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Impact of Climate Change on Rainfall Pattern and Distribution in Afikpo North Local Government Area of Ebonyi State, Nigeria

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Abstract

This research was carried out to generate information/data on the pattern and distribution of rainfall in the Area of study from 2012 to 2016 (5 years). Long before now, farmers had good knowledge of the weather conditions of their immediate environment, and on this basis planned their farming an activity effectively with little loses of their farm produce. But currently, this knowledge appears to have eluded them consequent on the influence of global warming and climate change. The field work was carried out in Afikpo North Local Government Area (LGA) of Ebonyi State. The LGA comprises of 12 Autonomous Communities and out of these, 10 were randomly selected. Two (2) research Assistants (RAs) were purposively selected from each of the communities to assist in the field work. The data generated were analyzed using tables and descriptive statistics. The result of the field work, among others, shows 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 shows the absence of the usual double peaks of rainfall in the year. The recommendations, among others, 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.

Keywords: *Global warming, Climate change, Rainfall pattern, Distribution*

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Background to the Study

Agriculture is an activity of man, carried out primarily to produce food, Fibre and Fuel as well as many other materials by the deliberate and controlled use of mainly plants and animals (Karami and Keshavrz, 2010). 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. 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, Akinwale and Ashomolowo (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, appropriate technologies and favorable 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 (Oguntola, 2007). 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, Madauka 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) and(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, determines 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, frequency, 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, most places involved in substantial agricultural production, among which is the LGA, desire to experience 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, 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.

Long before now, farmers had good knowledge of the weather conditions of their immediate environment, and on this basis planned their farming an activity effectively with little loses of their farm produce. But currently, this knowledge appears to have eluded them consequent on the influence of global warming and climate change. This has led to considerable changes in the weather conditions of their immediate environment, especially, in the pattern and distribution of rainfall. Consequently, farmers can no longer understand the present weather conditions of their immediate environment and this has affected the planning of their farming activities and has resulted to some considerable losses of their farm produce and other resources. Following this situation, farmers need assistance in this regard to help them mitigate the effects of these changes in their environment. This is where extension education is relevant. One of the potential strategies to help them achieve this is to make available to them current basic information on these changes especially as it bothers on rainfall pattern and distribution. This will provide guidance for farmers and enable them effectively plan their farming activities. Sequel to this, the field work was embarked upon.

The main objective of this field work was to generate information /data on pattern and distribution of rainfall in the LGA in the years 2012- 2016. Specific objectives were to determine the time of commencement of rainfall in each month of the years from 2012 to 2016, determine duration (in hours of rainfall in each month of the years from 2012 to 2016), determine the number of times (frequency) of rainfall in each day of rainfall of each month of the years from 2012 to 2016 and make recommendations on the strategies to help mitigate the effects of global warming and climate change.

Methodology

The Study Area

The field work was carried in Afikpo North Local Government Area (LGA) of Ebonyi State, Nigeria. Agricultural production in the LGA is mainly influenced by the annual weather conditions based on two major seasons: the dry (November to March) and wet (April to October) seasons.

Instruments for Data Collection

The recording instrument showed the dates/days of each month of the years, 2012, 2013, 2014, 2015 and 2016. 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 and making of phone calls with Global system of mobile communication (GSM) to relevant quarters.

Sampling procedure and data collection

Afikpo North Local Government Area (LGA) of Ebonyi State is made up of twelve (12) Autonomous Communities. Research Assistants (RAs) were needed to assist in the field work. Two RAs were purposively selected from 10 of the Autonomous Committees to give a total of 20 RAs who assisted in assessing the relevant parameters of the filed work.

Results and Discussion

Time of commencement of rainfall from 2012 to 2016 in the study area

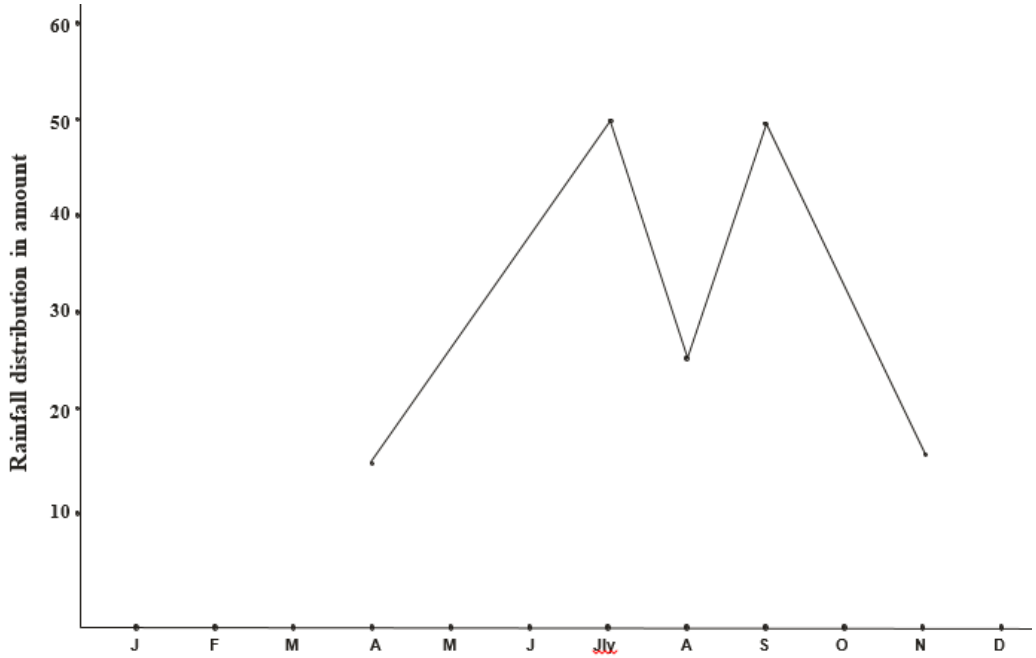

Fig 1: Months of the year showing the hypothetical representation of the usual heights of rainfall prior to the influence of global warming and climate change.
Source: Nnabo, Nwite and Nnabo (2007, Oguntola, 2007 and (Oga, 2014)

Usual rainfall pattern and distribution in Afikpo North Local Government Area 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 1.

But nowadays, this part of the Zone hardly experiences on the average four (4) months of well distributed rainfall. This situation is evident in Tables 1,2,3,4 and 5 and Figures 2,3,4,5 and 6. Also available records, information from (FGDs) and personal experiences have also shown that the rains now start early in the years covered between the months of February and March and suddenly disappear afterwards. The rains commence 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 present pattern and distribution of rainfall, no doubt, may not be favourable for both crops and livestock production. In a situation where well distributed rainfall is expected to last for six (6) months and only about four (4) months of rainfall which is not well distributed in the months of the year may be available, may not be supportive to rainfed crops or agricultural production.

Tables 1, 2, 3, 4, and 5 show the data generated for the period of five (5) years on rainfall distribution and Figures 1,2,3,4, 5 and 6 show the pattern of rainfall and distribution designed with the help of the data generated for the number of years covered. With the data generated and the pattern of rainfall shown, farmers in the LGA will be better guided in this respect with the help of extension agents. 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 they concern rainfall pattern and distribution. With the above scenario, farmers will now know when to cultivate the land, understand when to plant their crops, among other related farming activities.

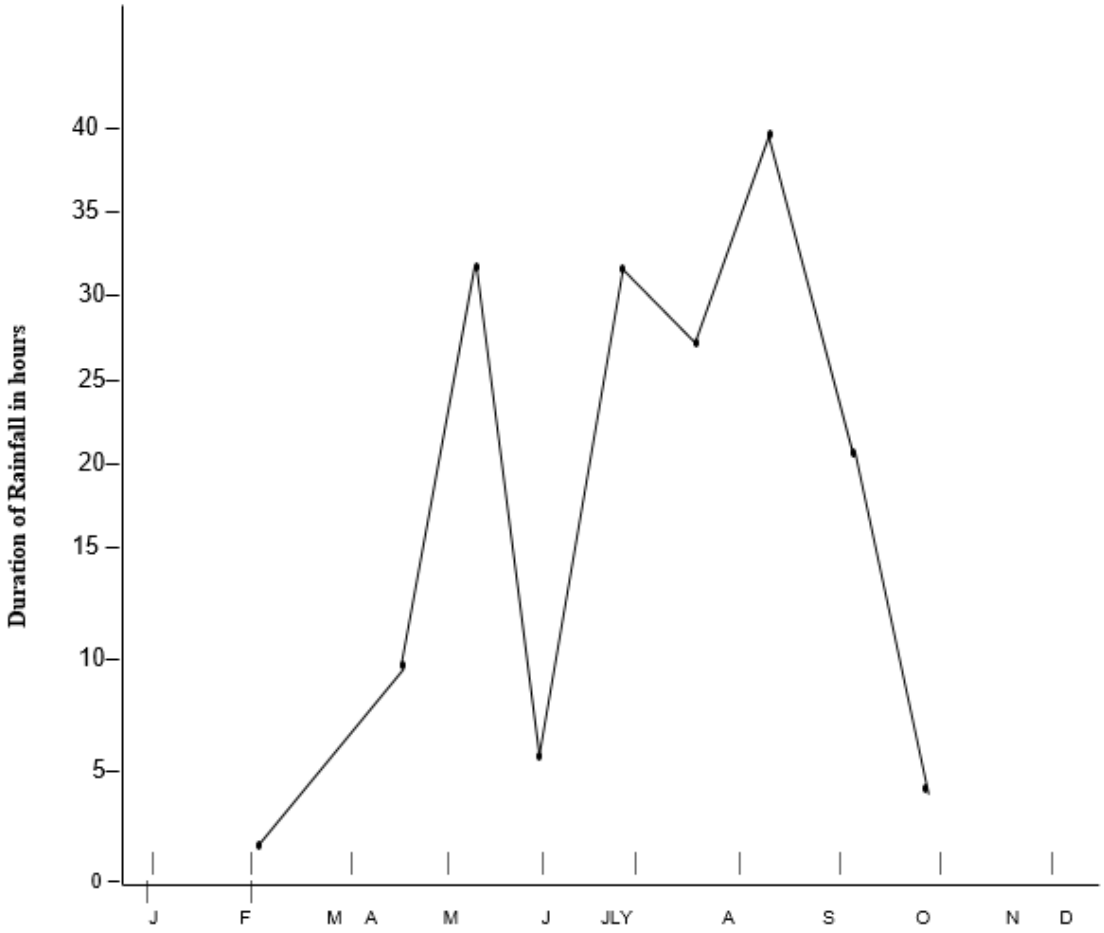

Fig. 2: Heights of rainfall for the year, 2012.

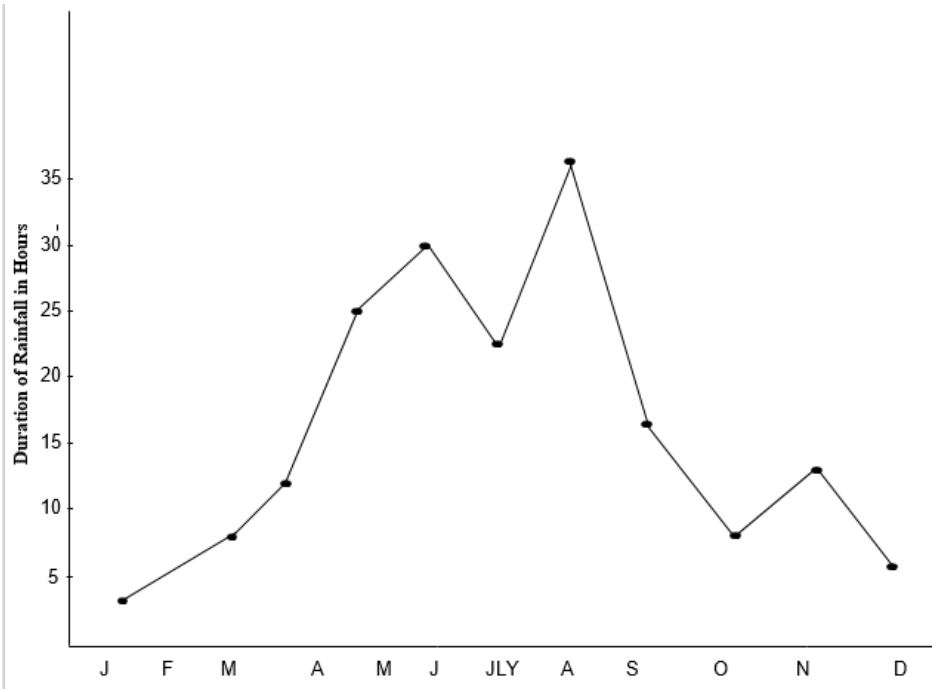

Fig. 3: Heights of rainfall for the year, 2013

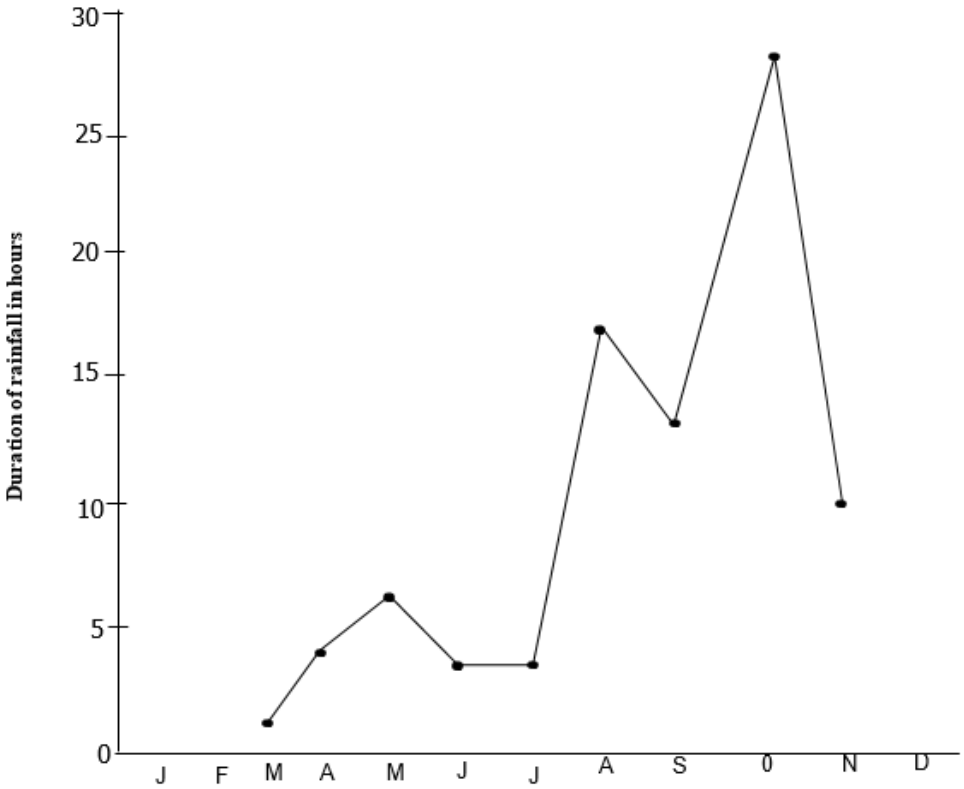

Fig. 4: Heights of rainfall for the year, 2014

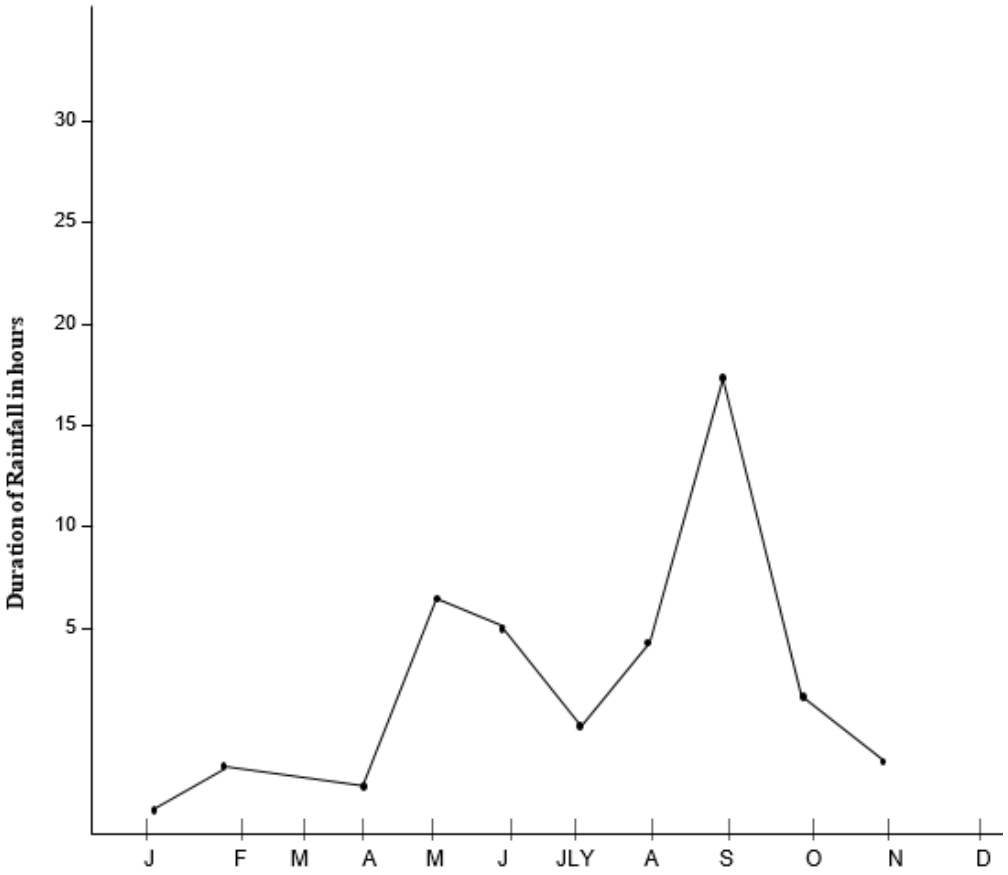

Fig. 5: Heights of rainfall for the year, 2015.

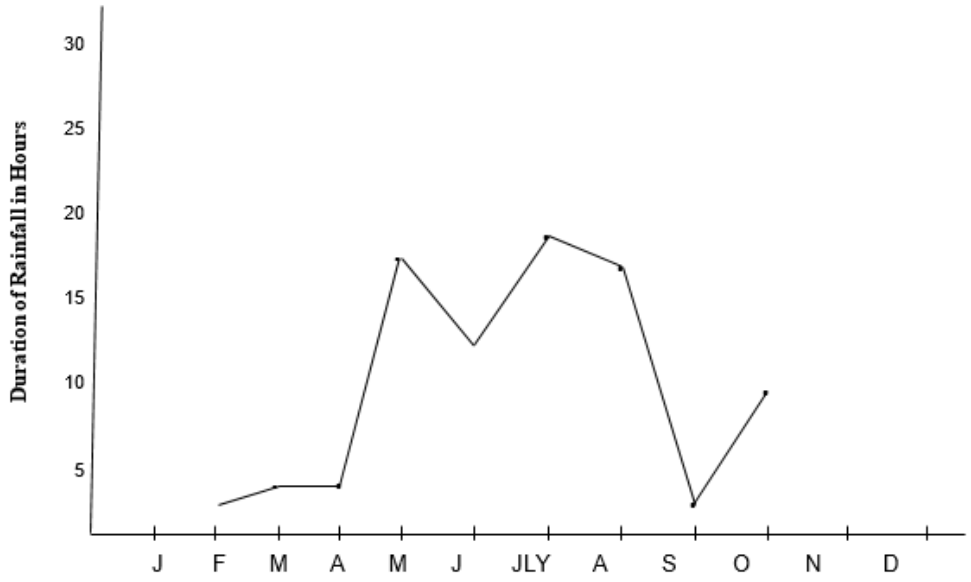

Fig. 6: Heights of rainfall in the year, 2016

Frequency and Duration of Rainfall from the Year 2012 to 2016 in the Study Area

Table 1: Monthly summary of rainfall in terms of frequency, duration, among others, in the year, 2012 in the study area

Months of the year, 2012		Rainfall		Frequency 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	Frequency of windy days in each month	No of sunny days in each month	No of moody days in each month		
		Yes	No						Very sunny day	Not very sunny	Very moody	Moody
1	Jan	✓		1	-	1	-					
2	Feb	✓		7	3	3	4					
3	Mar		✓	-	-		-		16			
4	Apr	✓		13	11	5	8	3				
5	May	✓		13	31	4	9					
6	Jun	✓		8	6	2	6					
7	Jul	✓		23	31	14	9					
8	Aug	✓		14	28	8	6					
9	Sept	✓		15	39	10	5		1	5	4	10
10	Oct	✓		12	23	4	8				1	3
11	Nov	✓		6	5	4	2					
12	Dec		✓	-	-	-	-					

Source: Field Work, 2012.

Table 2: Monthly summary of rainfall in terms of frequency, duration, among others, in the year, 2013 in the study area

Months of the year, 2013		Rainfall		Frequency of rainfall in each month	Duration of rainfall in hours in each month	Frequency 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						Very sunny day	Not very sunny	Very moody	moody
1	Jan	✓		2	3	2	2			27		
2	Feb	✓		2	-	1	1					
3	Mar	✓		5	6	1	4	2				
4	Apr	✓		10	8	4	6	3				
5	May	✓		17	25	6	11	5	5			11
6	Jun	✓		15	29	4	11					11
7	Jul	✓		14	22	4	10					9
8	Aug	✓		10	42	6	4			16		
9	Sept	✓		13	15	8	5			11		
10	Oct	✓		12	6	7	5			18		2
11	Nov	✓		5	11	1	4		10	15		
12	Dec	✓		4	4	1	3		8	20		

Source: Field Work, 2013.

Table 3: Monthly summary of rainfall in terms of frequency, duration, among others, in the year, 2014 in the study area

Months of the year, 2014		Rainfall		Frequency of rainfall in each month	Duration of rainfall in hours in each month	Frequency 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						Very sunny day	Not very sunny	Very moody	moody
1.	Jan	✓		1						27		
2.	Feb	✓		2								
3.	Mar	✓		5	1	4	1					
4.	Apr	✓		6	4	4	2	1				
5.	May	✓		8	6	7	1					
6.	Jun	✓		7	3	4	3					
7.	Jul	✓		7	3	3	4					
8.	Aug	✓		12	17	7	5					
9.	Sept	✓		13	13	6	7	6				
10	Oct	✓		13	28	9	4				3	1
11	Nov	✓		6	15	4	2				5	3
12	Dec	✓										

Source: Field Work, 2014.

Table 4: Monthly summary of rainfall in terms of frequency, duration, among others, in 2015 in the study area

Months of the year, 2015		Rainfall		Frequency of rainfall in each month	Duration of rainfall in hours in each month	Frequency 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						Very sunny day	Not very sunny	Very moody	Moody
1	Jan	✓		2	1		2					
2	Feb	✓		4	3	2	2		16			
3	Mar	✓		1	-		1		20	5		
4	Apr	✓		4	2	2	2		6	25		
5	May	✓		12	10	8	2					
6	Jun	✓		5	9	4	1					
7	Jul	✓		8	5	4	4		2			9
8	Aug	✓		11	8	5	6					13
9	Sept	✓		13	19	7	6					5
10	Oct	✓		3	6	2	1					
11	Nov	✓		5	4	5						
12	Dec											

Source: Field Work, 2015

Table 5: Monthly summary of rainfall in terms of frequency, duration, among others in 2016 in the study area

Months of the year, 2016		Rainfall		Frequency of rainfall in each month	Duration of rainfall in hours in each month	Frequency 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						Very sunny day	Not very sunny	Very moody	Moody
1	Jan		✓									
2	Feb	✓		1	2							
3	Mar	✓		5	3	3	2	2				
4	Apr	✓		2	3	1	1					
5	May	✓		11	16	8	3	3				
6	Jun	✓		9	12	6	3					
7	Jul	✓		14	18	9	5			10		7
8	Aug	✓		16	17	7	9					
9	Sept	✓		5	2	4	1					
10	Oct	✓		4	9	2	2					
11	Nov	✓		3	-	1	2		16			
12	Dec											

Source: Field Work, 2016

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 2012, 2013, 2014, 2015 and 2016 had rainfall except for the months of December, 2014, 2015 and 2016 and January 2016. In relation to frequency of rainfall in the years covered, there was a downward trend in this aspect, especially in the year, 2015, see Figure 5, with no meaningful impact, especially, between the months of February and April. It is important to note here that there were sharp drops in rainfall more in the month of September for the periods covered, see Figures 3,4 and 6. 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 rainfall which lasted for long hours and with much impact between the months of August and October. In terms of moderate rainfall, there was record of high moderate rainfall in the year, 2013. The highest peak of rainfall for the years 2012 and 2013 was recorded in the month of August and those of the year, 2014 was recorded in the month of October and in the year, 2015 in the month of September and for the year 2016 in the month of July, see Figures 4, 5 and 6 respectively. The results 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 pattern, from the results shows that the nature of rainfall was generally poor in the years, 2015 and 2016. These trends of rainfall in the years covered make available ample conviction that there has been a *"shift"* from what used to be to what is, in relation to rainfall pattern and distribution in the LGA, the state and even in other parts of the country.

The field works carried out by Oga and Oga (2011, 2012 and 2013 and beyond), on the pattern of rainfall and distribution in the LGA and in Ebonyi State, support 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 equally supported by (NIMET, 2016) .

Conclusion

Currently, the nature of rainfall in relation to agricultural production in the Afikpo North Local Government Area (LGA) is not encouraging due to the influence of global warming and climate change. Consequently, there is need to provide assistance in the form of making available information and data on rainfall pattern and distribution to farmers in order to help them mitigate the effects of global warming and climate change to enhance sustainable environment and agriculture.

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 cultivatetheir crop with the coming of the first rains but to delay planting and probably commence planting of crops after about 4-5 weeks after the first set of rains.
3 Farmers should cultivate crops that require much water between the months of August and October while those crops that do not require much water be cultivated between the months of April and July.
4. 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.
5. Government, philanthropists, and legislators should support in minimizing the impact of global warming and climate change by constructing dams and boreholes and well to provide water for farmers during periods of scarcity.

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