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Trend of Rainfall and Implications for Agricultural Production: Effects of Climate Change in Afikpo North Local Government Area of Ebonyi State, Nigeria

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Abstract

This research work was carried out to generate information/data on the pattern and distribution of rainfall in the Area of study from 2015 to 2016 (2 years). Hitherto, farmers embarked on farming activities adequately equipped with the knowledge of average weather conditions of their immediate environment. With this knowledge, they were able to plan their farming activities without much farm loses. But today the issue of global warming and climate change has made the exercise of this knowledge more of a mirage and consequently farmers incur huge losses on their farms. Following this, there is need to assist farmers with information/data in this regard. The field work was carried out in Afikpo North Local Government Area of Ebonyi State, Nigeria. The LGA is made up of 12 Autonomous Communities out of which 10 Autonomous Communities were randomly selected. This was followed by purposively selecting two (2) Research Assistants from the selected 10 Autonomous Communities to give a total of 20 Research Assistants who assisted in the field work. The data generated were analyzed using Tables and descriptive statistics. The result will form the basis on which to educate/ suggest to farmers when, probably, they can commence their farming activities in the months of the years in future in order to minimize losses on the farms due to current vagaries of weather/climate. The result of the field work, among others, showed that the rains now start early in the year between the months of February and March and cease thereafter and commence again in the month of May. The result also showed the absence of the usual double peaks of rainfall in the year. The recommendations include that farmers should not cultivate crops with the first set of rains but to delay planting of crops till about 3-4 weeks after the first set of rains and should cultivates "edible cover crops" as must crops.

Keywords: *Data, Climate change, Rainfall distribution, Agriculture*

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Background to the study

Agriculture for decades has been associated with the production of basic food crops and animals (Jifin, 2017). At present, agriculture in Nigeria, besides farming includes forestry, fruit cultivation, diary, poultry, mushroom, beekeeping and marketing, processing, distribution of agricultural products. 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 70% 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 twenty (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 for the populace and raw materials 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 at.* (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 technologies. 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.

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 high degree determines the type of and level of agricultural practices and production of a place respectively. 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, *et al* .(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 ie 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, Nigeria, is among, to have and appreciate this nature of rainfall. According to Jifin (2017), the current unfavourable nature of rainfall widely experienced 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(Oga *et al,*2014). 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 pathway to assisting in mitigating their negative effects and it is on this premise that this field work was embarked upon.

Statement of the Problem

Over the years, the rainfall pattern and distribution in the South East Region or Zone of the country, where Afikpo North Local Government is located, was such that the local farmers understood the pattern and distribution of rainfall and this guided them to plan their framing activities. They understood when the rains will commence, when and how to cultivate certain crops with the idea or perceived amount of water required.

Currently, farmers have found themselves in a state of confusion and unable to really understand and follow the present pattern and distribution of rainfall and this has affected the planning of their farming activities and has equally exposed them to some level of loses. Sequel to this, farmers desire solutions in this regard and need assistance in order to come out of this confused state and prevent loses of farm produce. This can be achieved by making ample efforts to understanding the current pattern and distribution of rainfall and with this, make available information/knowledge to farmers that will guide them in their farming activities.

Objectives of the Study

The main objective of this field work was to observe and generate data on the current pattern and distribution of rainfall in the LGA in the years 2015 and 2016.
These were to:

i. Access and record the time of commencement of rainfall in the days of rainfall in each month of the years, 2015 and 2016.
ii. Access and record duration (in minutes/hours of rainfall in the days of rainfall in each month of the years, 2015 and 2016.
iii. Access and record the number of times (frequency) of rainfall in each day of rainfall of each month of the years 2015 and 2016.
iv. Make recommendations on the strategies to help mitigate the effects of global warming and climate change.

Materials and Method

The Study Area

The field work was carried out in Afikpo North Local Government Area (LGA) of Ebonyi State, Nigeria, in 2015 and 2016. The LGA is an agrarian place with a substantial number of the people engaged in one form of agricultural production or the other mainly at subsistence level. The various crops cultivated in the locality, include, among others, yam, cassava, maize, rice, potatoes and vegetable. Aside cultivation of crops, livestock are kept and reared, especially, the small ruminants (sheep and goat), poultry and even fishing is equally done. Agricultural production in the LGA is mainly influenced by the annual weather conditions based on two major seasons: the dry and wet seasons. The dry season commences about the month of November and ends 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

Some instruments were used in the field work among which was a Self designed recording instrument. The instrument showed the dates/days of each month of the years 2015 and 2016. 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 observed and recorded the required parameters sought in relation to the field work 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 of phone calls to relevant quarters with Global System of Mobile Communication (GSM).

Method of Data Collection

The LGA is comprised of twelve (12) Autonomous communities. Out of these, 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 observing and recording the parameters considered relevant to the field work.

The Usual Pattern and Distribution of Rainfall in the LGA Prior to the Influence of Global Warming and Climate Change

Ordinarily, the usual rainfall pattern, prior to influence of climate change was that the rains commenced from the month of April and increased in frequency, intensity, amount and duration and got to the first peak in the month of July, after "*seven (7) days*" of continued rainfall from the middle part of the month. Shortly after this, the rains dropped in the later part of the month to early part of the month of August and paved way for "*August break*". (Nnado et al, 2007 and Oga, 2014). After this break, the rains commenced again from the later part of August and reached the second peak in the month of September and after which it gradually dropped until the early part of November for dry season to set in. There were usually "*two peaks*" (double maxima) of rainfall in the rainfall season in the months of July and September. See Fig X

Results/Discussion

The information in Tables 1 and 2 and Figures 1, 2, 3 and 4 show that rainfall occurred in all the months of the two (2) years covered except in the months of December in 2015 and January and December in 2016.

In relation to frequency of rainfall, the highest frequency in the year, 2015 was recorded in the month of September (13) and in 2016 in the month of August (16).

In relation to duration of rainfall, the year, 2015 recorded the highest duration of rainfall (in hours) in the month of September (19) and in the year, 2016 in the month of July (17)
From the data generated, the relationship between frequency and duration of rainfall in each of the months of the years covered, in most cases had "*inverse relationship*" for example, in the year, 2015, the frequencies of rainfall in the months of May and September were 12 and 13 respectively but the duration of rainfall (in hours) in the two months were 10 and 19 respectively which meant that there were more heavy downpours in the month of September than in the month of May, even though they had very close frequencies.

In contrary to the usual pattern of rainfall, the information in the accompanying Tables and Figures show a different pattern. The Figures designed with the generated data show that the rains commenced early in the months of the years covered between the months of February and April in small amounts and increased more in amounts in the month of May and dropped in the month of June and July without evidence of the "*seven (7) days*" of continuous rainfall, contrary to the usual expectations. This period was during which there should have been continued increase in rainfall (more in moderate amount) up to the month of July so as to support those crops that require much water to thrive, such as rice, yam, cassava and maize.

The information in the Tables and the designed rainfall pattern in the Figures also show that there was no "*August break*" the period during which the rains were expected to drop to permit/encourage the cultivation of late crops, such as late maize and those other crops that may not require much water to thrive such as groundnut, cowpea, etc. The information in the Tables and Figures show that there was absence of the usual "*Two peaks*" (double maxima) of rainfall in the periods covered.

Effects on Agricultural Production

The above pattern of rainfall and distribution currently experienced do not favour agricultural production as a result of absence of adequate rainfall for crops when actually required and rainfall being experienced more between the months of August and October, when not actually required in heavy amount due to crops that are supposed to be maturing/ripening in this period, such as rice, yam, etc.

Some crops that are usually allowed on the farm between the months of October and November to dry up and to be used for future consumption or inputs for future cultivation, are currently being destroyed by rains experienced around this period, contrary to farmers expectation.

With the rains coming early in the years covered, farmers cultivated their crops with the hope that the rains will continue, only to discover that the rains ceased after some weeks of commencement. This gave way to period of high temperature coming from the intense heat of the sun resulting in the scotching of crops and lost of some livestock such as poultry birds, goat, sheep, among others, due to heat stress. This situation caused loss of resources and increase in the cost of production as farmers had to replant and restock their livestock Units when the conditions of rainfall improved, probably from the month of May.

Sequel to above and from available information, there were reductions in the level of yield of some crops. For example, the yield of cassava reduced from the standard level of 12-15 tonnes per hectare of local best variety, to about 11-10.5 tonnes per hectare (Ebonyi State Agricultural Development, Programme (EBADEP), 2013).

In the case of maize, for local variety, there was reduced yield from the standard level of 1.5 tonnes per hectare to about 1.1 tones per hectare and for improved variety, there has been reduction in yield from the standard level of 1.5 tones per hectare to about less 1 tonne per hectare (EBADEP/Research Extension Farmers Input Linkage Systems (REFILS), 2013).

In the case of rice, the yield reduced from the standard level of 1.5-3.5 tonnes per hectare, depending on the variety, to about 1.7 tonnes per hectare (EBADEP/ REFILS, 2013).

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 and cultivation of *"edible cover"* crops as must crops.

Recommendations

1. There should be continued creation of awareness on the realities and increasing rate of global warming and climate change to the famers and the public.
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. Individual farmers should advised and encourage to practice agro-forestry
5. Deforestation should be discouraged and Farmers and youths advised to plant trees through youths' and farmers' organizations.
6. Government as a matter of urgency needs to 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.
7. 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.
8. Government should support in minimizing the effect of global warming and climate change by constructing dams and boreholes and wells where necessary and as the need warrants.
9. Philanthropists, legislators, among others, should encourage construction of boreholes/wells in their localities and constituencies respectively in order to provide water for agricultural productions and for domestic needs.
10. 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.
10. Zero tillage should be practiced by farmers especially in areas where the soil is fragile and vulnerable to erosion.

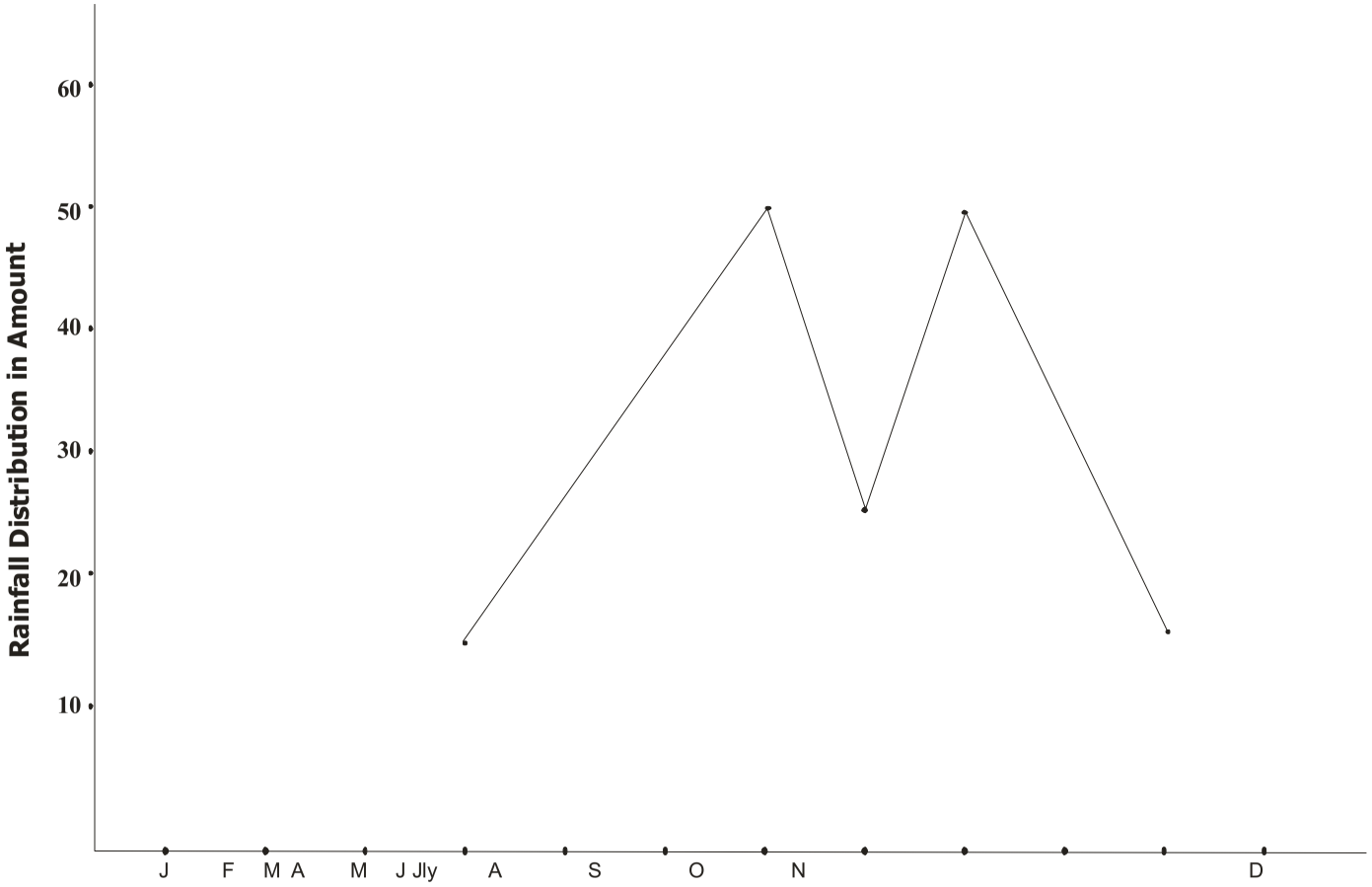

Fig X: Months of the year showing the hypothetical representation of the usual heights of rainfall for the influence of global warming and climate change.

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

Table 1: Monthly summary of rainfall in terms of frequency, duration, among others in 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

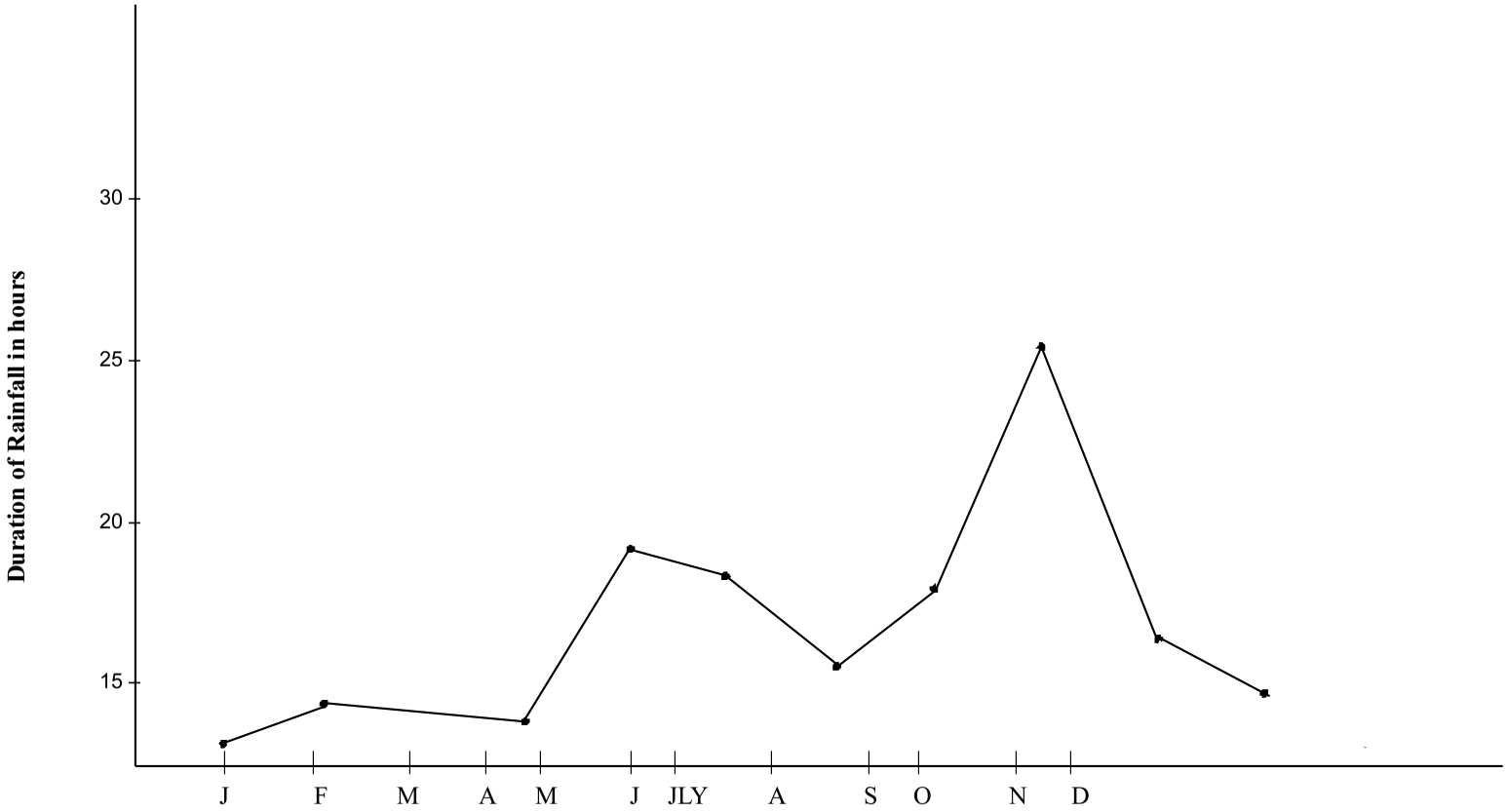

Fig. 1: Heights of rainfall for the year, 2015.

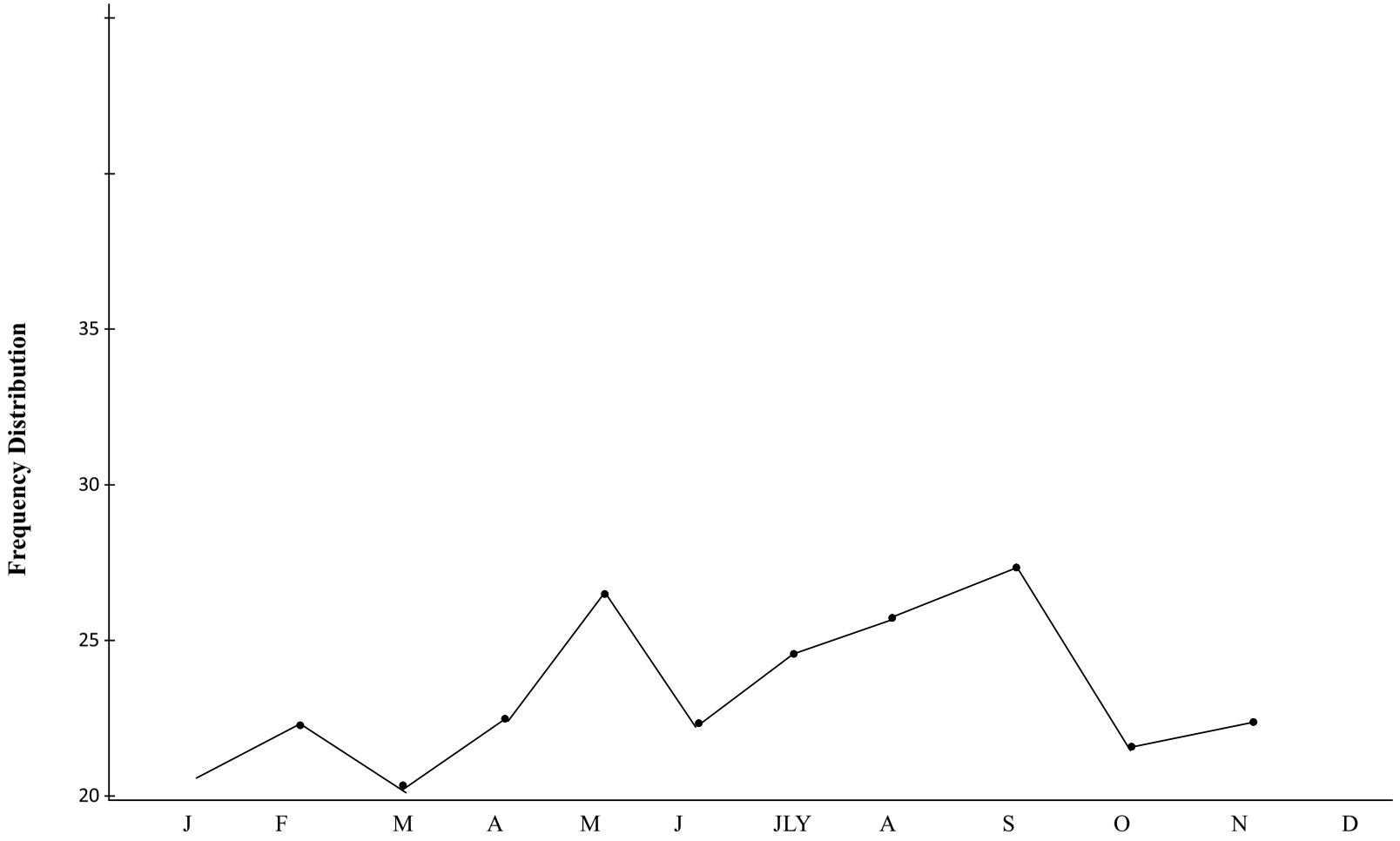

Fig: 2 **Frequency distribution of rainfall in the year, 2015**

Table 2: Monthly summary of rainfall in terms of frequency, duration, among others in 2016.

Months of the year, 2016		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	Feb	✓		1	2								
3	Mar	✓		5	3	10	3	2	2				
4	Apr	✓		2	3	45	1	1					
5	May	✓		11	16	15	8	3	3				
6	Jun	✓		9	12	40	6	3					
7	Jul	✓		14	18	20	9	5			10		7
8	Aug	✓		16	17	50	7	9					
9	Sep	✓		5	2	45	4	1					
10	Oct	✓		4	9	30	2	2					
11	Nov	✓		3	-	55	1	2		16			
12	Dec												

Source: Field Work, 2016

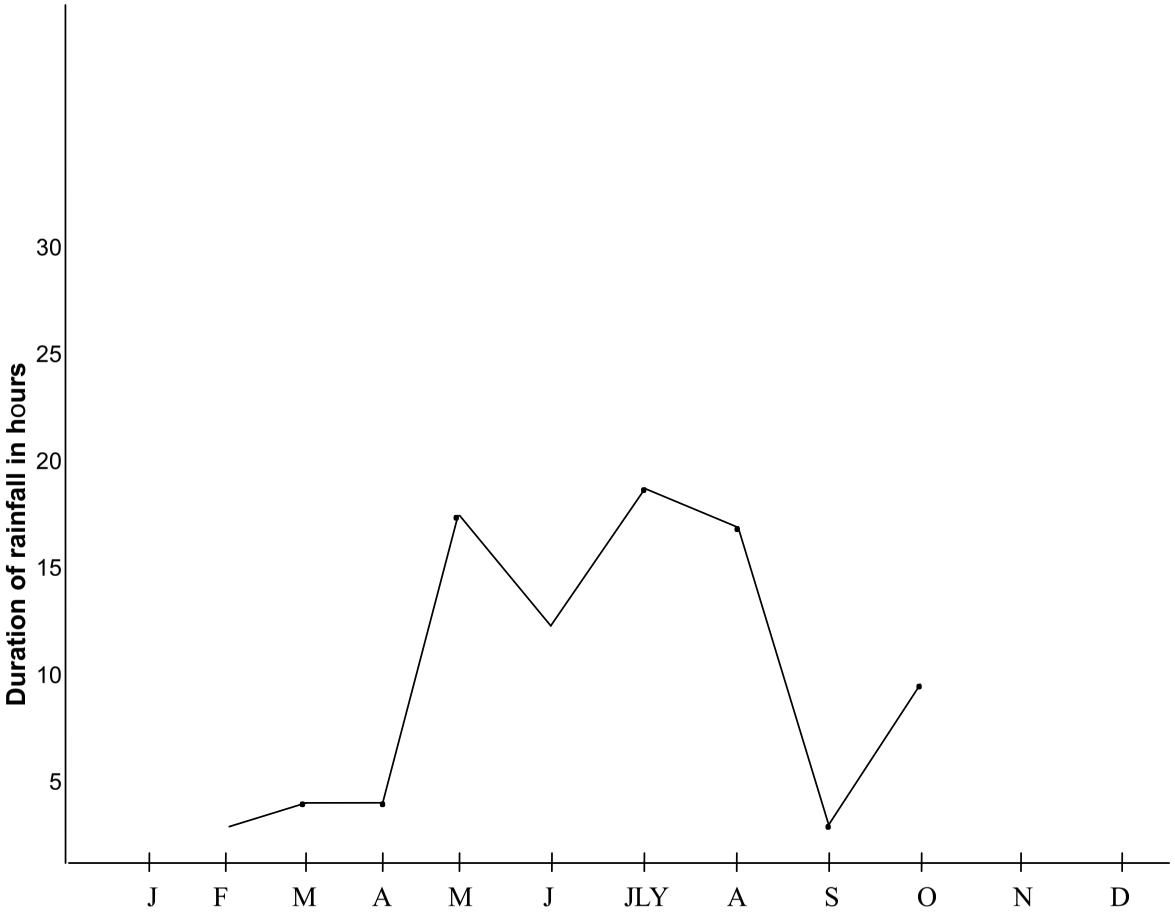

Fig. 3: Heights of rainfall in the year, 2016

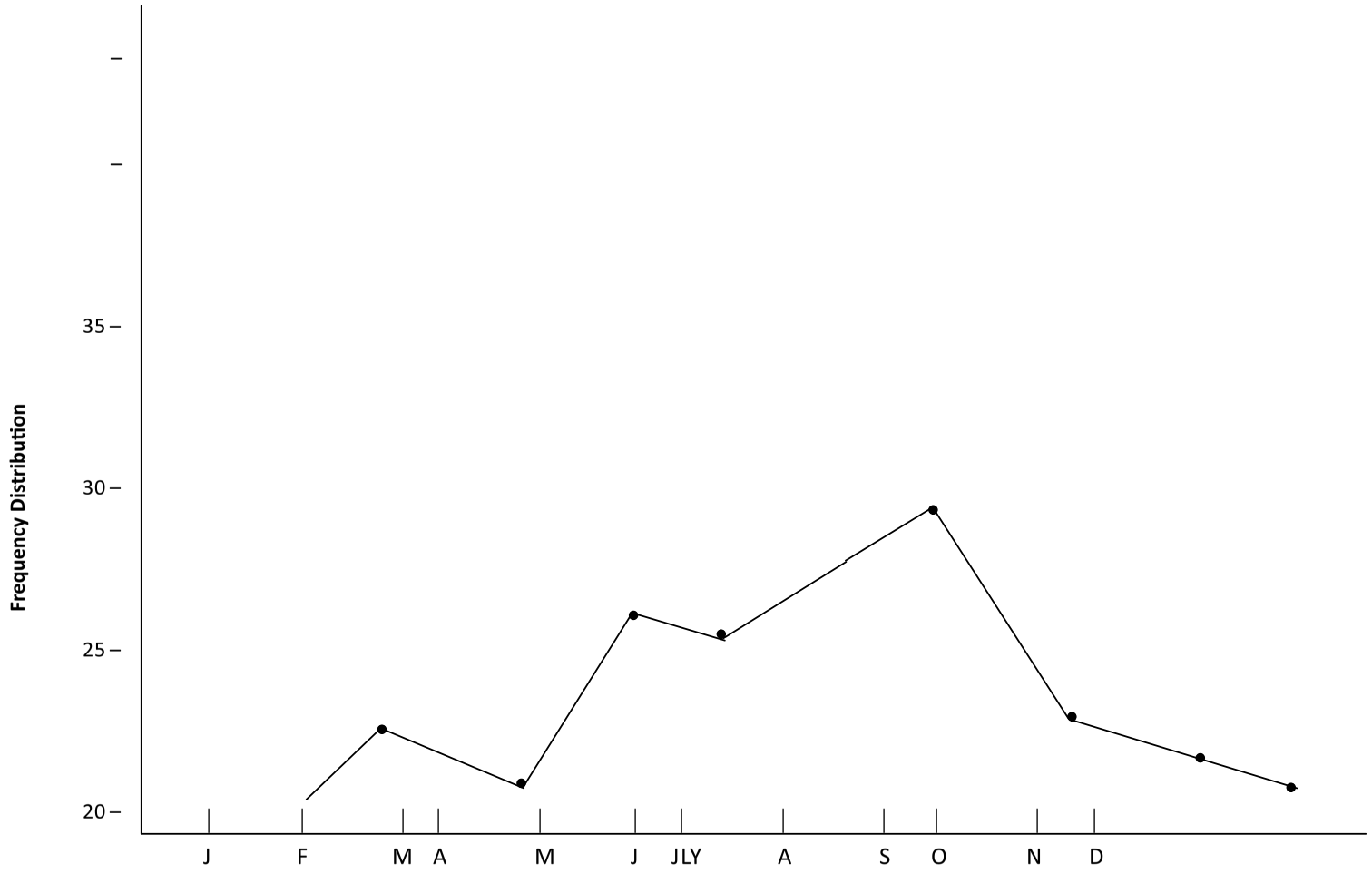

Fig: 4 Frequency distribution of rainfall in the year, 2016

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