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Data on the Pattern and Distribution of Rainfall: a Potential Strategy towards Mitigating the Effects of Global Warming and Climate Change

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Abstract

The field work aimed at accessing and generating data on the pattern and distribution of rainfall in Afikpo North Local Government Area (LGA) of Ebonyi State, Nigeria, for the years 2011, 2012, 2013, 2014 and 2015(Five (5) years). The LGA is made up of Twelve (12) Autonomous Communities (ACs) out of which 10 ACs were randomly selected. Research Assistants (RAs) were needed for the field work and Two (2) RAs were purposefully selected from each of the randomly selected 10 ACs to give Twenty (20) RAs. A Self-designed recording instrument was used in the field work and data were collected and analyzed using frequency Tables and graphs. The result will offer the platform on which to suggest to farmers on how to probably plan their farming activities in the future to, among others, minimize losses of farm produce on the farm. Results revealed that there has been deviation from the usual pattern of rainfall and distribution in the years covered The results equally revealed that there was absence of the usual 'August break" in the month of August of the years covered and heavy downpours were experienced between the months of August and October in the same periods covered (2011-2015). There was also absence of the usual "double maxima" in the month of July and September of the years covered The recommendations, among others, include that; farmers should not cultivate their crops with the coming of the first set of rains which now start early in the year (between February and March), not to allow crops, as had been the usual practice, to dry up in the farm between the months of October and November in other to avert losses that may occur on the farm due to rains experienced around this time of the year, farmers to cultivate edible cover crops as 'must crops" during the cropping season

Keywords: *Data, Global Warming, Climate Change, Rainfall, Distribution.*

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Background to the Study

According to Moghalu, (2012), 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. 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. 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. 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).

In efforts 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 access and generate data on the present trend and distribution of rainfall in the LGA in the years, 2011, 2012, 2013, 2014 and 2015.

Objectives of the Study

These were to:

i. Examine records of rainfall in 2011, 2012, 2013, 2014 and 2015 in Afikpo North Local Government Area (LGA) of Ebonyi State.
ii. Examine the time of commencement of rainfall in each day of rainfall in each month of the years, 2011, 2012, 2013, 2014 and 2015 in the LGA
iii. Assess the duration (in minutes/hrs) of rainfall in the days of rainfall in each month of the years, 2011, 2012, 2013, 2014 and 2015 in the LGA
iv. Assess the trend of rainfall and its distribution in each month of the years, 2011, 2012, 2013, 2014 and 2015
v. Make recommendations on the strategies to help mitigate the effects of Global warming and climate change as they border on rainfall and subsequently agricultural production in the LGA.

Statement of the Problem

Hitherto, 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 provide guidance for farmers and 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 2011, 2012, 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, 2011, 2012, 2013, 2014 and 2015. The instrument was face validated by two Agricultural experts in the Department of Agricultural Technology, Akanu Ibiam Federal Polytechnic, Unwana, 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

It is pertinent here, before highlighting the results from the field work to present a senerio of the usual rainfall pattern and distribution in the LGA before the incidence of Global warming and climate change. 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, 3, 4 and 5 and Figures 1, 2, 3, 4 and 5. 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 current pattern of rainfall and distribution may not be 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.

Tables 1, 2, 3, 4 and 5 show the data generated for the five (5) years on the rainfall for the years covered. Then Figures 1, 2, 3, 4 and 5 show the pattern of rainfall and distribution designed with the help of the data generated for the number of years equally covered. With the data generated, and the pattern of rainfall shown, farmers in the LGA will be better disposed to understand the current changes in rainfall trend and distribution and better guided in this regard. This guidance will help them plan their farming activities better and thereby minimize losses on their farms. This guidance, to some extent, will equally shield them from the vagaries of weather, especially, as the border on rainfall pattern and distribution. With the above scenario, farmers will know when to cultivate the land, understand when to plant their crops, among others. Now, in relation to the results from the field work, Tables 1, 2, 3, 4 and 5, information therein show that all the months of the years 2011, 2012, 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. 5, 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 rainfalls in the year, 2013. The highest peak of rainfall for the years, 2011 and 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 3, 4 and 5 respectively. The result show that the peaks of rainfall that usually occur in the months of July and September now occur often between the months of August and October. These observations are contrary to popular opinion. The rainfall scenario, from the results shows that the nature of rainfall was generally poor in the year, 2015. This trend in the years covered provides ample evidence that they has been a "shift" from what used to be to what is now in relation to rainfall pattern and distribution. 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, supported the fact that there has been convincing deviation from the usual pattern of rainfall and distribution in both areas and in other parts of the country. This position was corroborated by (NIMET, 2016).

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 services 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. Zero tillage should be practiced by farmers especially in areas where the soil is fragile and vulnerable to erosion.

Table 1: Monthly Summary of Rainfall in Terms of Frequency, Duration, Among Others, in the year, 2011

Months of the year 2011		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.	Feb	✓		06	16		5	1					
3.	Mar	✓		06	3		3	3	3				
4.	Apr	✓		11	4		6	5				1	
5.	May	✓		14	27		7	8	2				
6.	Jun	✓		10	8		12	3					12
7.	Jul	✓		15	30		16	3					5
8.	Aug	✓		18	58		6	2		1	13	1	18
9.	Sep	✓		11	15		5	5					
10.	Oct	✓		9	8		-	4					
11.	Nov	✓		1	-								
12.	Dec	✓	✓	-									

Source: Field Work, 2011.

A graph of Trend and distribution of Rainfall in the Year, 2011 in Afikpo North LGA

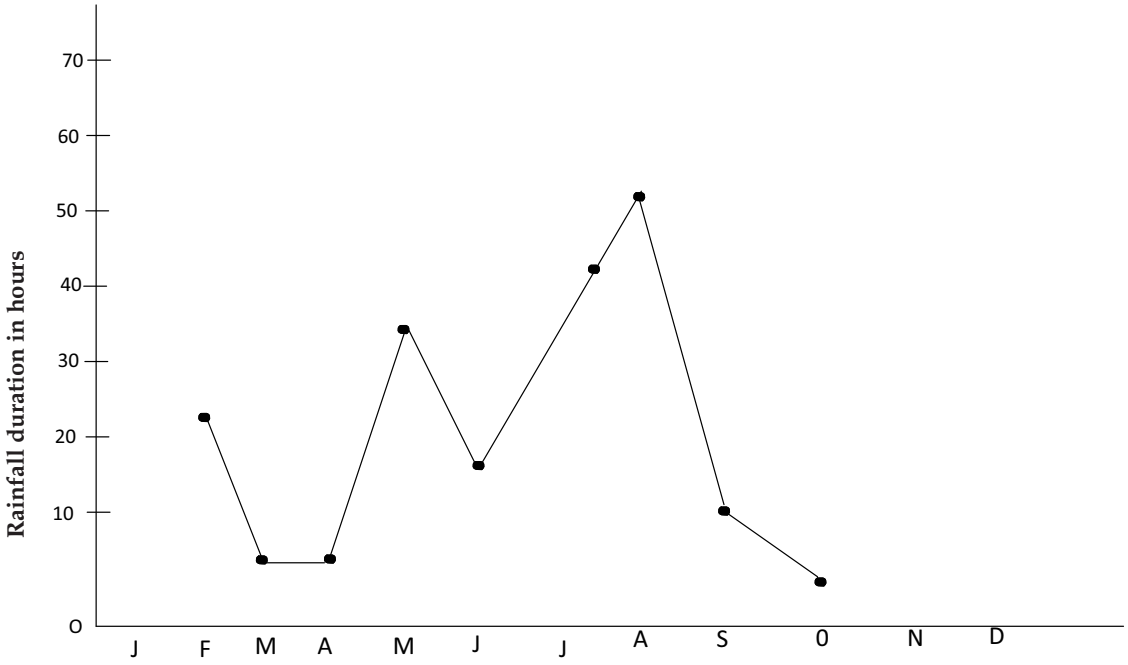

Fig. 1: Heights of rainfall in the year, 2011 in Afikpo North LGA

Table 2: Monthly Summary of Rainfall in Terms of Frequency, Duration, among others, in the year, 2012

Months of the year, 2012		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	✓		1	-	15	1	-					
2	Feb	✓		7	3	-	3	4					
3	Mar		✓	-	-	-		-		16			
4	Apr	✓		13	11	41	5	9	3				
5	May	✓		13	31	38	3	9					
6	Jun	✓		8	6	33	2	6					
7	Jul	✓		23	31	40	14	3					
8	Aug	✓		14	28	15	4	2					
9	Sep	✓		15	39	02	10	7		1	5	4	10
10	Oct	✓		12	23	33	4	6				1	3
11	Nov	✓		6	5	40	2	1					
12	Dec		✓	-	-	-	-	-					

Source: Field Work, 2012.

Graph Showing Monthly Duration of Rainfall in Hours in Afikpo North Local Government Area of Ebonyi State Nigeria in the year, 2012.

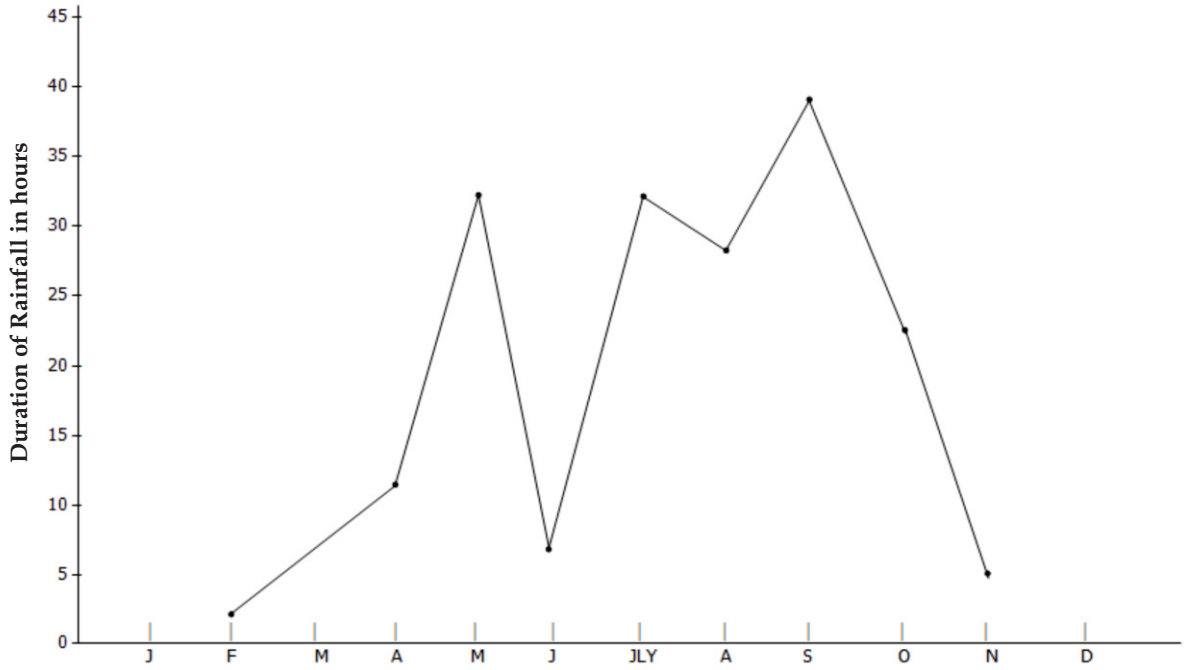

Fig. 2: Heights of rainfall in the year, 2012 in Afikpo North LGA.

Table 3: 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 50Afikpo North Local Government Area of Ebonyi State.

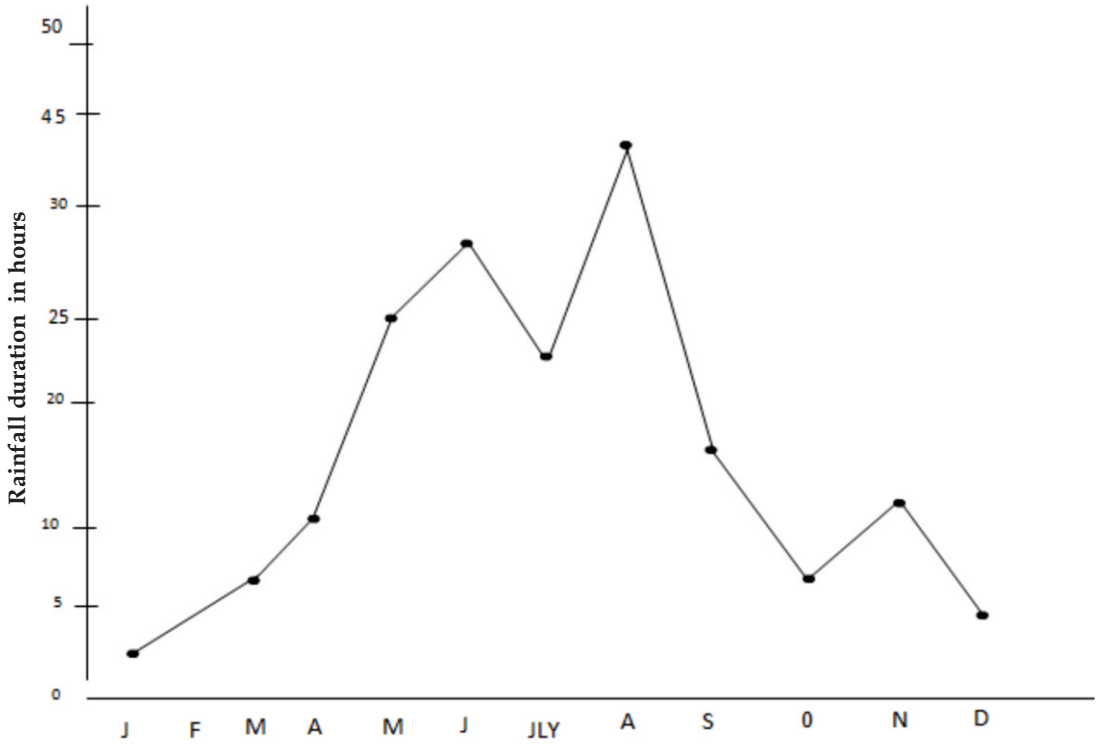

Fig. 3: Heights of rainfall in the year, 2013 in Afikpo North LGA.

Table 4: 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 Work, 2014.

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

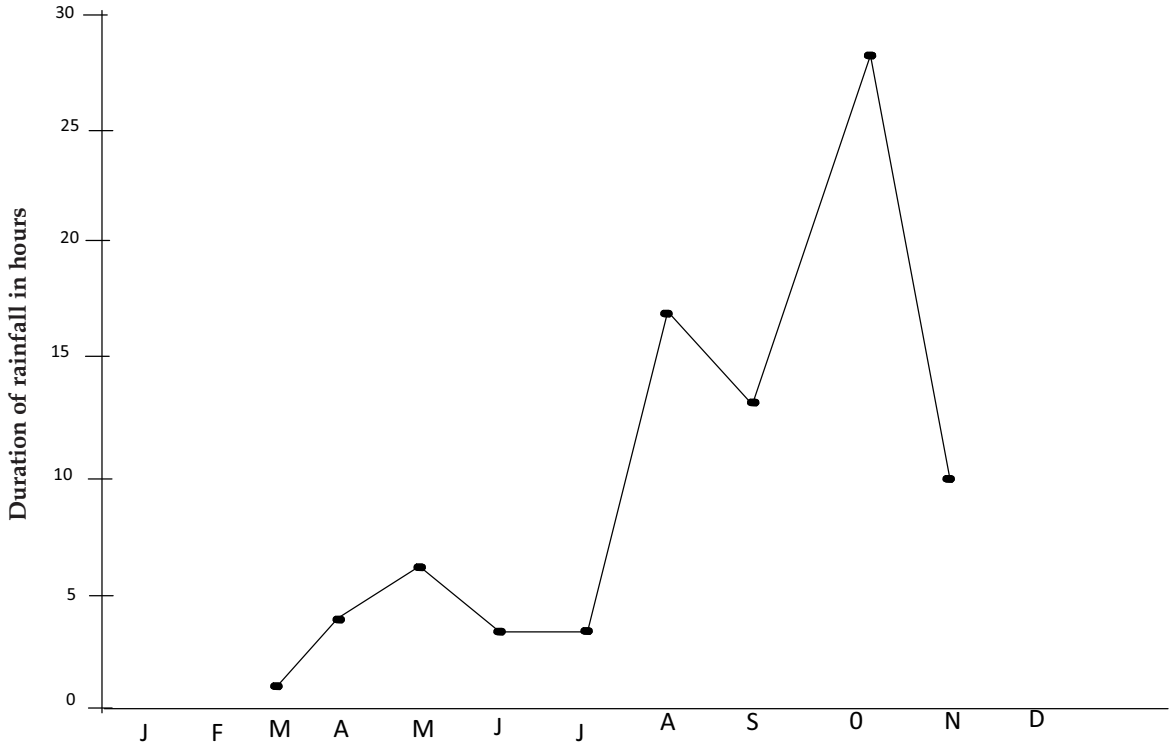

Figure 4: Heights of rainfall in the year, 2014 in Afikpo North LGA.

Table 5: 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 LGA in the Year, 2015

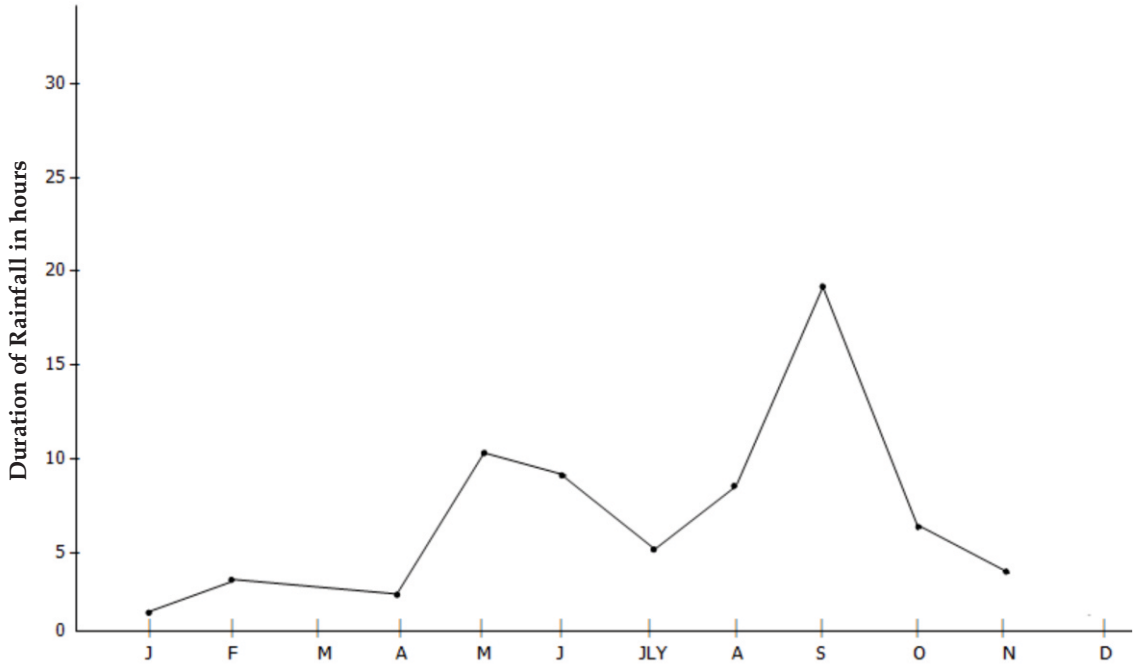

Fig. 5: Heights of rainfall distribution in each month of the year, 2015 in Afikpo North LGA

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