

## DATA ON THE VARIABILITY IN THE PATTERN AND DISTRIBUTION OF RAINFALL: EFFECT OF GLOBAL WARMING AND CLIMATE CHANGE

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### Abstract

This field work was carried out to examine and generate data on the pattern and distribution of rainfall in Afikpo North Local Government Area (LGA) of Ebonyi State for the years, 2013, 2014 and 2015. The LGA is made up of Twelve (12) Autonomous Communities out of which Ten (10) were randomly selected. Research Assistance (RAs) were needed for the field work and Two (2) RAs were purposively selected from the Ten (10) randomly selected Autonomous Communities to give Twenty (20) RAs. Some instruments, among which was a Self designed recording instrument, were used in the exercise and data were collected and analyzed using frequency Tables and graphs. The result will help to suggest to farmers on how to plan their farming activities in order to among others, minimize losses of farm produce on the farm. Some of the results showed that there was absence of the usual “August break” in the month of August and heavy downpours of few frequencies that lasted for long hours were experienced between the months of August and October and there was also absence of the usual “double maxima” in the months of July and September of the three years covered. Recommendations, among others, were that farmers should delay planting and commence crop planting after about 4-5 weeks after the first set of rains, they should not allow crops, as has been the usual practice, to dry-up in the farms between the months of September and October to reduce losses of farm produce in the farm.

**Keywords:** Data, Global warming, Climate change, Rainfall pattern, Agriculture.

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## **Background to the Study**

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. Agriculture remains the critical strategic sector that addresses the multiple challenges of achieving broad-based economic growth, creating wealth, generating employment, alleviating poverty, and attaining national food security, as well as promoting Nigeria to among the 20 world leading economies by the year 2020 as set out by the federal Government of Nigeria (FSDH Securities Limited, 2011). The mainstay of Nigerian Economy since independence according to Bureau of Public Enterprise (BPE) (2004), is agriculture, as it accounts for 38% of the non-oil foreign exchange earnings and employs about 70% of the active labour force of the population.

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 practice of agriculture requires adequate availability of land and supply of vital inputs such as 'improved seeds, fertilizer, agro-chemicals, among others. The farmers, according to Akinbile, *et al* (2006) 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. 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, in relation to agricultural production.

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, amount, duration, intensity and distribution) to a very large extent determines the type of and level of agricultural practices and production of a place. According to Emedo, *et al* (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 Nwite, Nnabo and Nnoke (2007, Oga, 2014) 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, amount, duration, intensity, etc) of rainfall has not been encouraging. There has been a deviation from the natural pattern of rainfall (Nigerian 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: This situation does not augur well for agriculture and agricultural productions, and this, no doubt, has multiplier effects. Often, it has been observed and recorded that the rains do not come when expected and when it is eventually experienced, may be fair, moderate or torrential and in the 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 (Midori, 2007). This position was corroborated by (Parry, 2001). There is equally, reduction in the area of cultivable land and decreased food supply. According to (Kluger, 2006) 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 mitigating their negative effects and this informed the study.

### **Objectives of the Study**

The main objective of this work was to examine and generate data on the present trend and distribution of rainfall in the LGA in the years, 2013, 2014 and 2015.

### **Specific Objectives**

These were to:

1. Examine records of rainfall in 2013, 2014 and 2015 in Afikpo North Local Government Area (LGA) of Ebonyi State.
2. Examine the time of commencement of rainfall in each day of rainfall in each month of the years, 2013, 2014 and 2015 in the LGA
3. Assess the duration (in minutes/hrs) of rainfall in the days of rainfall in each month of the years, 2013 and 2014 in the LGA
4. Assess the trend of rainfall and its distribution in each month of the years, 2013, 2014 and 2015
5. Make recommendations on the strategies to help mitigate the effect of Global warming and climate change as they affect rainfall and subsequently agricultural production in the LGA.

### **Statement of the Problem**

Over the years, farmers carried out their farming activities with a 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 seem 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 environment, 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 to help them mitigate the effects of these changes in their environment. One of the ways to help them achieve this, is to provide them with current basic information/data on these changes, among which are changes in the pattern and distribution of rainfall. These will enable them effectively plan their farming activities and subsequently minimize the effects of the present vagaries of weather conditions as they concern their farming activities.

## **Materials and Methods**

### **The Study Area**

The work was conducted in Afikpo North Local Government Area (LGA) of Ebonyi State of Nigeria, in 2013, 2014 and 2015.

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, 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).

### **Instruments for Data Collection**

One of the instruments for data collection was a Self designed recording instrument. The instrument showed the days/dates of each month of the years, 2013, 2014 and 2015. The instrument was face validated by two Agricultural experts in the Department of Agricultural Technology, Akanu Ibiam Federal Polytechnic, Unwana, and Ebonyi State. The Experts suggestions were considered in the final design of the instrument. The instrument was considered suitable since it solicited information purposively from Research Assistants (RAs) in the Autonomous Communities who examined and recorded trends of rainfall in the LGA. Timing instruments such as Table clock and Wrist Watches were also used. Information were equally sought from friends, relations and well wishers in relation to this work verbally and making phone calls with Global system of Mobile Communication (GSM).

### **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 Discussions**

In Tables 1, 2 and 3, information therein show that all the months of the years 2013 and 2014 had rainfall except for the months of December, 2014 and 2015. In relation to frequency of rainfall in the periods covered, there was a downward experience in this regard, especially in the year, 2015, see Fig. 3, with no meaningful impact especially between the months of February and April. With regards to duration of rainfall, this was experienced more between the months of August and October for the periods covered.

In relation to heavy/moderate rainfall, there were few numbers of heavy rainfalls which lasted for long hours and with much impact between the months of August and October. In terms of moderate rainfall, there was high record of moderate rainfall in the year, 2013. The highest peak of rainfall for the year, 2013 was recorded in the month of August and that of the year, 2014 was recorded in the month of October and in the year, 2015 in the month of September. See Figures 1, 2 and 3 respectively. These observations are contrary to popular opinion. The rainfall scenario, from the results showed that the nature of rainfall was generally poor in the year, 2015.

## **Implications for Agricultural Production**

Prior to incidence of Global warming and Climate change, available records, information from Focus Group (FG) discussions and personal experiences show that the usual rainfall pattern and distribution in South East zone of Nigeria where Afikpo North Local Government Area of Ebonyi State is located experienced on the average six (6) months of rainfall from the month of April to September with “double maxima” (two peaks of rainfall) in the months of July and September. See Figure X.

But currently, this part of the zone hardly experiences on the average four (4) months of well distributed rainfall. This is evident in Tables 1, 2 and 3 and Figures 1, 2 and 3. Also available records, information from (FG) discussions and personal experiences have also shown that the rains now commence early in the years between the months of February and March and suddenly disappear thereafter. The rains start again in the month of May increasing gradually in frequency, duration and intensity which fluctuate and with heavy downpours with much impact between the months of August and October. This pattern of rainfall and distribution is not favourable for both crops and livestock production. In a situation where rainfall is expected to last for six (6) months and only about four (4) months of rainfall which are not well distributed in the months of the year may be available, may not augur well for agricultural production. Consequently, crops are not cultivated at the appropriate time. This position is supported by Anam *et al.* (2015) who stated that the rain does not fall in the way it used to, and the crops do not grow the way they used to. With the above trend and position, some crops such as rice, maize, yam, cassava, etc that require much water to thrive well may suffer, especially between the months of May and June. There may also be absence of crops cultivated early in the year such as early maize due to inadequate rainfall and late cultivated crops such as late maize due to excessive downpours during the later part of the year (i.e. between the months of August and October). Often, when crops are cultivated, the rains may come down heavily between the months of August and October, washing and carrying away plants and animal materials and destroying farm lands.

In most parts of the country, the South-East Zone and the LGA inclusive, some farmers allow un-harvested crops in the farm between the months of September and November to dry up and later used as future farm inputs or for home consumption. To this regard, these farmers have suffered losses of such crops as a result of rainfall experienced around this period of the year contrary to the usual trend. According to the field work carried out by Oga and Oga (2011, 2012 & 2013) on the Pattern of Rainfall and distribution in Ebonyi State and the LGA, there has been convincing deviation from the usual pattern of rainfall and distribution in both areas. This position was corroborated by (NIMET, 2016).

### **Effects on Agricultural Production in the LGA**

On the coming of the rains early in the years 2013, 2014 and 2015, farmers quickly planted some of their crops only to find out that the rains ceased for about 4 – 5 weeks. This resulted in the loss of some of these crops due to absence of rainfall and very high temperatures which scotched the crops. This position is supported by Parry (2007) on the effects of very high temperatures on farm resources. Some farmers also lost their livestock (sheep, goat and poultry birds) due to high level of heat as a result of very high temperatures between the months of February and March. These resulted in increase in cost of production as farmers purchased more farm inputs to replant and restock when the weather conditions ameliorated.

It is worthy of note here that between the months of August and October of the years covered, some crops were lost due to heavy downpours which caused flooding resulting in the loss of plants and animal materials and other farmers' resources. This situation is backed up by Midori, (2007). Generally, there was high cost of production, lost of farm produce and other resources and reduced output contrary to farmers' expectations. This is backed up by the opinion of Kluger, (2006) in relation to decreased food supply consequent on unfavourable weather conditions.

### **Conclusion**

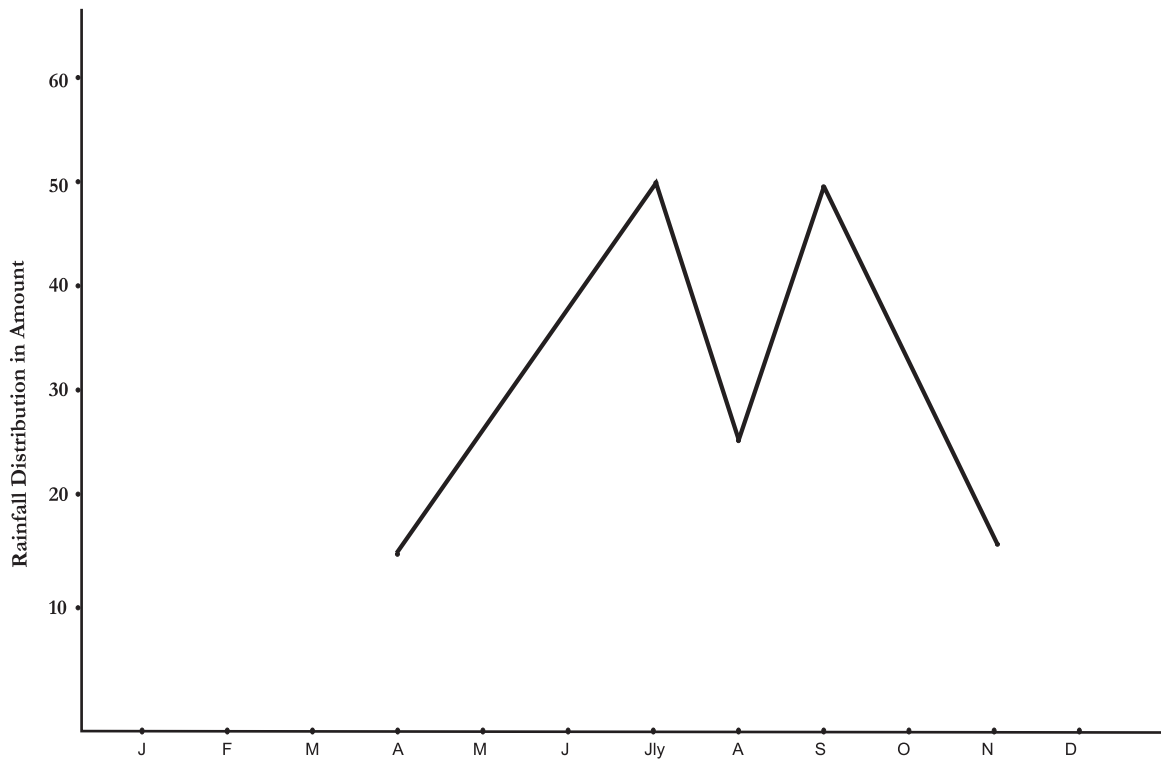
The practice of agriculture is affected by various factors especially climate. The effect of climate is felt through one of its potential elements, rainfall. The rainfall of a place, to a large extent determines the scenario of agricultural production of the place. Currently, the nature of rainfall in relation to agricultural production in the LGA 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, need to be mitigated. Strategies to be employed in this regard include among others, creating adequate awareness to the public and especially to farmers on the realities of Global warming and Climate change, farmers to delay cultivation of crops to about 4-5 weeks after the first set of rains which now occur early in the year and farmers to avoid setting fire on cut down vegetation on the whole farm but to pack them at strategic places probably on the farm to rot away over time.

### **Recommendations**

1. Adequate 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 delay planting and probably commence planting after about 4-5 weeks after the first set of rains.
3. Farmers should be advised as a matter of necessity to cultivate edible cover crops as “must crops” during each cropping season.
4. Deforestation should be discouraged and Farmers and youths advised to plant trees (Agro-forestry) through youths' and farmers' organizations.
5. 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 activities and personnel trained in this regard.
6. Local Government Councils should establish appropriate Centres in their localities for keeping records on weather conditions and equipped with modern facilities and well trained staff for this purpose.
7. Government at all tiers should support in minimizing the impact of Global warming and Climate change by constructing dams and boreholes and wells where necessary and as the need warrants.
8. Philanthropists, legislators among others should encourage siting of boreholes/wells in their localities and constituencies respectively in order to provide water for agricultural productions and for domestic needs.
9. Farmers should be discouraged from setting fires to cut down vegetation on the whole farm but to pack them at strategic spots to rot and decay for further use on the farm. This will reduce the emission of Carbon (iv) Oxide (CO<sub>2</sub>) to the atmosphere
10. Zero tillage should be practiced by farmers especially in areas where the soil is fragile and vulnerable to erosion.

**A graph showing the usual pattern and Distribution of Rainfall**



**Fig X: Months of the year showing the hypothetical representation of the usual heights of rainfall prior to the influence of Global warming and Climate change.**

**Source:** Nnabo et al (2007) and Oga, ( 2014)

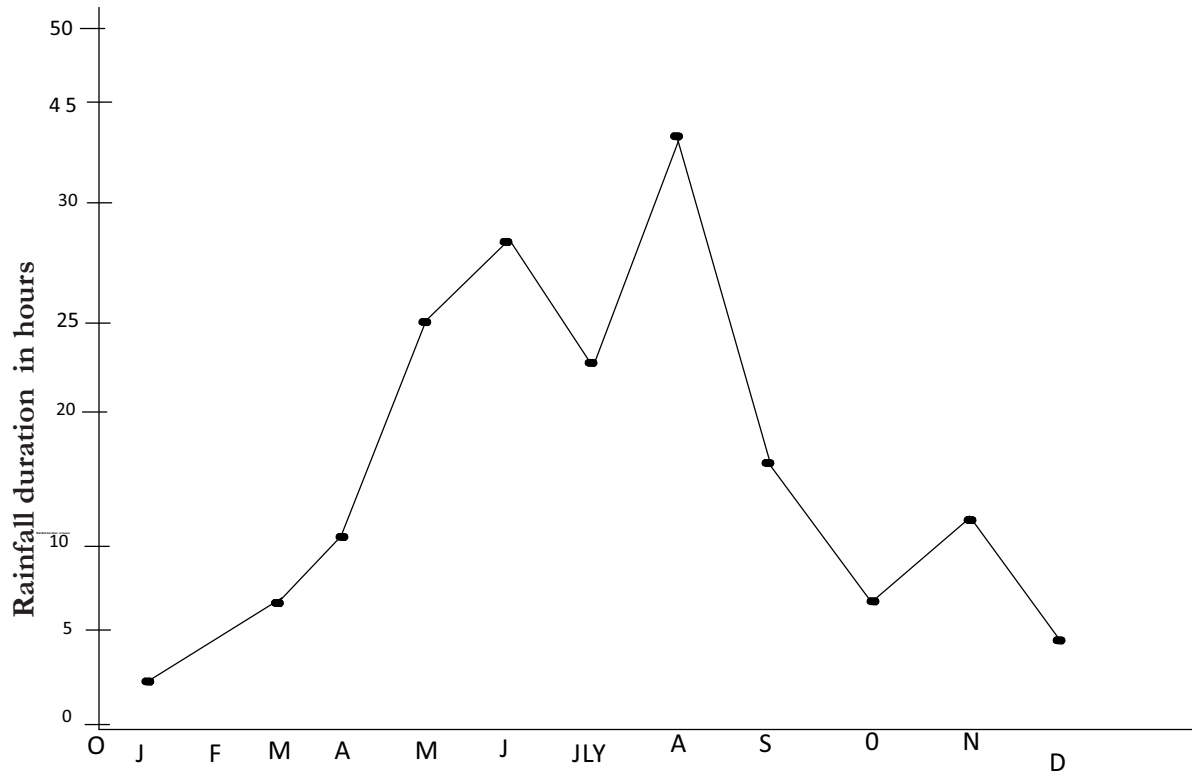


Table 1: Monthly Summary of Rainfall in Terms of Frequency, Duration, Among Others, in the year, 2013.

Months of the year 2013	Rainfall		No of times of rainfall in each month	Duration of rainfall in hrs/ mins in each month		No of times of moderate rainfall in each month	Frequency of Heavy rainfall in each month	Frequency of windy days in each month	No of days of sunny days		No of moody days	
	Yes	No		Hrs	Mins				Very sunny day	Not very sunny	Very moody	moody
1. Jan	✓		2	3	-	2	2			27		
2. Feb	✓		2	-	35	1	1					
3. Mar	✓		5	6	-	1	4	2				
4. Apr	✓		10	8	47	4	6	3				
5. May	✓		17	25	30	6	11	5	5			11
6. Jun	✓		15	29	10	4	11					11
7. Jul	✓		14	22	4	4	10					9
8. Aug	✓		10	42	40	6	4			16		
9. Sep	✓		13	15	50	5	4			11		
10. Oct	✓		12	6	40	7	5			18		2
11. Nov	✓		5	11	25	1	4		10	15		
12. Dec	✓		4	4		1	3		8	20		

Source: Field Work, 2013.

**A Graph showing Mean monthly Duration of Distribution of rainfall in hours in the year, 2013 in Afikpo North Local Government Area of Ebonyi State.**



**Fig. 1: Months of the year, 2013 showing mean monthly duration of rainfall in hours.**

**Source:** Field Work, 2013.

Table 2 : Monthly Summary of Rainfall in Terms of Frequency, Duration, Among Others, in the year, 2014

Months of the year, 2014	Rainfall		No of times of rainfall in each month	Duration of rainfall in hrs/mins in each month		No of times of moderate rainfall in each month	Frequency of Heavy rainfall in each month	Frequency of windy days in each month	No of days of sunny days		No of moody days	
	Yes	No		Hrs	Mins				Very sunny day	Not very sunny	Very moody	moody
1. Jan	✓		1							27		
2. Feb	✓		2									
3. Mar	✓		5	1		1	1					
4. Apr	✓		6	4		1	2	1				
5. May	✓		8	6		7	1					
6. Jun	✓		7	3		4	3					
7. Jul	✓		7	3		3	4					
8. Aug	✓		12	17	40	7	5					
9. Sep	✓		13	13	20	6	7	6				
10. Oct	✓		13	28	15	9	4				3	1
11. Nov	✓		6	15	10	4	2				5	3
12. Dec	✓											

Source: Field Works, 2014.

Summary of duration of rainfall in hours in each month of the year, 2014

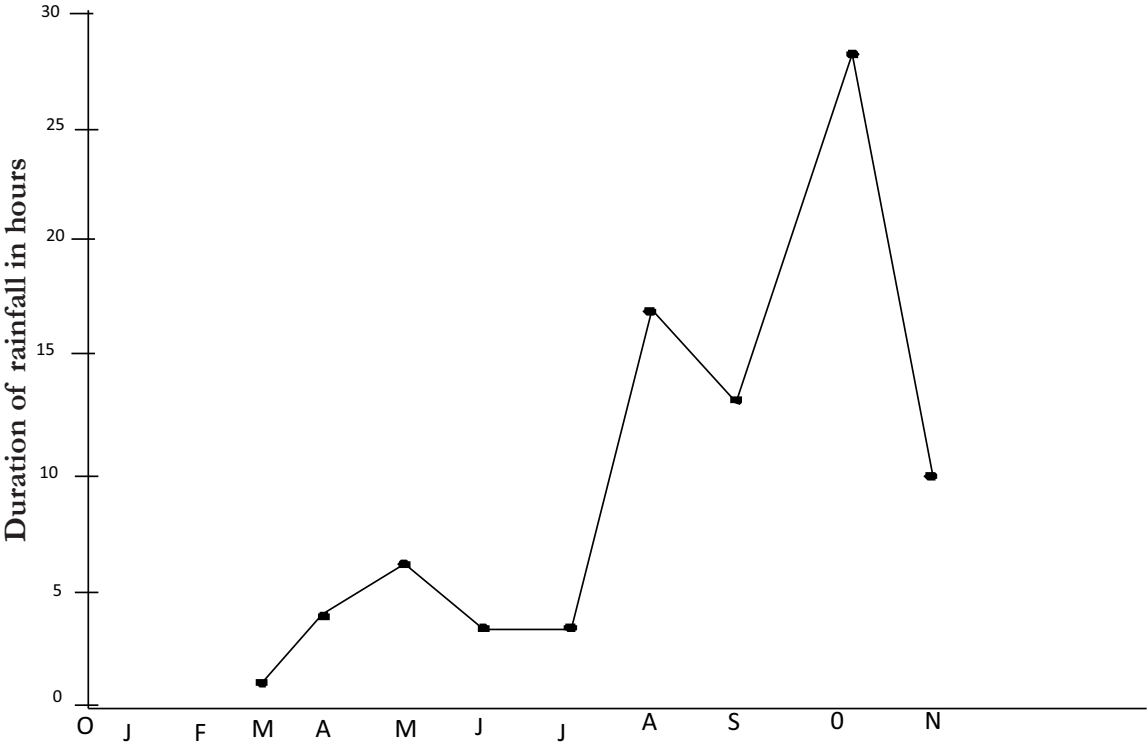


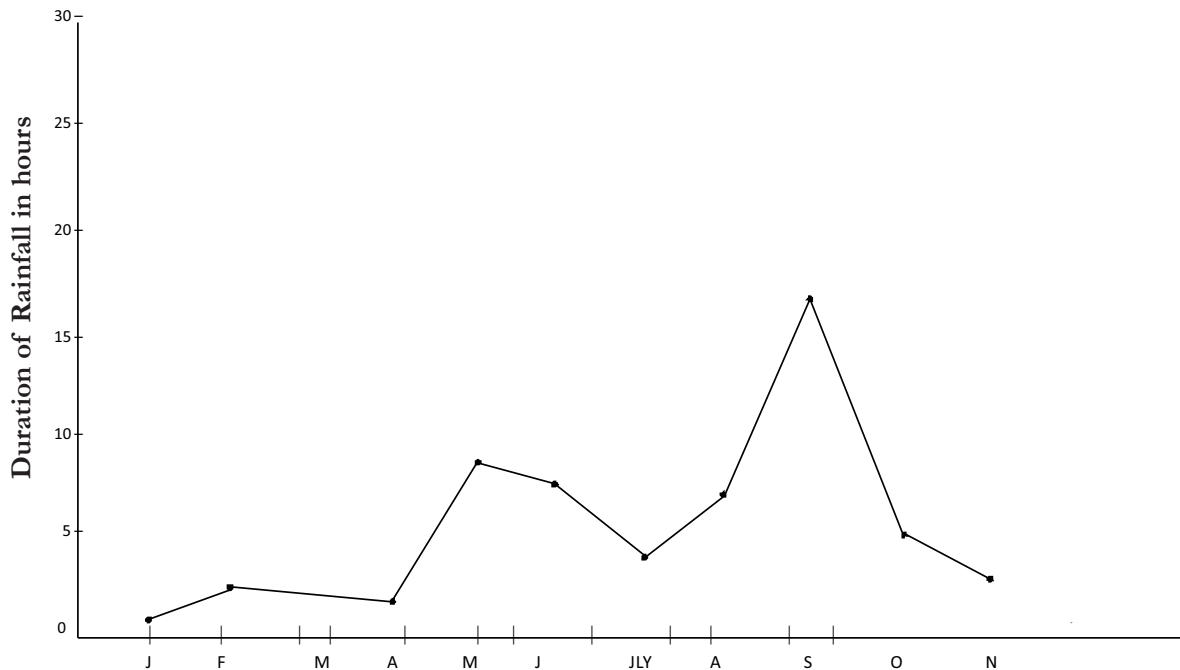
Figure 2: Rainfall distribution in hours in each month of the year, 2014

Table 3: Monthly Summary of Rainfall in Terms of Frequency, Duration, among others in 2015.

Months of the year, 2015	Rainfall		No of times of rainfall in each month	Duration of rainfall in hrs/mins in each month		No of times of moderate rainfall in each month	Frequency of Heavy rainfall in each month	Frequency of windy days in each month	No of sunny days in each month		No of moody days in each month	
	Yes	No		Hrs	Mins				Very sunny day	Not very sunny	Very moody	Moody
1 Jan	✓		2	1	20		2					
2 Feb	✓		4	3	25	2	2	16				
3 Mar	✓		1	-	25		1	20	5			
4 Apr	✓		4	2	5	2	2	6	25			
5 May	✓		12	10	25	8	4					
6 Jun	✓		5	9	5	6						
7 Jul	✓		8	5	45	4	2	2				9
8 Aug	✓		11	8		5	4					13
9 Sep	✓		13	19	40	6	6					5
10 Oct	✓		3	6	40	3	2					
11 Nov	✓		5	4	15	5						
12 Dec												

Source: Field Work, 2015

**Graph Showing Monthly Duration of Rainfall in Hours in Afikpo North Local Government Area of Ebonyi State, Nigeria in the Year, 2015**



**Fig. 3: Rainfall distribution in hours in each month of the year, 2015**

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