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Rainfall Pattern and Agricultural Production in Afikpo North Local Government Area of Ebonyi State, Nigeria: Effects of Climate Change and Adaptation Strategies

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Abstract

The field work aimed at generating data/information on the pattern and distribution of rainfall in Afikpo North Local Government Area (LGA) of Ebonyi State, Nigeria, for the years 2017 – 2018 two (2) 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 and adaptation strategies 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 were heavy downpours experienced in the months of August and October in the same periods covered (2017-2018). There were sharp drops in rainfall in the month of September in 2017 and October in 2018. 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, 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: *Climate change, Rainfall, Agriculture, Adaptation*

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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 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 Akinbile, Akinwale and Ashimolwo (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, 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 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 Nwite, Nnabo and Nnoke (2007, Oguntola, 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. 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: 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 suggesting adaptation strategies against their negative effects and this informed the study.

Objectives of the Study

The general objective of this research was to generate data on rainfall pattern and distribution in Afikpo North Local Government Area (LGA) of Ebonyi State from 2017- 2018 two (2) years.

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 goat0 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 has been a deviation in the time of commencement of rainfall. These days' rainfall starts early in the year between the months of January and February contrary to popular opinion. See Figure 1 and compare 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.

Effects on Agricultural Production in the LGA

On the coming of the rains early in the years 2017-2018, 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 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 stress as a result of very high temperatures between the months of February and March. These situations 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 crop plants and animal materials and other farmers' resources. This situation is backed up by Midori (2007). Generally, there was high cost of production, loss of farm produce and other resources and reduced output contrary to farmers' expectations. This position is backed up with the opinion of Kluger (2006) in relation to decreased food supply consequent on unfavourable weather conditions.

Suggested Adaptation Strategies to Climate Change

Climate change adaptation is the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects that reduce harm or exploit beneficial opportunities.

Some of the adaptation strategies suggested in relation to this research include, among others:

1. **Agronomic Practices:** These are techniques farmers incorporate into their farm management systems to improve soil quality, enhance water use efficiency, manage crop residue and improve the environment through better fertilizer management. These steps decrease input costs and also improve the environment by decreasing water use and over-fertilization. Practices under this include:

a. **Cover crops and Green Manure:** Cover crops are planted to conserve the soil on bare or fallow farmland. Green manure is a fast growing legume sown in a field several weeks or months before the main crop is planted. These practices help as adaptation strategies by conserving the soil and also help protect the soil from excessive heat, exposure to wind and moisture loss.

b. **Improved Crop Varieties**: These are crops that have been developed through research and testing to have special qualities, such as fast maturation rates, high yields and pest and disease tolerance. Adaptation strategies could be by farmers selecting crop varieties that withstand effects of climate change (i.e. drought tolerance, pest resistant, etc.).

2. **Soil and Water Management:**

Soil management is the prevention and reduction of the amount of soil lost through erosion. It seeks to increase the amount of water seeping into the soil and reduce the speed and amount of water run-off. Water management on the other hand involves improving water use efficiency and minimizing losses of water from evaporation, run-off or drainage. This includes various techniques such as storing water in reservoirs to allow it to sink into the soil and increase soil moisture level. It also includes using a protective cover of vegetation on the soil surface to slow down the flow of running water and spread water over a large area. Under this strategy include such strategies as:

a. **Improve Irrigation**-which involves the efficient utilization of water for agricultural purposes. Small-scale irrigation increases the water use efficiency of the crops.

Diversion Ditches and Drainage Channels

These remove excess water from the land. They can increase yields in flood-prone zones due to increased water drainage. By facilitating good aeration of the soil, they can also help avoid emission of N_2O gas.

Terraces

These are promoted in hilly regions with substantial erosion hazard. The terrace walls or risers are earth structures and beds are leveled in order to encourage rainwater infiltration. Terraces can make cultivating on steep slopes easier. Terraces with diversion ditches can help control excess water runoff, helping with adaptation to climate change.

Planting Basin and Pits

These are circular holes within the crop fields which harvest runoff water. Planting basins improve water use efficiency by crops due to increased rates of water infiltration into the soil,

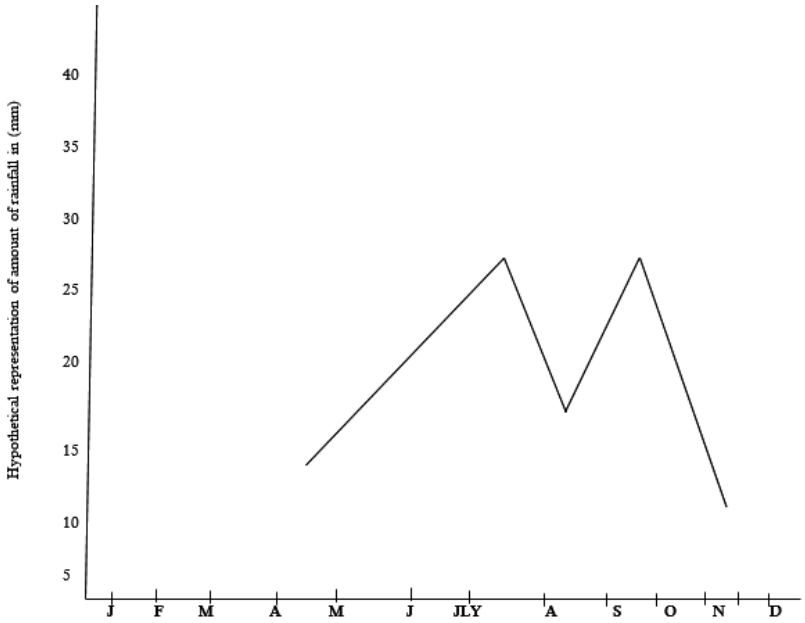
which can improve yields and increase the intensity of agriculture. They are important for conserving water in areas where there is not enough rainfall or when rainfall is sporadic.

Drainage and infiltration ditches
These are wide channels that collect surface run-off water, allowing it to slowly infiltrate into the ground.

Water pan
This is a shallow hole that collects and holds run-off water. Sometimes the pans are lined with plastic to prevent water loss.

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 Afikpo North Local Government Area 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. 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 cultivation of crops to about 4-5 weeks after the first set of rains which now occur early in the year and farmers to cultivate cover crops etc.

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 delay planting 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. 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.



Source: Oguntola and Nwite et al, 2007 and Oga, 2014

Fig. 1: Showing the usual pattern and distribution of rainfall before the incidence of global warming and climate change

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

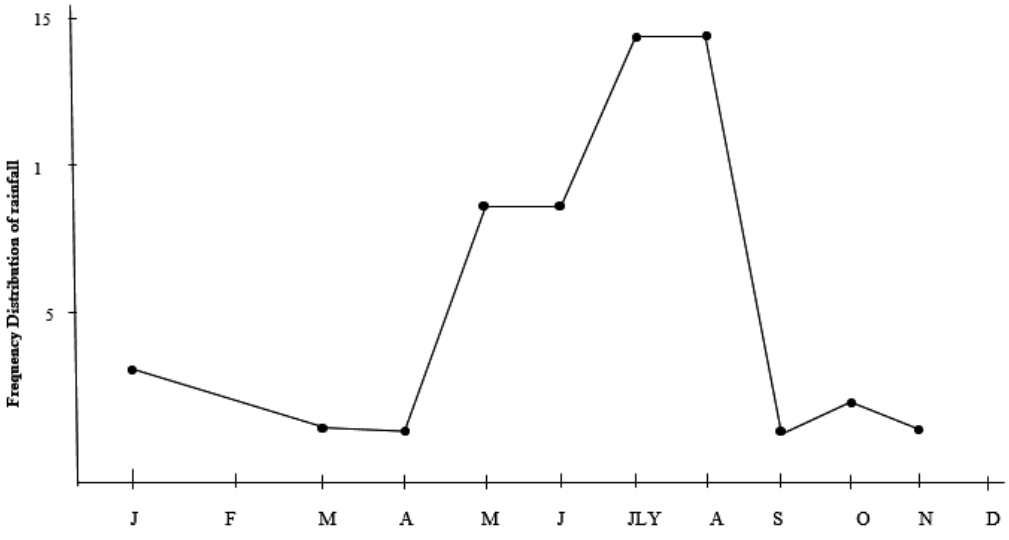


Fig 2: Heights of rainfall in the months of the year, 2017

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

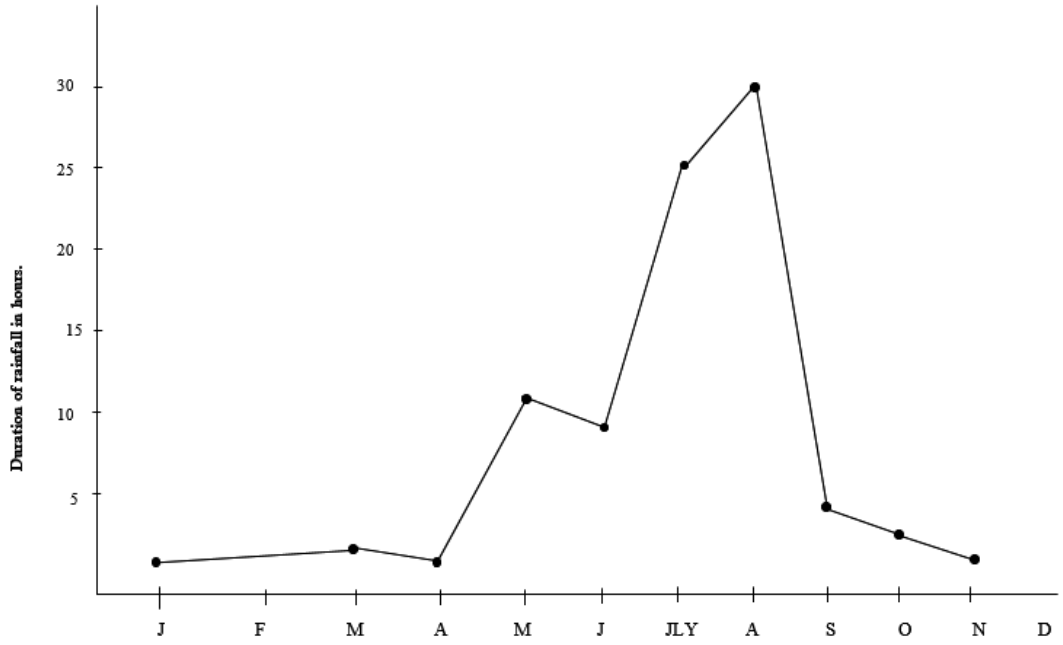


Fig 3: Heights of rainfall in the year, 2017

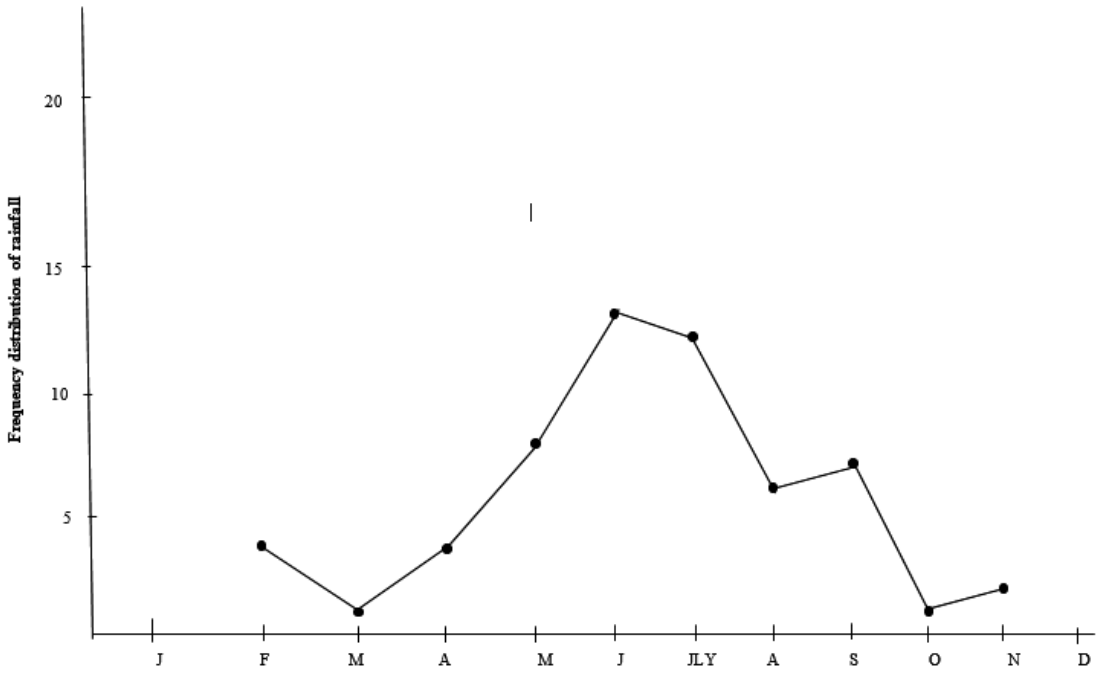


Fig 4: Heights of rainfall in the year, 2018

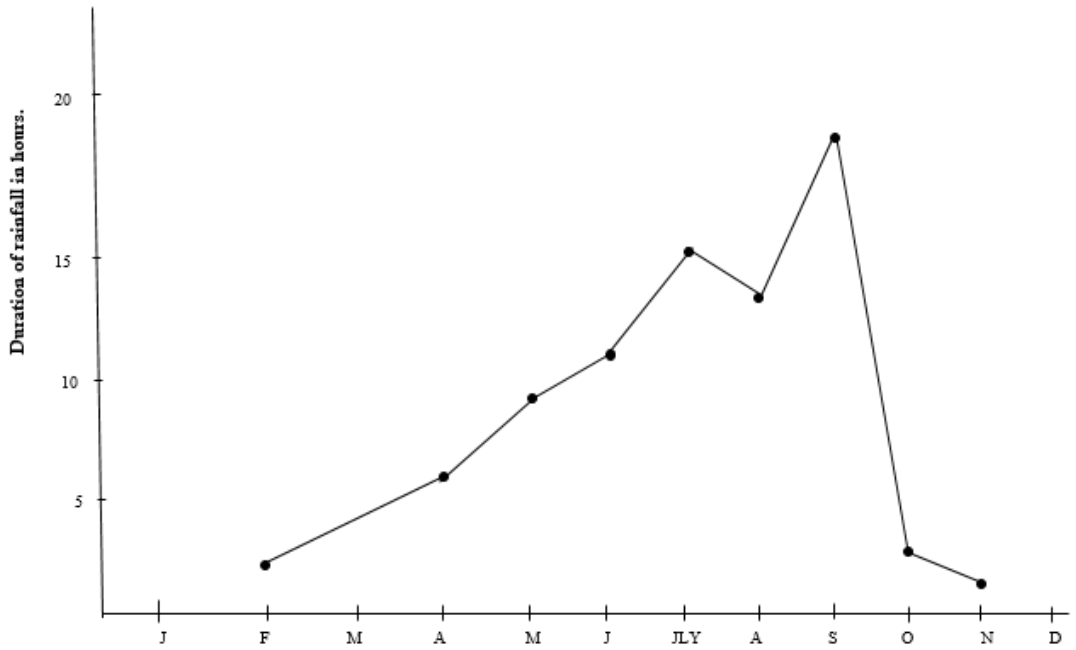


Fig 5: Heights of rainfall in the year, 2018

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	-	2
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
5	Oct	√		1	3	-	1
11	Nov	√		2	2	1	1
12	Dec						

Source: Field Work, 2018.

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