Rainfall Trend and Cereals Production in Afikpo North Local Government Area of Ebonyi State, Nigeria: Effect of Climate Change

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Abstract

The aim of this research was to generate information/data on the trend of rainfall in Afikpo North Local Government Area (LGA) of Ebonyi State, Nigeria for the periods 2017-2018. Long before the realities of global warming and subsequently climate change, farmers had good knowledge of the weather conditions of their immediate environment. With this, they planned their farming activities effectively with little or no losses of their farm produce and other farm resources. But today, this knowledge appears to have eluded the farmer's consequent on global warming and climate change. The LGA comprises of twelve (12) Autonomous Communities (ACs) out of which ten (10) were randomly selected. Field Assistants (FAs) were required for this research and two (2) (FAs) were purposively selected from the randomly selected CAs to assist in recording the parameters relevant to the field work. The data generated were analyzed using tables and descriptive statistics. The result of this research will provide the guide with which to suggest to farmers on how to probably plan their farming activities in the future to, among others, help minimize losses of farm produce on the farm. The result of this research, among others, shows that there have been "shifts" from the usual pattern of rainfall and distribution. The result also shows that there was absence of the two usual peaks "double maxima" of rainfall in the months of July and September and "August break" in the month of August. The recommendations, among others, include that farmers should "shift" the planting period for maize and rice and construct water channels as source of irrigation.

Keywords: *Rainfall, Trend, Climate change, Cereals production*

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Background to the Study

In Nigeria, like other developing countries, agriculture remains the most viable economic sector and considerably contributes towards production and employment (Suleiman, Yakubu and Yusuf, 2018). According to Ballo, Olutegbe and Adekoya (2016), agriculture as a sector provides the source of livelihood for almost two-thirds of the population in the continent. To this regard, agriculture must of necessity be accorded a pride of place.

Agriculture offers Nigeria the most cost-effective path to growth and development. With its ever extending value chains, agriculture provides jobs to over 60% of the working population, and if well-harnessed could be a sustainable springboard for the much awaited industrialization (Moghalu, 2012). This is because the produce from agriculture when exported to foreign countries earns the country foreign exchange with which acquisition of the necessary items or materials for the industrialization of the nation is made.

In effort to achieve the desired level and targets in agriculture, in terms of adequate food production and provision of substantial support for the local industries, the practices of agriculture re quires adequate availability of land and supply of vital inputs such as 'improved seeds, fertilizer, agro-chemicals, among others. The farmers, according to Olaniyan and Ogunkunle (2018), should be assisted by Extension Organizations to have current knowledge of improved sources of information and have access to all inputs needed for effective production. There is equally the need, among others, to provide relevant infrastructure such as storage facilities and other assistance to include provision of credit facilities, education, training and extension services, research and appropriate technology (Oladele, 2015).   There is also the need for a favourable climate as an all important ingredient or input in agriculture. The effect of climate, a major requirement in agricultural production need not be over emphasized. 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. Other sources include streams, rivers, lakes and ponds.

Water is used for various agricultural activities such as testing seed viability washing of produce, implements, mixing agro- chemicals for use on the farm, for feeding livestock operate and maintain farm machines, process farm products, etc.

Rainfall, a very essential element of climate has numerous implications for agricultural production of a place (Oga, 2014). This is because its nature (time of commencement in a given period, frequency, amount, duration, intensity and distribution) to a very large extent determines the types of and level of agricultural practices and production of a place. According to Nwaiwu et al (2014) and Emedo, Maduka and Oranekwulu (1995), much of the water for agricultural production comes from rainfall. Where rainfall is well distributed and in adequate amount, growth and productivity of crops like yam, cocoyam, cassava, plantain, corn, rice and tree crops like rubber, kola-nut, oil palm, citrus, among others, is guaranteed.

According to Nwajiuba (2013) and Nwite, Nnabo and Nnoke (2007), the most important element of climate is rainfall, the amount that falls, how it falls e.g steadily over several days or suddenly in torrential downpours, hence its effectiveness i.e how much of it is available for use by plants. Currently, it has been observed, and even available records have shown that the nature (time of commencement, frequency, amount, duration, intensity, etc) of rainfall has not been encouraging (Oga and Oga, 2012). There has been a deviation from the natural pattern of rainfall (Nigeria Meteorological Agency (NIMET), 2016). An encouraging nature of rainfall in terms of commencement at the right time, moderate or adequate in amount, duration and intensity, no doubt, is desired and generally accepted as the "best nature" of rainfall for any desired level of agricultural production. Consequent upon this best nature of rainfall, it is the utmost desire of places substantially involved in agricultural production, of which Afikpo North Local Government Area (LGA) of Ebonyi State is among, to have and appreciate this nature of rainfall. The current unfavourable nature of rainfall widely experience is due to global warming and subsequently climate change (Djoudi and Brockhaus, 2011).This situation does not augur well for agriculture and agricultural productions, and this, no doubt, has multiplier effects (Oga and Oga, 2011).

Often, it has been observed and recorded that the rains do not come when expected. This situation is in agreement with Anam and Antai (2015). When it is eventually experienced, may be fair, moderate or torrential and in t eh process may not be adequate for agricultural production or may even be very destructive to physical structures as well as agricultural products (Radio Nigeria (RN), 2011) . As a result of Global warming and subsequently climate change, there is rise in sea level and increased flooding (Moore, 2013). This position was corroborated by (UNESCAP, 2011). There is equally, reduction in the area of cultivable land and decreased food supply. According to (Danielou, 2012), records have shown reduction, relocation or even extinction of some plants and animal species e.g butterflies, polar bear, walrus, caribou, mistletoe, etc. Sequel to the above discouraging scenario of rainfall as a result of global warming and climate change, there is need to chart a path to assisting in suggesting adaptation/mitigation strategies against their negative effects and this informed the study.

Objectives of the Study
The general objective of this research was to generate information/data on rainfall pattern and distribution in Afikpo North Local Government Area (LGA) of Ebonyi State from 2017- 2018.

Specific Objectives
   i.   To determine the time of commencement of rainfall in each day of rainfall in the months of the years covered.
   ii. To determine the frequency of rainfall in each day of the months of the years covered
   iii. To determine the duration of rainfall in hours in each day of rainfall in the months of the years covered
   iv. To make recommendations

Statement of the Problem

Over the years, farmers carried out their farming activities with good background knowledge of the weather conditions of their immediate environment, especially, in relation to the pattern and distribution of rainfall. Equipped with this knowledge, they considerably understood their immediate environment and on this premise planned their farming activities effectively with minimal loses of their farm produce. But nowadays, this background knowledge seems to have been eroded as a result of the influence of Global warming and Climate change. This has caused considerable changes in the weather conditions of their immediate environmental, especially, the trend and distribution of rainfall. Consequently, farmers can no longer understand the current weather conditions of their immediate environment and this has affected the planning of their farming activities and has resulted to some huge losses of their farm produce and other resources. Sequel to this, farmers need assistance in this regard and to help them achieve this, there is need to provide them with current basic information/data on these changes, among which are changes in the pattern and distribution of rainfall and also suggest adaptation strategies. These will provide guidance for the farmers and enable them to effectively plan their farming activities and subsequently minimize the effects of the present vagaries of weather conditions as they concern their farming activities and water management.

Materials and Methods

The Study Area

The work was conducted in Afikpo North Local Government Area (LGA) of Ebonyi State of Nigeria from 2017-2018. Afikpo North Local Government Area of Ebonyi State is an agrarian LGA with a good number of the populace engaged in one form of agricultural production or the other mainly at subsistence level. The crops cultivated in the LGA include: maize, rice, yam, cassava, cocoyam, potatoes, and vegetables, among others. Besides cultivation of crops, animals are reared especially the small ruminants (sheep and goat and fishing is also practiced by the people. The keeping of poultry is also practiced. The pattern of agricultural production is mainly affected or defined by the influence of the annual weather condition of the LGA based on two distinct seasons: the dry and wet seasons. The dry season starts about the month of November and terminates around the month of March, while the wet season starts in the month of April and ends in the month of October with the average annual rainfall of about 134mm (Ebonyi State Agricultural Development Programme (EBADEP), 2001).

Method of Data Collections

Afikpo North Local Government Area (LGA) is made up of twelve (12) Autonomous Communities. Ten (10) Autonomous Communities were randomly selected for the field work and Research Assistants (RAs) were needed to assist in the work. Two RAs were purposively selected from each of the 10 Autonomous Communities to give a total number of 20 RAs who assisted in examining and recording the parameters considered relevant to the field work.

Results and Discussion

    1. Time of commencement of Rainfall in the periods covered (2017-2018)

Prior to incidence of Global warming and climate change; the usual time of commencement of rainfall in the South East Region and even in the area of study was in the month of April (Nwite et al, 2007). This position is in agreement with the opinion of Oguntola (2007) and Oga (2014),see Figure 1. This timing of rainfall encouraged and guided farmers in the planning and execution of their farming activities. With this background information, the results of the field work for the periods covered show that there have been deviations in the time of commencement of rainfall. These day rainfall starts early in the year between the months of January and February contrary to popular opinion. See Figure 1 and compared with Figures 2 and 4.

    2. Frequency of rainfall in the periods covered

Rainfall was experienced four (4) times in the month of January, 2017 and the same frequency in the month of February, 2018. After this, there were less frequencies of rainfall between the months of February and April for the periods covered. Frequency of rainfall increased fairly from the month of May to the month of August after which it dropped drastically. See Tables 1 and 2 and Figure 4.

    3. Duration of rainfall in hours for the periods covered

There was high increase in hours of rainfall in the month of May 2017 and this was very poor in the month of June 2017. This was the reverse in these same months in the year, 2018 for the periods covered. Generally, there were long hours of rainfall, especially between the months of June and August, except in the month of June 2017. There were "inverse relationships" between frequency and duration of rainfall in hours for the periods covered.

Implications for Cereal Production

Cereals belong to the crop family, *Gramineae* and cultivated for their seeds (Grains) Nigeria Education Research and Development Council (NERDEC, 1999). They constitute a large percentage of the World's food supply. They are important in the feeding of human beings and livestock because they have a high starch (carbohydrate content) and varying amounts of protein and vitamins. They also serve as raw materials for many industries. Some important cereal crops grown in Nigeria are maize, Guinea corn, rice, millet and wheat.

With the foregoing, there is no gainsaying cereals are vital to human existence and essential to the survival of some industrials. But with regards to this research and the study area the discussion will be narrowed down to maize and rice production.

Long before now, the cultivation of maize, even in the study area, usually starts from the month of April ie early maize and which matures between the months of June and July depending on the time of planting, and late maize cultivated towards the end of July to the middle part of the month of August ie during "August break" (Nwajiuba and

Onyenekwe, 2010) and (Oga, 2014). Currently, the pattern and distribution of rainfall in the South Eastern Region of the country, where Afikpo North Local Government Area (LGA) of Ebonyi State is located, has not been encouraging, especially for cereal crops such as maize and rice. The usual nature of rainfall during the period, April – August, was such that rainfall will commence in the month of April and rise gradually with the intensity being (moderate and heavy) in some cases, and well distributed, had two peaks, "double maxima" of rainfall in the months of July and September and therefore dropped gradually (Nwite, Nnabo and Nnoke, 2007) and (Oga, 2014) See Fig. 1.

Currently, the pattern and distribution of rainfall in the Southeast region where the study area is located, often starts between the months of February and March and after which it will cease. Within this period, farmers with the feeling that the rains have come will cultivate some crops among which is maize. These crops were scotched due to much heat on and in the soil due to high temperatures. This position is supported by (Enwelu et al, 2018). This trend did not guarantee enough early maize. After the month of March, much of the rains commenced again from the month of May leaving the month of April with little or no rain and which was supposed to be the month farmers usually expect commencement of rainfall and which supports the production of early maize. The rains experienced in the month of May came down heavily, flooded the farm land and carried away the top soil, among other materials and continued unevenly distributed up to the month of August. This position is in agreement with Focus Group Discussions (FGDs, 2017-2018). By the late of the month of July to middle of August when rainfall was supposed to have subsided, the pattern and distribution of rainfall around this period was such that it fell heavily on rainy days and for long hours which resulted in the absence of August break and subsequently made it difficult for late Maize to be cultivated, see Figures 2 and 3. This situation was equally in agreement with (FGDs, 2018). This situation was equally in agreement with Focus Group Discuss (FGDs, 2017 – 2018) rice farmers and other farmers. The implication of this discouraging scenario was that not much of both early and late maize were cultivated in the usual months of April and July in some places in the study area at the right time and the produce not always available as usual or when supposed. In the case of rice, its cultivation usually starts in the nursery from the month of May - June and matures between 5-7 months from the time of planting, say, from the month of June - November and depending on the variety cultivated.

Rice requires between 76-127cm (i.e 760-1270mm) of annual rainfall (Emedo et al, 1995). The result of the field work, see Figures 2 and 3, rainfall in the month of May was heavy flooding the farmland and made it difficult for rice to start in the nursery. The rains continued, with poor distribution and did not span the average of 5-6 moths which is usually ideal for rice production. The implication of this is that rice may not be cultivated at the usual time i.e between the months of June and July and to mature between the periods of 5-7 months i.e (June- November) may not be achieved. This is because, as can be inferred from the result of the field work, rainfall in the month of May was so heavy that it made it difficult to have rice in the nursery around this period. This situation was corroborated by (FGDs, 2018) and in agreement with Oga and Oga, (2011 and 2012).

In the month of August, when some farmers were getting ready to transplant rice, the rains fell in such a way that the permanent sites for rice were greatly flooded due to heavy rainfall that lasted for long hours during the period and reached the kneel level (FGDs, 2018) rice farmers and others farmers. The implication of this was that rice was not on the permanent sites at the right time since farmers found it difficult to transplant as a result of high level of flood on the farm land. It also implied that the farmers had to wait for some time for the flood to recede to enable them transplant. This equally implied that rice stayed in the nursery beyond the required time. Consequently, it implied that rice may not have matured at the usual time (i.e between October and November) but probably in the month of December when harmattan had started showing its effect. This situation no doubt, caused shortage/scarcity of rice for sale, consumption and other purposes.

Conclusion

The practice of agriculture is affected by various factors especially climate. The effect of climate is felt through one of its potential elements, rainfall. Rainfall, to a large extent, determines the scenario of agricultural production. Currently, the nature of rainfall in relation to agricultural production in the Afikpo North Local Government Area of Ebonyi State, is not encouraging due to the influence of Global warming and Climate change. In order that agriculture continues to play its role as the backbone of a nation's economy, global warming and subsequently climate change, there is need for adaptation/mitigation strategies. Suggested strategies to be employed in this regard include, among others, adoption of sustainable agriculture and land management practices and water management practices. Farmers to delay/shift cultivation dates of some crops to about 4-5 weeks after the first set of rains which now occur early in the year, farmers to cultivate cover crops and construct water channels or water holding structures in the farm.

Recommendations
1. Sufficient awareness should be created on the realities of Global warming and climate change both for the farmers and public consumption
2. Farmers should be advised not to plant with the coming of the first rains but to shift or delay planting dates and probably commence planting after about 4-5 weeks after the first set of rains.
3. Farmers should be advised to cultivate crops that may not require much water during the early rains in the year.
4. Farmers should be advised as a matter of necessity to cultivate edible cover crops as "must crops" during each cropping season.
5. Farmers should cultivate crops that are resilient to climate change eg. Resistant varieties.
6. Government as a matter of urgency should revitalize relevant Agencies such as NIMET and equip them with appropriate technologies in order for them to improve on their services and personnel trained in this regard.
7. There should be establishment of Meteorological stations in some localities where necessary to help provide information on weather conditions to enable farmers plan their farming activities.

8. Farmers should be supported by Government, Cooperative Organizations and even Philanthropists to construct water channels or water holding structures in farm to serve as source of irrigation.

Fig. 1: Showing the usual pattern and distribution of rainfall before the incidence of global warming and climate change
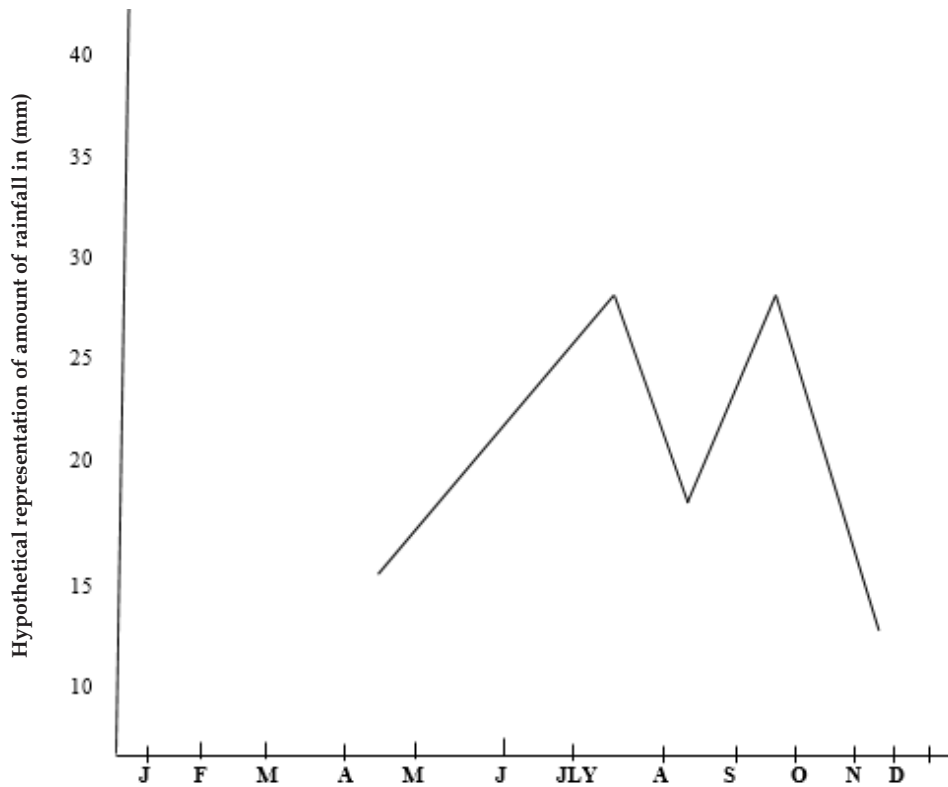
Source: Oguntola and Nwite et al, (2007) and Oga, (2014)

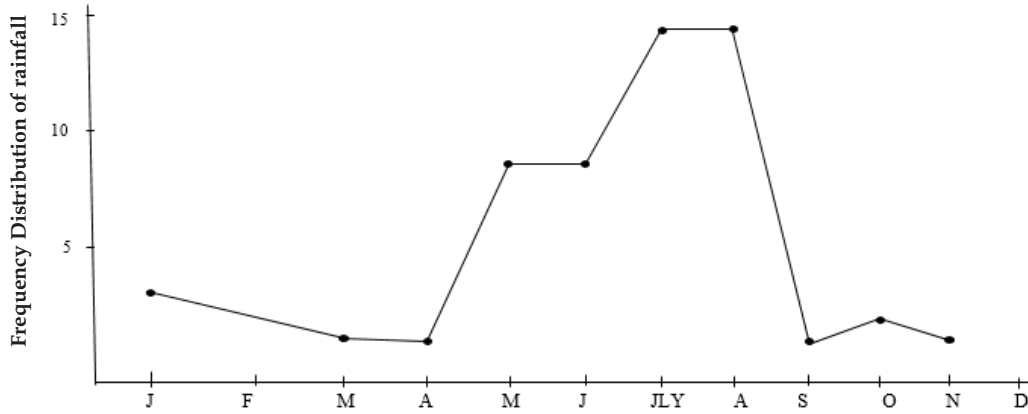**Graphical Representation of Frequency of rainfall in the months of the year, 2017**

Fig 2: Pattern of rainfall in the months of the year, 2017
Source: Fieldwork, 2017.

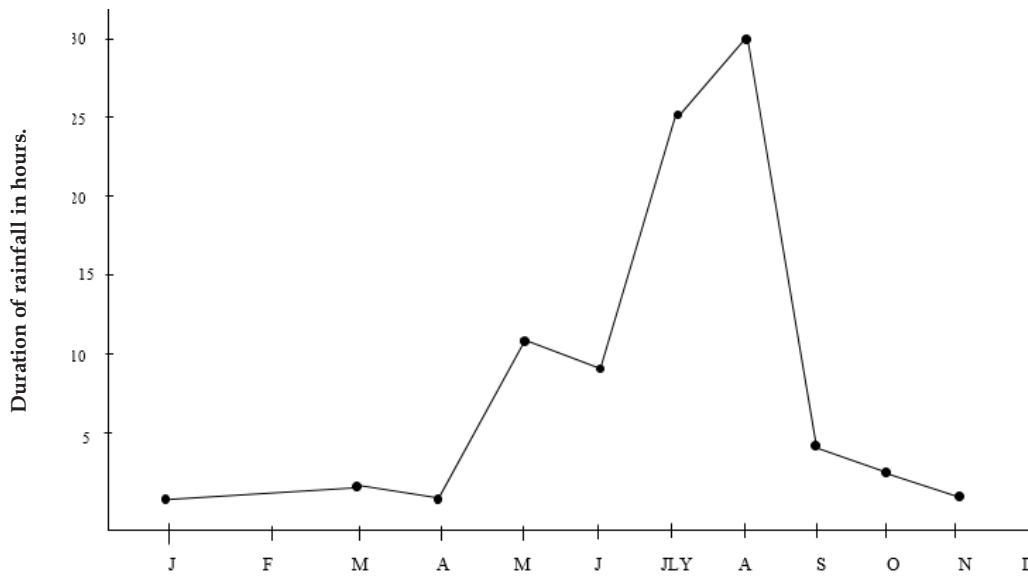**Graphical Representation of Frequency of rainfall in the months of the year 2017**

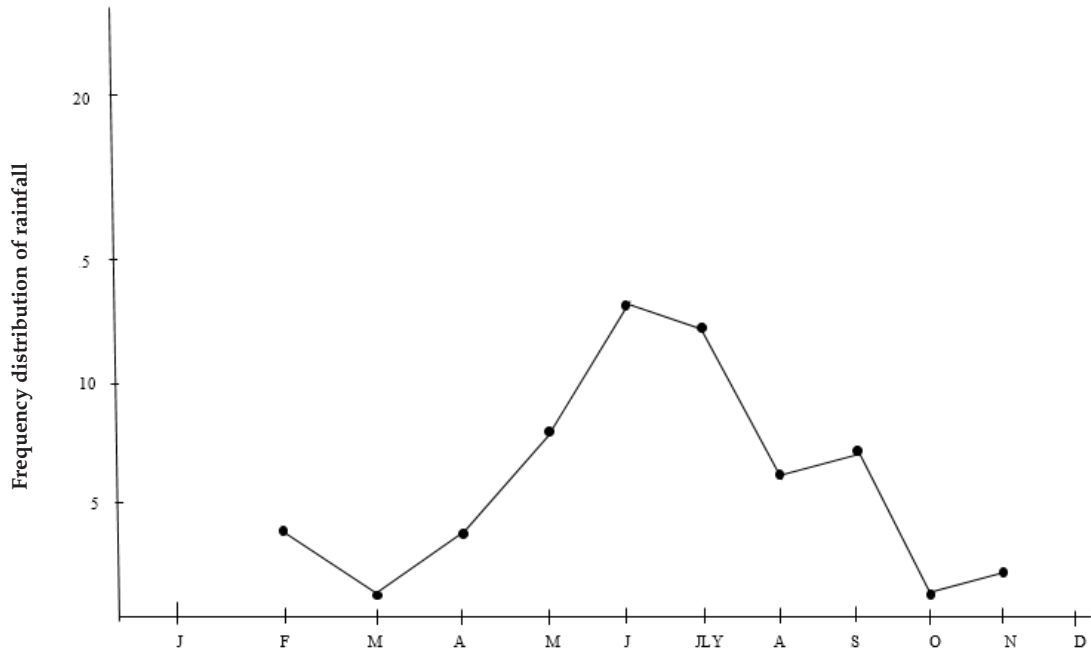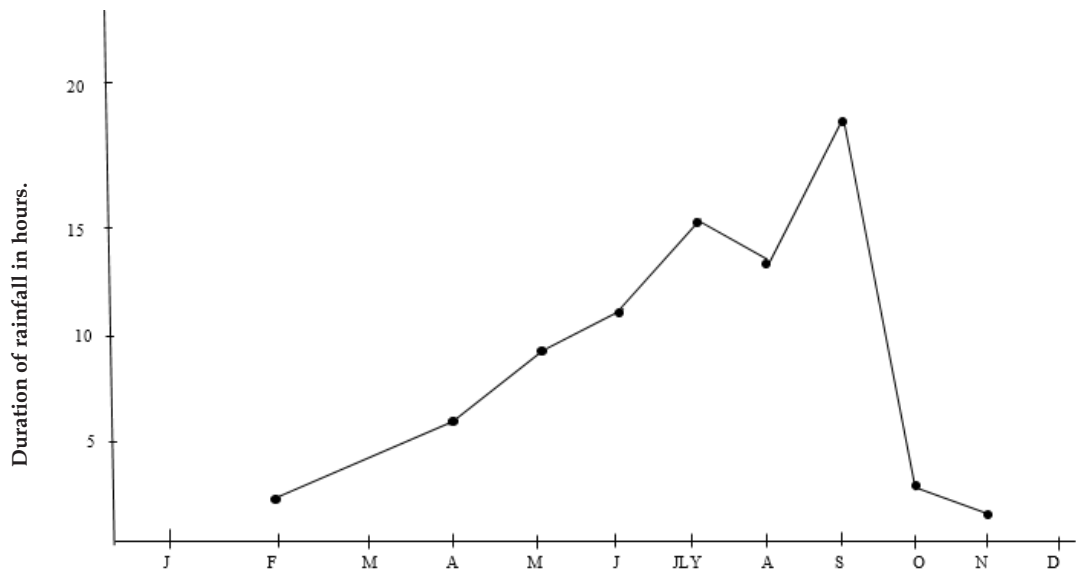**Fig 3:** Pattern of rainfall in the year, 2017
Source: Fieldwork, 2017.

Fig 4: Pattern of rainfall in the year, 2018
Source: Fieldwork, 2018.

Fig 5: Pattern of rainfall in the year, 2018
Source: Fieldwork, 2018.

Table 1: Monthly summary of rainfall in terms of Frequency, Duration, among others, in the year, 2017.

	Months of the year, 2017	Rainfall		No of times of rainfall in each month	Duration of rainfall in hours in each month	No of times of moderate rainfall in each month	Frequency of heavy rainfall in each month
		Yes	No				
1	Jan			4	1	1	3
2	Feb	-	√	-	-	-	-
3	Mar	√		2	2	-	2
4	Apr	√		2	1	2	-
5	May	√		8	11	6	2
6	Jun	√		8	8	3	5
7	Jul	√		14	25	11	3
8	Aug	√		14	30	9	5
9	Sep	√		2	5	-	4
10	Oct	√		3	3	3	-
11	Nov	√		2	1	2	
12	Dec						

Source: Field Work, 2018.

Table 2: Monthly summary of rainfall in terms of Frequency, Duration, among others, in the year, 2018.

	Months of the year, 2018	Rainfall		No of times of rainfall in each month	Duration of rainfall in hours in each month	No of times of moderate rainfall in each month	Frequency of heavy rainfall in each month
		Yes	No				
1	Jan	√	√	-			
2	Feb	√		4	2	2	2
3	Mar	√		1	-	1	-
4	Apr	√		4	6	3	1
5	May	√		8	8	6	2
6	Jun	√		13	11	10	3
7	Jul	√		12	15	6	6
8	Aug	√		6	13	5	1
9	Sep	√		7	16	2	5
10	Oct	√		1	3	-	1
11	Nov	√		2	2	1	1
12	Dec						

Source: Field Work, 2018.

References

Anam, B. & Antai, A. S., (2015). African economy: Poverty challenges, Dire of infrastructure and framework for policy actions: In infrastructure, *Economic Development and Poverty Reduction in African,* India: KEJA Publications.

Ballo, M., Olutegbe, N. S. & Adekoya, A. E. (2016). Welfare status of rice farming household in office du Niger Segour Region of Mali http://dx.doi.org/10.4313/iae.V22i3.7, *Journal of Agricultural Extension 22* (3) 65.

Danielou, M. (2012). *Riot2o: Did it move forward? Global food policy report*, www.ifpri.org/2012/green-economy Accessed 20/09/2014.

Djoudi, H. & Brockhaus, M, (2011). Is adaptation to climate change gender neutral? Lessons from communities dependent on livestock and forests in northern Mali, *International Forestry Review 13* (2), 123-135.

EBADEP, (2011). *Ebonyi state agricultural development programme monthly meterorological data*, *Ebonyi: Nigeria*

Emedo, A. B. C., Maduka, B. C. & Oranekwulu, S. C. (1995). *Comprehensive agricultural science for West African senior secondary schools,* Onitsha: de. Diamond (J.M.B) Publishers.

Enwelu, I. C., Ozioko, R. I., Edeh, I., Ohagwu, V. A, Udo-ye, C. E., & Okoro, J. C., (2018). *Value addition in rice processing and marketing in rural communities of Enugu State, Nigeria.* Conference processing of the 23rd Annual National Conference of Agricultural Extension Society of Nigeria, 2018.

Focus Group Discussions (FGDs, 2018)

Medugu, N. I., (2009*). Nigeria: Climate change – A threat to the country's developme*nt, Retrived August 7, 2015 from http://www.allfrica.com/nigeria/

Moghalu, K. C., (2012). *A keynote address presented at the International Agricultural Conference, May 7, 2012, at faculty of Agricultur*e, Anambra State University, Igbariam Campus.

Moore, W., (2013). Green economy in practice: The barbadian perspective: Caribbean green economy action learning group, *Discussions Paper Series* 5, pp. 1–4.

Nigerian Meteorological Agency, (2016). *Nigerian Television Authority (NTA) News weekend File*.

Nigeria Education Research and Development Council (NERDEC, 1999)

Nwaiwu, I. U. O, Ohajianya, D. O., Orebiyi, J. S., Ibekwe, U. C., Lemchi, J. I., Onyeajuocha, S. U. O, Odoemena, Utazi, C.O., Osuagwu, C. O. & Tasie, C. M. (2014). Climate change and appropriate mitigation and adaptation strategies in South East Nigeria, *Global Journal of Biology Agriculture and Health Sciences*.

Nwajuiba, C. (2013). Nigeria's Agriculture and Food Security Challenges, Internet paper accessed 10/07/2014.

Nwite, J. N, Nnabo, P. N. & Nnoke, F. N., (2007). *Essentials of agricultural climatology and biography*, Enugu SNAAP Press (Nig) Ltd.

Oga, I. O. & Oga, M. O., (2011). *Pattern and distribution of rainfall in Afikpo North Local Government Are of Ebonyi State in 2011: Impact of global warming and climate change*, A paper presented at the 12th Annual National Conference, 2011 of Home Economics Research Association of Nigeria (HERAN), University of Nigeria Nsukka.

Oga, I. O. & Oga, M. O. (2012). *Variability in the pattern and distribution of rainfall in Afikpo North local government are of Ebonyi State in 2012: Impact of global warming and climate change*, A paper presented at the International Agricultural Conference Proceedings ANSUIAC, May, 2012 (2), Anambra State University, Igbariam Campus.

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

Oguntola, S., (2007). *How climate changes evolution, genetic patter*ns, Retrieved from http://www.jama.com.

Oladele, O. (2015). Challenges and prospects of agriculture in Nigeria: the way forward, *Journal of Economics and Sustainable Development, 4* (6), 37 – 45.

Olaniyan, O. A., & Ogunkunle, T. (2018). Agricultural and nutrition information needs of Arable crop farmers in Ondo State Nigeria, *Journal of Agricultural Extension 22* (3)10.

Radio Nigeria, (2012). *Radio Link Discussions* Source: Field work, 2017.

UNESCAP, (2011). *Sustainable development in Asia and the pacific: Key challenges and opportunities – Green economy in the context of sustainable development and poverty eradication,* The Asian and pacific Regional Preparatory meeting for the United Nations Conference on Sustainable Development. Seoul, 19 – 20 October, 2011.

Yusuf, H. O., Suleiman, R., Yukubu, L. L. & Yusuf, O., (2018). *Enhancing capabilities of farmers and farm communities: Agricultural extension conference proceedings of the 23rd Annual National Conference, 2018.*