become irregular, it disturbs food and crop production as extreme weather situations put individuals at substantial health risk such as disease and injury. Palmetto (2021) stated that weather is the local meteorological conditions experienced over short periods of time such as temperature, precipitation, wind speed, humidity and visibility. Weather could be sunny, hot, windy, cloudy, raining or snowy. Weather is uninterruptedly changing as temperature and humidity change in the atmosphere. According to Tropical Weather (2020), weather could mean the state of the atmosphere explaining the degree to which it is hot or cold, wet or dry, calm or stormy, clear or cloudy.

In Nigeria, especially in Delta State, has been concomitantly experiencing erratic temperature, drought, floods, strong windstorm and other extreme weather conditions which influence farming activities. Weather variability has disrupted productivity of crops and quality, causing food shortages and reduction in quantity especially yam production. Weather variability extreme events include irregular rainfall pattern, increase temperature, changes in precipitation pattern and relative humidity as well as windstorm. These impacted the production and profitability of farmers by the rapid retrogression in yam productivity

Recently, the booming population of Delta State is increasing the call for more food production and yam which is a noteworthy homegrown crop have not kept progress with expected productivity due to vagaries of weather in Delta State. Tackling these perturbing issues formed the research gap and reason for this study in Delta State. The objectives of this study were: i. to examine the weather trend from 2019 - 2023. ii. determine the effect of temperature on yam productivity in the study area, and iii. determine the effect of rainfall on yam productivity in the study. A null hypothesis was

stated for this study. Ho: There is no significant difference in yam productivity from 2019 to 2023 in Delta State.

METHODOLOGY

This study was carried out in Delta state, Nigeria. Delta State has an extensive coastal belt interlaced with rivulets and streams, that formed part of the Niger Delta. .Delta State is made up of twenty-five (25) Local Government Areas. The State was classified by Delta State Agricultural Development Programme (DADP) into three (3) agricultural zones, which are Delta North, Delta Central and Delta South. The State has a tropical climate marked by two distinct seasons, wet season and dry season. The wet season occurs between March and November while dry season occurs between December and March. The annual rainfall in the coastal areas is about 266.5cm and 190cm in the Northern fringes of the State. The temperature is between 20^0C and 34^0C, with an average temperature of 30^0C (80^0F). Delta State is blessed with fertile soil and that makes the State a significant food and cash crops producers.

Secondary data were collected on weather variability and yam productivity for five years (2019 - 2023). From publications of the Nigerian Institute of Meteorology (NIMET) and Ministry of Agriculture Asaba, Delta State, Nigeria

The main weather variables measured in this study were temperature and rainfall, others were relative humidity and sunlight. Secondary information on these weather variables were sought from Nigerian Institute of Meteorology (NIMET). Temperature was measured in Degree Celsius (°C); Rainfall was measured in millimeters (mm); Relative humidity was measured in percentage (%) and Sunlight was measured in sunshine duration hours.

Data generated were analyzed using inferential statistics. The specific analytic tool for each objective was: Objective (i) - was achieved with trend analysis. Objective (ii) and (iii) were achieved with Pearson Product Moment Correlation. The Null hypothesis stated : There is no significant difference in yam productivity from 2019 to 2023 in Delta State, was tested with Analysis of Variance (ANOVA)

Model Specification:

The Pearson Product Moment Correlation formular is as follows:

$$r_{xy} = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n\sum x_i^2 - (\sum x_i)^2}\,\sqrt{n\sum y_i^2 - (\sum y_i)^2}}$$

Where:

rxy = Pearson r correlation coefficient between x and y.

yi = Changes in temperature/rainfall

xi = yam output

N = Number of years

RESULTS AND DISCUSSION

Weather trend in Delta State from 2019 - 2023

The result in figure 1.1 presents the weather trend in Delta State from 2019 to 2023, highlighting key climatic variables such as average annual rainfall, temperature, relative humidity and sunshine duration.

Average Annual Rainfall: The trend of the rainfall is that of increase within the five-year period. From 2,450 mm in 2019, the rainfall increased to 2,893 mm in 2023, indicating better water availability and therefore, was supposed to be more beneficial to increased yam productivity in Delta State. On the other hand, excessive rainfall beyond the optimum level may cause waterlogging, soil erosion, and heightened susceptibility to pest and disease, thereby becoming detrimental to yam production. The result is in agreement with Ibrahim (2024), who reviewed that rainfall has a positive effect on yam productivity but excessive rainfall consequentially reduce yam productivity resulting from degraded soil. The result also corroborates Aturamu, Thompson, and Akintuyi (2021), who opined that in the rainforest zones, excessive rainfall inversely affects yam productivity because the waterlogged soils restrict oxygen supplies to the roots and, hence, retard the growth of yams as well causing low yam productivity.

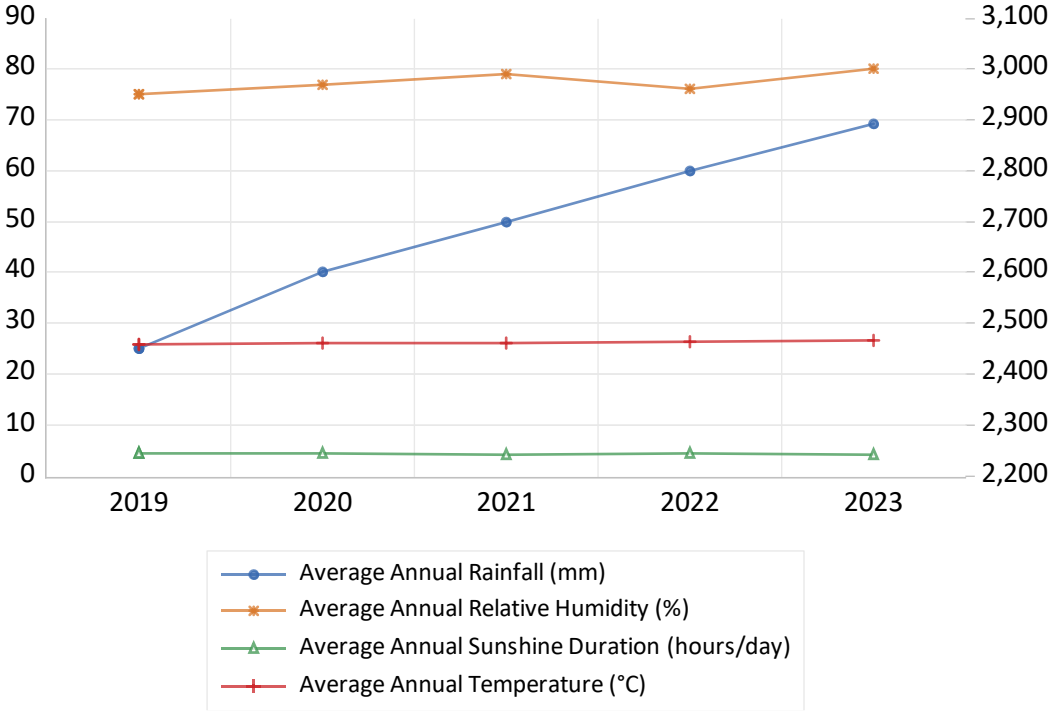
Average Annual Temperature: Temperature is another important weather factor in yam production. In figure 1.1, from 2019, with 25.8°C, the temperature increased up to 26.5°C in 2023. Generally, yam does well in the tropical climate with temperature ranges of between 25°C and 30°C. With the gradual increase in temperature, if water and nutrients are readily available sufficiently, yam productivity rates may be faster. High temperatures however increase the susceptibility of yam to some of its pests and diseases causing low productivity. The results agreed with Angba, Baines and Butler (2020) observation that with increased temperatures, infestation of yam tubers by beetles increases injuries to yam tubers which have effects on yam productivity. The result is in tandem with Amuwah *et al.* (2021) that stated that in moderately increasing temperatures, the long-term response of yam productivity is positive, but further increase in high

temperature may lead to low productivity due to heat stress.

Average Annual Relative Humidity (%): The relative humidity varies from year to year and increases generally from 75% in 2019 to 80% in the 2023 year. Humidity is an important environmental variable, which has a strong effect on yam productivity, because it affects the rates of transpiration, diseases prevalence, and tuber development. At high levels of humidity, as obtained in 2023, Delta State of Nigeria, diseases caused by fungi increase; this includes anthracnose a leaf and vine disease of yam plants affecting yam productivity. The result is in line with Onyeneke *et al*. (2021) and Osuji *et al*. (2023), who stated that crop loss to a disease is more likely under conditions of high humidity. High humidity, though which allows for the unparalleled growth rate, keeps soil moisture replenished, therefore enabling healthier blooms of crops.

Mean Annual Sunshine Duration hours/ day: From Figure 1.1, the trend of sunshine hours in Delta State of Nigeria is declining, from 4.5 hours/day in 2019 to 4.2 hours/day in 2023. Sunshine duration is important in the plant for photosynthesis and determines tuber formation. Shortened hours of sunshine will definitely retard growth and tuber size, translating to reduced productivity. Since yam requires a balance of light for photosynthesis, this could be limiting the development of yam crop when combined with high humidity levels. The result agreed with assertion of Chukwuone (2015), that reduced sunshine duration reduces tuber production since the crops are under insufficient photosynthetic tendencies and hence are lacking in growth stages.

Figure 1.1: Weather trend from 2019 - 2023



Weather trend from 2019 -2023
Source: NIMET, 2024.

Effect of temperature on yam productivity

The results from Table 1 shows a statistically significant negative correlation between temperature and yam productivity, with a Pearson correlation coefficient of -0.587 and a p-value of 0.002. This indicates that as temperature rises, yam productivity decreases, highlighting an inverse relationship between these two variables. The statistical significance at the 0.01 level emphasizes the strength of this connection, suggesting that changes in temperature have a substantial effect on yam productivity in Delta State, Nigeria. This finding is consistent with concerns about how weather variability, particularly rising temperatures, threatens agricultural productivity in the State.

The findings are in agreement with Angba, *et. al.*, (2020), who found that increasing temperatures in Cross River State of Nigeria negatively affected yam productivity and suggested the development of heat-tolerant yam varieties to mitigate this effects.

Similarly, Ibrahim (2024) reported that temperature had adverse effects on crop yields, including yam across Nigeria, and stressed the importance of proactive climate adaptation strategies. The study highlighted the need for farmers to adopt methods to cope with temperature variations. These findings align with broader research on climate variability, such as that by Aturamu, *et. al.,* (2021),who predicted that future yam productivity in Nigeria's rainforest agro-ecological zone would decline due to rising temperatures under climate change scenarios. These studies emphasize the urgent need for policymakers to implement effective extension services, focused on educating farmers about adaptive practices like improved crop varieties, climate-smart farming techniques, and timely access to climate information to sustain yam production in the face of rising temperatures.

Table 1. Effect of temperature on yam productivity

Correlations		Yam productivity (tonnes)	Temperature (ºC)
Yam productivity (tonnes)	Pearson Correlation	1	-0.587**
	Sig. (2-tailed)		0.002
	N	5	5

**. Correlation is significant at the 0.01 level (2-tailed).

Effect of rainfall on yam productivity

The results from Table 2 shows a statistically significant negative correlation between rainfall and yam productivity, with a Pearson correlation coefficient of -0.685 and a p-value of 0.002. The results indicate that as rainfall increases, yam productivity have a tendency to decrease, signifying an inverse relationship between these two variables. The significance at the 0.01 level (two-tailed) suggests that the probability of this relationship occurring by chance is less than 1%, underscoring the strong influence rainfall patterns have on yam production in Delta State, Nigeria.

Previous studies reinforce the connection between rainfall variability and reduced yam productivity. Aturamu, *et. al.,* (2021), demonstrated that excessive rainfall negatively impacted yam productivity in Nigeria's rainforest and Guinea savannah zones. Their model predicted declining yam productivity in future climate scenarios characterized by increased rainfall. Similarly, Ibrahim (2024) reported that while temperature had a positive effect on yam productivity, rainfall showed a negative correlation, indicating that erratic or excessive rainfall could harm yam productivity. These findings remain consistent with research by Osuji, *et. al.,* (2023), that cassava farmers in Ebonyi State of Nigeria also experienced reduced crop yields due to excessive rainfall, which led to crop failure and increased soil acidity. Together, these studies emphasize the need for agricultural extension services to focus on adaptive strategies, such as improved drainage systems, appropriate planting dates, and the use of water-efficient technologies, to mitigate the negative effects of rainfall fluctuations on yam productivity.

Table 2. Effect of rainfall on yam productivity

Correlations		Yam productivity (tonnes)	Rainfall (mm)
Yam productivity (tonnes)	Pearson Correlation	1	-0.685**
	Sig. (2-tailed)		0.002
	N	5	5

**. Correlation is significant at the 0.01 level (2-tailed).

Difference in yam productivity between 2019 and 2023 in Delta State

The results from Table 3 present an ANOVA analysis examining the difference in yam productivity between 2019 and 2023 in Delta State. The F-statistic is 0.274, with a corresponding p-value of 0.888, indicating no statistically significant difference in yam output across the years. The Sum of Squares Between Groups (representing the variability in yam productivity between the five years) is 581,288,820.931, while the Within Groups Sum of Squares (representing the variability within each year) is much higher at 5,306,211,297.907, suggesting that the variation within each year is more substantial than the variation between the years. Given the high p-value, it can be concluded that the differences in yam productivity from 2019 and 2023 are not significant, meaning that the productivity of yam has remained relatively stable across these years in Delta State because the major yam producing communities are not affected by environmental disasters such as floods.

This lack of significant variation in yam productivity between 2019 and 2023 contrasts with findings from some studies which highlight the influence of climate variability on crop production. For instance, Aturamu, Thompson, and Akintuyi (2021) predicted a decline in yam yields due to climate changes, particularly rainfall variability and rising temperatures. However, the

stability observed in Delta State's yam productivity may suggest that farmers in the region have either adopted effective adaptation strategies or that climate conditions were less volatile during this period. Additionally, Ibrahim (2024) noted that despite climate challenges, proactive measures such as irrigation and improved farming techniques can help stabilize crop yields. The findings in this ANOVA analysis could point to the need for further investigation into the factors contributing to this stability, including potential improvements in farming practices or external support through extension services. Nonetheless, the results suggest that, for this period, despite drastic environmental challenges (the floods of 2022) that have severely impacted agricultural production in Delta State. Yam productivity remain relatively stable because the floods did not occur in major yam producing communities of Delta state.

Since the p-value (0.888) is much greater than 0.05, the study fails to reject the null hypothesis. Therefore, the study concludes that there is no significant difference in yam productivity between 2019 and 2023 in Delta State.

Table 3. Difference in yam productivity between 2019 and 2023 in Delta State

ANOVA					
Yam output	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	581288820.931	4	145322205.233	0.274	0.888
Within Groups	5306211297.907	10	530621129.791		
Total	5887500118.837	14			

CONCLUSION AND RECOMMENDATIONS

Weather variability have momentarily disrupted yam productivity and quality, causing reduction in quantity, food shortages and environmental threats in the study area. It effects include rising temperature and increasing rainfall as observed in the weather trend, that impacted negatively on yam productivity. Relative humidity increases which also has strong effect on yam productivity and a declining sun shine hour affecting photosynthesis of yam causing low productivity. Weather variability in the study area was due to climate change. The study concludes that there is no significant difference in yam productivity between 2019 and 2023 in Delta State. With findings showing a significant correlation between weather variability (temperature and rainfall) and yam productivity, it is essential for policymakers to address these issues by setting up weather adaptation and mitigation policies specifically targeting yam farmers. Farmers should be mindful of rainfall and temperature fluctuations and be able to adopt adaptation and mitigation measures suitable to enhance yam productivity. Early warnings about yearly weather from Nigerian Institute of Meteorology (NIMET) to farmers will help farmers plan well on yam production to have good productivity.

REFERENCES

Amuwah, V. O., Filho, W. L., & Amos, T. T. (2021). Effects of Climate Change on Yam Production in South-South Nigeria. In *Handbook of Climate Change Management: Research, Leadership, Transformation* (pp. 635-656). Cham: Springer International Publishing.

Angba, C. W., Baines, R. N., & Butler, A. J. (2020). Examining yam production in response to climate change in Nigeria: A co-integration model approach. *Social Sciences*, *9*(4), 42.

Aturamu, O. A., Thompson, O. A., &Akintuyi, B. O. (2021). Forecasting the effect of climate variability on yam yield in rainforest and Guinea Savannah agro-ecological zone of Nigeria. *Journal of Global Agriculture and Ecology*, *11*(4), 1-12.

Chukwuone, N. (2015). Analysis of impact of climate change on growth and yield of yam and cassava and adaptation strategies by farmers in Southern Nigeria.

Druckenmiller, H. (2023). Weather variability explorer. Resources for the future. Washington DC. 2003.202-32. 5000.

Ibrahim, I. M. (2024). *Effect of Climate Change on Crop Output Level in Nigeria* (Master's thesis, Kwara State University (Nigeria)).

Olatinwo, L.K., Yusuf, O.J. & Bamidele, O.O (2023). Effect of crop cooperation Societies on agricultural production in Kwara State, Nigeria. *International Journal of Agriculture and Rural Development*. SAAT FUTO 2023. 26(1): 6622-6628.

Onyeneke, R.U., Amadi, M.U., Njoku, C.L. & Osuji, E.E. (2021). Climate change perception and uptake of climate smart agriculture in

rice production in Ebonyi State, Nigeria. Atmosphere, 12,1503. https://doi.org/10.3390/atmos12111503.

Osuji, E.E., Igberi, C.O.& Ehirim, N.C. (2023). Climate change impacts and adaptation strategies of cassava farmers in Ebonyi State, Nigeria. *Journal of Agricultural Society of Nigeria.* 27(1):35-48.

Palmetto, S. (2021) learning centre. https://palmetto.com

Tropical Weather (2020). I learn science at scitable. www.nature.com. Achieved from the original on 8th September, 2020. Retrieved 8th September, 2020.