Assessment of Rainfall Distribution and Implications for Agricultural Production: Effect of Climate Change

[1]**Oga I. O.** & [2]**Oga M. O.**
[1]*Department of Agricultural Technology*
Akanu Ibiam Federal Polytechnic Unwana, Afikpo Ebonyi State.
[2]*Department of Home Science,*
Michael Okpara University of Agriculture, Umudike Abia State

Abstract

This study examined the pattern and distribution of rainfall in the year, 2021. Data were from secondary sources and analyzed with descriptive statistics. Results showed that the first four (4) months of the year recorded very poor amounts of rainfall. The highest peak of rainfall was recorded in the month of August. The result also showed absence of "August break". There was absence of double maxima in the months of July and August and heavy downpours were experienced between the months of July and September. Recommendations, among others, include that farmers should shift the planting period of some crops, crops that do not require much water to thrive well should not be cultivated between the months of July and September and farmers should cultivate "edible cover crops as must crops.

Keywords*: Climate change, Rainfall, Implications and crop production*

Corresponding Author: **Oga I. O.**

Background to the Study

Agriculture remains the critical/strategic sector that addresses the multiple challenges of achieving broad-based economic growth, creating wealth, generating employment, alleviating poverty (Onyegbula, 2015). Agriculture offers Nigeria the most cost-effective path to growth and development. With its ever-extending value chains, agriculture provides job to over 70% of the working population, and if well-harnessed could be sustainable pathway to the much-awaited industrialization (Moghalu, 2012). This is because the produce from agriculture when exported to foreign countries, earn the country foreign exchange with which to acquire the necessary items or materials for the nation's industrialization.

In effort to achieve the desired level and targets in agriculture, in relation to adequate food production and provision of substantial support for the local industries, the practice of agriculture requires adequate land and other vital inputs such as improved seeds, agrochemicals, etc. Farmers, in the opinion of Oga and Oga (2019), should be assisted by agricultural extension organization to access current knowledge of improved sources of information and equally have access to all inputs needed for effective agricultural production. According to Moshroofa and Senevirathne (2014), farmers need information to identify the cost, storage, usage of varieties of newly introduced, practices among others, and on weather in order to get maximum yields and best production.

There is also the need for a favorable climate as an important ingredient or input in agriculture. The effect of climate, a major requirement in agricultural production is very important. This is in consideration of the crucial roles of its various elements, especially, rainfall, a major source of water resource use in agriculture by farming households. Rainfall, a very essential element of weather and climate has numerous implications for agricultural production. This is because its nature (i.e time commencement in a given period, frequency, amount, duration, intensity and distribution) to a very high degree determines the types of farming practices to be adopted and the level of agricultural production to attain. When rainfall is evenly distributed and in adequate amount, growth and productivity of crops is guaranteed.

Currently, it has been observed that the nature of rainfall has changed. There has been deviation from the usual pattern of rainfall (Nigeria Meteorological Agency) (NIMET, 2016). This situation is consequent on climate change (Gifin, 2017). The current unfavorable nature of rainfall widely experienced is due to global warming and subsequently climate change.

Nigeria is experiencing adverse climate conditions with negative impacts on the welfare of millions of people. Seasonal variations, unpredictability and unreliability rainfall pattern in the dry sub-humid and semi-arid ecological zones is being experienced. Persistent droughts and flooding, off-season rains and dry spells have sent growing seasons out of place. One of the adaptation measures as a response to this tide is the establishment of Nigeria Meteorological Agency (NIMET). The main objective of this agency involves providing weather, climate and water information for sustainable development and safety. However, its mandates include; ensuring that international best standard practices are maintained in all areas of meteorology including agriculture, promote the services of meteorology in agriculture, drought and

desertification activities, predication of early season weather storms, rainfall predictions, wind dimension, sensitizing the farmers on the warnings and predictions, organizing workshops for farmers groups.

Several studies have established the effects of climate change on agricultural production and adaptation strategies required to boost agriculture in Nigeria. Adebisi (2013) investigated farmers' perception of the effect of climate change in production of citrus and tomatoes in Nigeria. Onyegbula (2015), chronicled the climatic change adaptation strategies of rice farmers in Nigeria and Tella (2016) examined the livelihood analysis and coping strategies of rural women to climate change in North-eastern Nigeria, among others. However, the utilization of Nigeria Meteorological Agency (NIMET) services as a measure to climate change among arable crop farmers has not been adequately assessed. Local weather report or support strategy should be put in place to lend support to NIMET services among others. There is need to chart a path to assist in suggesting adaptation strategies against their negative effects and this informed the study. It is on this basis that this research is embarked on with the foregoing, this research tends to address the following questions: what is the time of commencement of rainfall, what is the trend in the day of rainfall/recorded in days of rainfall what is the amount of rainfall, what are the implication's and for crop production.

The main objective of the research was to assess data on the pattern of rainfall and discuss the implications for agricultural production. Specific objectives included; to determine the time of commencement of rainfall in the period covered, determine the rainy days in the period covered, determine the trend in the amounts of rainfall for the period covered etc. Over the years, farmers embarked on their farming activities with good background knowledge of the weather conditions of their immediate environment with particular reference to the pattern and distribution of rainfall. Equipped with this knowledge, they considerably understood their immediate environment, and this guided the planning of their farming activities effectively with minimal losses of their farm produce and other farm resources. But currently, this background knowledge appears to be a "mirage", consequent on climate change. This situation has caused considerable changes in the weather conditions of their immediate environment, especially, rainfall pattern. As a result of this, farmers can no longer understand the current prevailing weather conditions of their immediate environment, and this has affected the planning of their farming activities and resulted to some huge losses of their farm produce and other farm resources. Sequel to this, farmers need assistance in this regard and to help achieve this, there is need to provide current basic information/data on these changes among which are changes in the pattern and distribution of rainfall and also suggest adaptation strategies.

Methodology
The materials used for this study were sourced from the Agromet Unit of the National Root Crops Research Institute (NRCRI) Umudike, Abia State. Umudike is located about 8km East of Umuahia town along Umuahia-Ikot Ekpene Road with Latitude 05^0 29^1 N, Longitude $07^0 33^1$ East and at an altitude of 122m above the mean sea level (Emeka-Chris, 2011). Umudike is 140km North of Port Harcourt International Airport and 135Km South of Enugu

Airport and only 80km east of Owerri Airport in Imo state. It is within the subequatorial climatic belt characterized by two major seasons; the wet dry seasons, the wet season starts in April and ends in September with a peak in June and July, while the dry season lasts from October to March. However, recent global climatic change has affected the durations of these seasons. Rainfall is high in the area, with an annual average of about 2,217.86 mm. Relative humidity is also high and generally over 70%, while mean annual temperature is about 27^0C.

Data Collection and Analysis

The fundamental data required for this research were rainfall data for the year, 2021. The source of the data is the Agromet Unit of the National Root Crops Research Institute (NRCRI), Umudike. The data were analyzed using descriptive statistics.

Review of Some Environmental Factors Affecting Land Use

(Excerpts from Akinyosoye, 1999).

The environment plays a leading role in the adaptation of crops and farm animals to particular agricultural zones. The environmental factors mainly responsible can be divided into climatic, physical and biological factors. It should be borne in mind that, for any agricultural plant or animal to survive in any environment, it must be adapted to all the conditions prevailing there. In most cases, one factor plays a major role in determining the degree of adaptation of a crop or an animal. This is why different agricultural crops and animals are found in different parts of the world. Owing to the variation in environmental conditions, crops and farm animals which are adapted to temperate zones are completely different from those of the tropics.

Climatic Factors

The climate of a place is the condition of weather over a long period. Weather is the average condition of rainfall, temperature, pressure, wind, humidity and sunlight over a relatively short period. The main climatic factors which affect crop and animal husbandry in West Africa are rainfall, temperature, light and wind. The importance of rainfall in the growth of crops and farm animals cannot be over-emphasized, as water plays a great role in metabolism and other vital processes of life. It has a significant role in determining where crops and farm animals can live successfully. Agricultural crops and animals vary in the amount of water they need for survival. Hence crops and farm animals adapted to dry savanna regions cannot survive in the wet forest regions of west Africa. Generally, there is an average of five (5) months of wet season and seven (7) months of dry season in the savanna, and vice versa in the forest region which generally have five (5) months of dry season and seven months of rainy season. Crops which have a high-water requirement to thrive well in the forest regions and crops which need a relatively shorter duration of rainfall to complete their life-span do well in the savanna.

Temperature is mainly important in determining which plant and animals are found in the different ecological zones. Both the range of temperature in a region and the rate at which the temperature changes during the day and seasonally are important in determining whether a given agricultural crop and animal can survive in a particular place. The soft, fleshy parts of most crops are killed by freezing temperatures. Other crops cannot exist in hot tropical climates because the temperature is too high.

Biological Factors

These include the influence of insects, worms and other parasites and pests on land use. These organisms affect crops in general and farm animals. The insect life of any area is generally related to the climate and vegetation. In West Africa, the forest zone has a dense vegetation which provides a habitat for the tsetse fly while the savanna does not. The presence of the tsetse fly in the forest zone prevents or reduces the development of animal husbandry, because the tsetse fly acts as a vector for the trypanosome, a parasite that causes in man and in ruminants the disease known as trypanosomiasis or sleeping sickness.

The distribution of farm and animals is largely controlled by climatic as well as biotical factors. A wide range of farm animals is found in the savanna zone, while pigs, dwarf goats, sheep and cattle thrive in the forest areas. Poultry such as chickens and ducks are kept or reared extensively and intensively in many parts of West Africa. Horses and donkeys are familiar sights in the savanna areas, as are also cattle, goats and sheep. Cattle, sheep, pigs, goats and poultry are the most important farm animals of West Africa. Poultry and pigs can be bred and raised in most areas if there are adequate food supplies and if the environmental conditions are suitable.

Results and Discussion
1.   Time of commencement of rainfall
The month rains commenced in the year covered was noted and recorded. The results for period covered are shown in Table 1. For about 3-4 decades before now, available weather records showed that the usual time of starting of rainfall in the South East Region was in the month of April. This position is in agreement with (Oga, 2019), see Figure 1, which was designed with available records and information in (Oga, 2014). This timing of rainfall and its pattern encouraged and guided farmers in the planning and implementation of farm activities plans. With this background information, the results of the field work for the period covered show a different scenario i.e shift in the time of commencement of rainfall. These days, from available records, the rains now start early in the year, usually between the months of January and February contrary to what was previously obtained, see Figure 1 compared to Figures 2 and 3.

Fig. 1: Hypothetical representation of the usual pattern of rainfall before the realities of global warming and climate change.
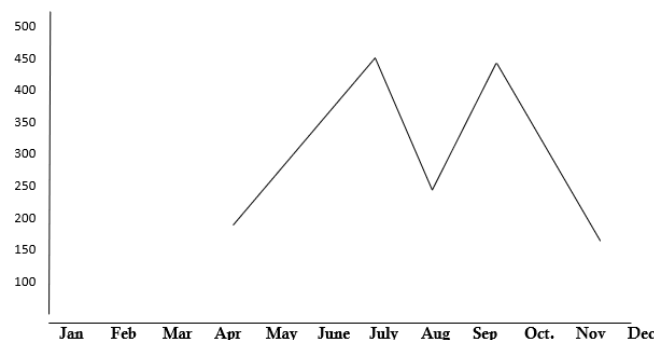
Source: Designed with information from (Oga, 2014)

2. Frequency of Rainfall

The number of times of rainy days in each of the month of the year covered was noted and recorded and the mean determined for each month. The results in Table 1 showed that rainfall was experienced ten (10) times with very poor frequencies in six (6) months. The lowest and high frequencies were recorded in the months of March and August respectively.

3. Amount of Rainfall

In each day of rainfall in each of the months for the period covered, amount of rainfall in millimeters were determined. The monthly mean of this was also determined. The result in Table 1 showed that there were increases in the amounts of rainfall from the month of June up to the month of October. The highest and lowest amounts were recorded in the months of August and March respectively. Generally, the result shows that there were heavy downpours in three (3) months-July, August and September. The heaviest downpour was recorded in the month of August, contrary to the usual pattern.

Table 1: Rainfall frequencies, amount and temperature, its minimum, maximum and mean for the year, 2021.

Variables	Months											
	JAN	FEB	MAR	APR.	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Rainfall												
Frequencies	0	0	4	10	5	14	17	23	19	15	7	0
Amount (mm)	0	0	36.3	75.5	47.9	272	301.4	556.8	344.2	238	99	0
Temperature °C												
Min	22	21	22	21	21	22	23	22	21	22	23	34
Max	35	36	35	34	33	31	30	30	32	33	33	21
Mean	**28.5**	**28.5**	**28.5**	**27.5**	**27**	**26.5**	**26.5**	**26**	**26.5**	**27.5**	**28**	**27.5**

Sources: Agromet Unit of National Root Crop Research Institute, (NRCRI) Umudike, Abia State.

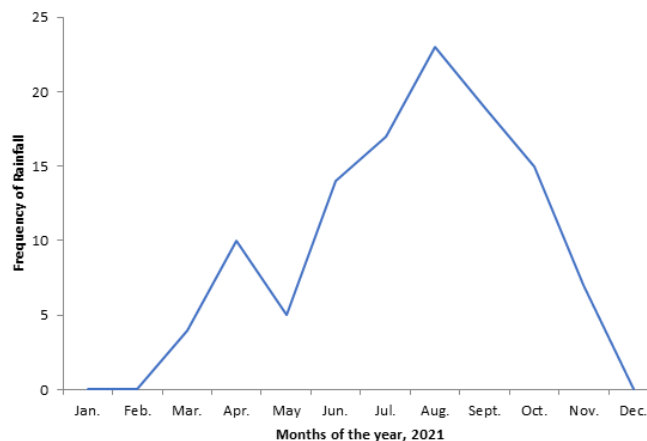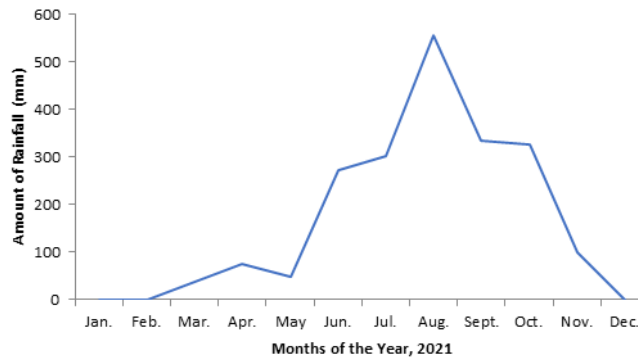**Fig 2:** Frequency of rainfall in the year, 2021

Fig. 3: Amount of rainfall in the year, 2021

Implications for Agricultural Production

Generally, the pattern of rainfall and distribution in the year, 2021 in the area covered can be considered as not much and poorly distributed. This can be evidenced from vivid observation of the absence of rainfall in the months of January and February and very little amounts between the months of March and May. The frequencies and amounts of rainfall improved and appreciated from the month of June up to the month of October (5 months) after which it dropped sharply, see Figure 2. Two peaks of rainfall were recorded in the months of August and September contrary to popular opinion. Apparently, there was absence of the popular "August Break" in the month of August as the month did not record any spell or trough but recorded the highest amount of rainfall in the month and even the highest in the year, contrary to popular opinion. Much amounts of rainfall were recorded only in four (4) months - July, August, September and October. Much inverse relationships were observed to exist between frequencies of rainfall and amounts, especially from the month March to June. The highest frequency and amount of rainfall were both recorded in the month of August, which as well is considered contrary to popular opinion. With the foregoing, the implications are that, early cultivated crops in the year such as melon, vegetables, etc, may not be cultivated in the first two months of the year. Crops such as maize, yam, cassava and even rice that require much water to thrive well may suffer due to inadequate rainfall from the month of March up to the month of May.

Another implication is that some varieties of the rice crop which usually start early in the nursery may not be possible due to absence of or inadequate rainfall. Ordinarily, rice is supposed to start in the nursery month of May. Consequently, rice in the nursery should be considered appropriate to start in the nursery in the month of July. The absence of "August Break" in the month of August, implies that the popular late may not be cultivated as well as crops like cassava, groundnut, cowpea, etc due to high and heavy rainfall between the months of August and September (flood situation), this condition may compel harvesting of some crops prematurely. Farm animals such as pigs, cattle, poultry may suffer heat stress, especially poultry and pigs in the early months of the year, especially in the month of February and March due to high level of temperature. The totality of the implications is that there will be late maturity of some crops e.g rice and shortage of same in supply among other crops, leading to

scarcity, hunger and starvation. Loss of livestock through death as a result of heat stress consequent on high temperature and subsequently shortage in the supply of protein need of the populace.

Conclusion

Climate change has caused some drastic changes in the patterns of rainfall and has equally impacted other weather elements and human livelihood among which is agriculture, and this demands adaptation strategies. Following this, there is need to chart a new path to assist and guide farmers in the form of providing information on rainfall pattern so as to assist them in the planning of their farming activities. Consequently, the main objective of the study was to access data/information on rainfall distribution in the year, and 2021 accomplish some specific objectives. The practice of crops and animal husbandry is influenced by various factor, especially, climate. The effect of climate in agriculture is felt through one of its potential elements, especially, rainfall. Currently, the nature of rainfall in relation to agricultural production has not been favourable due climate change. As a result of this, there is need to access data/information on the patterns of rainfall for some periods. For farmers use. In order that agriculture may continue to support related human endeavors, there is need for adaptation strategies to the effect of climate change. Strategies to be employed in this regard, in the opinion of the study are, among others, shifting the planting dates of some crops, cultivating edible cover crops as must crop, etc

Recommendations
1. Creating awareness on the realities of global warming and climate change
2. Farmers to shift the planting dates of some crops.
3. Farmers groups or cooperatives to assist in constructing water channels to help in providing water during period of scarcity.
4. Government and non-governmental organizations and even Philanthropists should help establish local weather stations to help support Nigeria Meteorological Agency (NIMET) in their services.

References

Akinyosoye, V. O. (1999). *Senior tropical agriculture,* Ibadan: Macmillan Nigeria Publishers Ltd 198

Danielou, M. (2012). Rio + 20: Did it move forward? Global Food Policy Report. www.ifpri.org/2012/green-economyaccessed 20/0/2014.

Ebonyi State Agricultural Development Programme (EBADEP), (2013). Ebonyi State Agricultural Development Programme Monthly Meteorological Data.

Jifin, D. T. (2017). Impact of climate change of Agricultural production by farmers in Taraba State, Nigeria, *International Journal of Entrepreneurial Development, Education & Science Research 4(1)*, 180.

Mashroofa, D. & Senevirathne, J. (2014). Influence of information literacy skills in accessing agricultural information: With special reference to paddy farmers of Ampara district, Srilanka. Being a paper presented during the IFLA conference held in Lyon. Available at Library. Ifla.org/1003/1/140-mashroofa-en.pdf.

More, W. (2013). Green economy in practice: The Barbadian perspective Caribbean Green Economy Action Learning Group. *Discussion Paper Series 5,* 1-4.

Nigeria Meteorological Agency (2016). Nigerian television authority (NTA), *News Weekend file*.

Nigeria Meteorological Agency (NIMET) (2012). *Agro-meteorological bulletin No. 35*, Dekad 2, December (11-20) 2012 Pp 1-2.

Nwajiuba, C. (2013). Nigeria's agriculture and food security challenges, *Internet paper* accessed 10/07/2014.

Oga, I. O. & Oga, M. O. (2019). *Effects of rainfall pattern on agricultural production in Afikpo North Local Government Area of Ebonyi*, Nigeria: Proceedings of the 24 Annual Conference of the Agricultural Extension society of Nigeria.

Oga, I. O. (2014). *Fundamentals of agricultural climatology*, Abakaliki Ugub's Printing & Publishing Co., 65 – 66.

Onyegbula, C. B. (2015). *Climate change adaptation strategies of rice farmers in Nigeria*, An Ph.D Thesis in the Department of Agricultural Extension and Rural Development, University of Ibadan: Ibadan 1-127.

Tella, M. O. (2016). *Livelihood analysis and coping strategies of rural women to climate change in North-Western Nigeria*. An Ph.D Thesis in the Department of Agricultural Extension and Rural Development, University of Ibadan, 1-112.

Thomas, K. A. & Sanyadu, A. S. (2017). Utilization of Agro-meteorological services among Arable crop farmers in Oyo State, Nigeria, *Journal of Agricultural Extension*. *21 (1)* Pp 51-69.