

Assessment of Rainfall Pattern and Agricultural Production in Afikpo North Local Government Area of Ebonyi State: Effect of Climate Change and Mitigation Strategies

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Abstract

The purpose of this research was to assess the pattern and distribution of rainfall in Afikpo North Local Government Area (LGA) of Ebonyi State, Nigeria for the years 2017 - 2018. The LGA constitute of five (5) Autonomous Communities. Research Assistants (RAs) were needed for the field work and two (2) RAs were purposefully selected from each of the five (5) Communities to give ten (10) RAs. A self-designed recording instrument was used in the field work and data were collected and analysed using frequency distribution, means, tables and graphs. The result will provide the guide with which to suggest to farmers on how to probably plan their farming activities in the future to, among others, help minimize losses of farm produce on the farm. Results revealed that there has been deviation "shift" from the usual pattern of rainfall and distribution in the years covered. The result also showed that there was absence of the usual "August break" in the month of August of the years covered and heavy downpours were experienced more between the months of August and October in the same period (2017 - 2018). There was equally absence of the usual "double maxima" in the months of July and September for the periods 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 but to shift the planting dates following the pattern of rainfall.

Keywords: *Assessment, Rainfall Pattern, Agricultural production, climate change, Mitigation*

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Background to the Study

According to West Africa Agricultural Productivity Programme (WAAPP, 2014), agriculture as a sector provides the source of livelihoods for almost two-thirds of the population in the continent. To this regard agriculture must of necessity be given a pride of place. In effort to achieve the desired level and targets in agriculture, in terms of adequate food production and provision of substantial support for the local industries, the practice of agriculture requires adequate availability of land and supply of vital inputs such as 'improved seeds, fertilizer, agro-chemicals, among others. The farmers, 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. According to Mashroofa and Senevirathne (2014) farmers need information to identify the cost, storage, usage, varieties of newly introduced seeds, pesticides, and weather in order to get maximum yields and best production. 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.

Rainfall, a very essential element of climate has numerous implications for agricultural production (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. According to Nwajuiba (2013), 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 Nwajuiba (2013) 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, records have shown that the nature (time of commencement, frequency, amount, duration, intensity, etc) of rainfall has not been encouraging. There has been 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 (Moore, 2013). 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 (Moore, 2013). This position was corroborated by (UNESCAP, 2011). There is equally, reduction in the area of cultivable land and decreased food supply. According to Danielou(2012) 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 mitigation strategies against their negative effects and this informed the study.

Objective of the Study

The general objective of this work is to assess rainfall pattern and distribution in Afikpo North Local Government Area (LGA) of Ebonyi State from 2017- 2018.

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 a good background knowledge of the weather conditions of their immediate environment, especially, in relation to the pattern and distribution of rainfall. With this knowledge, they 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 position is supported by (Moore, 2013). 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. This situation is in agreement with (Danielou, 2012). 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 mitigation efforts.

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, 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, 2013).

Method of Data Collections

Afikpo North Local Government Area (LGA) is made up of five (5) Autonomous Communities. Two RAs were purposively selected from each of the 5 Autonomous Communities to give a total number of 10 RAs who assisted in recording the parameters considered relevant to the field work.

Results and Discussion

1. Time of commencement of Rainfall in the periods covered (2017-2018).

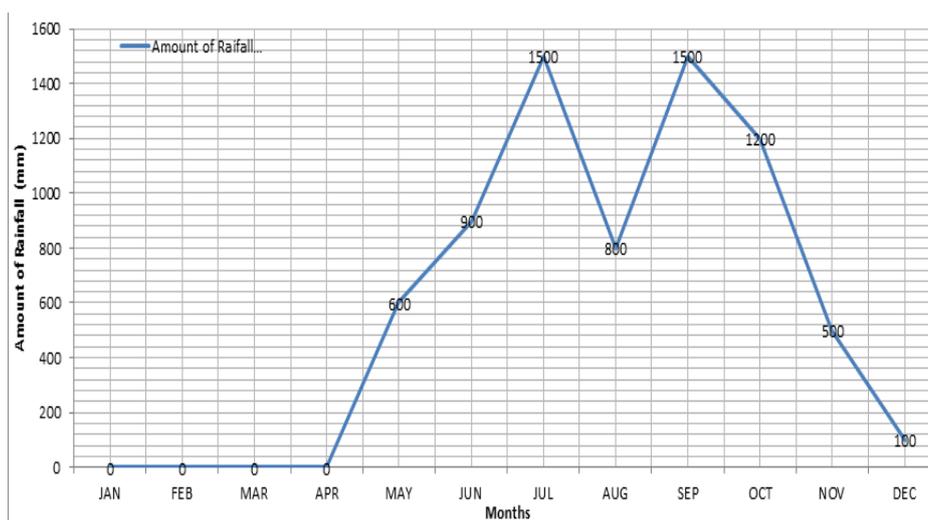


Figure 1: Showing the usual pattern and distribution of rainfall before the incidence of global warming and climate change

Source: Designed with available record and information in (Oga, 2014)

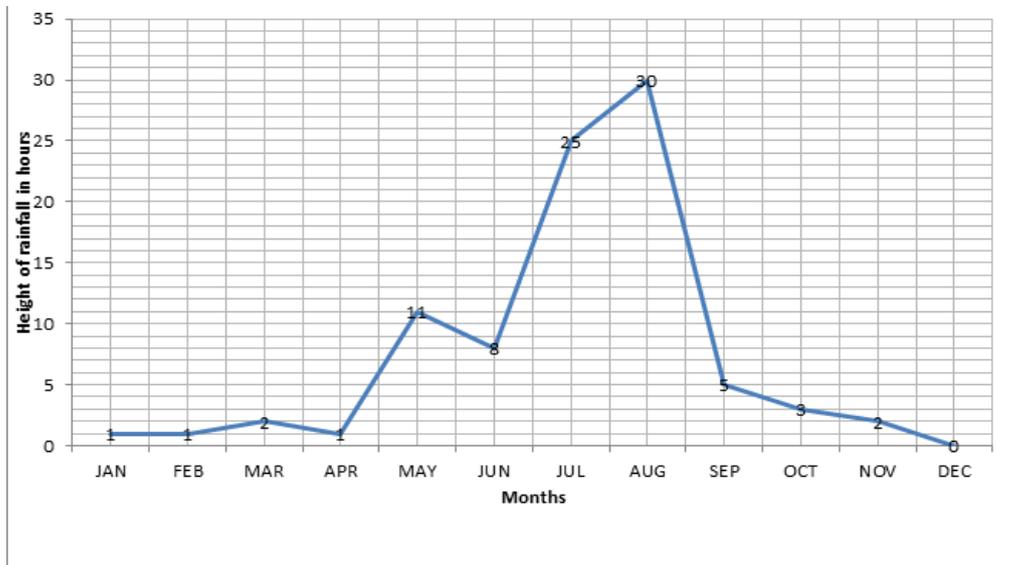


Fig. 2: Height of rainfall in the year, 2017
Source: Fieldwork, 2017

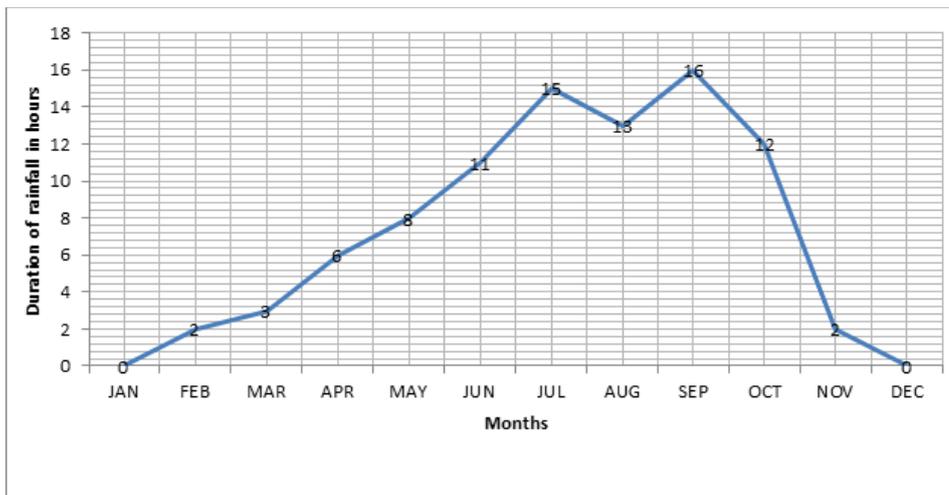


Fig. 3: Height of rainfall in the year, 2018
Source: Field work, 2018

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 (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 deviations 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 compared with Figures 2 and 3.

The field works carried out by Oga and Oga (2011, 2012 and beyond) on the pattern and distribution of rainfall in Afikpo North Local Government Area of Ebonyi State and in Ebonyi State support the fact that there has been convincing “deviations” from the usual pattern of rainfall and distribution in both areas and in other parts of the country. This position is equally supported by (NIMET, 2016).

Table 1: Monthly summary of weather elements' conditions in the study area in the year, 2017

Months of the year, 2017		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
		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	Sept.	√		4	5	-	4
10	Oct.	√		3	3	3	-
11	Nov.	√		2	1	2	-
12	Dec.	-					

Source: Field work 2017

Table 2: Monthly summary of weather elements' conditions in the study area in the year, 2018

Months of the year, 2018		Rainfall		Frequency of rainfall in each month	Duration of rainfall in hours in each month	Intensity	
		Yes	No			Frequency of moderate rainfall in each month	Frequency of heavy rainfall in each month
1	Jan.		√	-			
2	Feb.	√		4	2	2	2
3	Mar.	√		1	-	1	-
4	Apr.	√		4	6	3	2
5	May	√		8	8	6	3
6	Jun.	√		13	11	10	6
7	Jul.	√		12	15	6	1
8	Aug.	√		6	13	5	1
9	Sept.	√		7	16	2	7
10	Oct.	√		1		-	1
11	Nov.	√		2	2	1	1
12	Dec.						

Sources: Field work 2018

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 2.

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, Focus Group Discussions (FGDs, 2017 – 2018). This position is supported by UNESCAP (2011) 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 plants and animal materials and other farmers' resources. This situation is backed up by (Moore, 2013). Generally, there was high cost of production, lost of farm produce and other resources and reduced output contrary to farmers' expectations. This position is backed up with the opinion of (Danielous, 2012) in relation to decreased food supply consequent on unfavourable weather conditions.

Mitigation Strategies to Climate Change

According to Recha, Kapukha, Wekesa, Shames, and Heninar, (2014)

Climate change mitigation can be accomplished in the following:

1. **Agro forestry:** Agro forestry is a collective name for land use systems and practices in which woody perennials are deliberately integrated with crops and/or animals on the same land management unit. The integration can be either in a spatial mixture or in a temporal sequence. There are ecological and economic interactions between woody and non-woody components in agro forestry. Agro forestry is helpful for climate change mitigation in the following ways:
 - i. Agro forestry trees store carbon

- ii. The soils of agro forestry systems contain significant quantities of carbon. Generally the amount of carbon stored in a system's soil remains steady, increasing slowly with time.
- 2. Agronomic practices:** Agronomic practices are techniques farmers incorporate into their farm management systems to improve soil quality, enhancing 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. Some of the practices here include:
- i. **Cover crops and green manure:** These are crops 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. Tree legumes used as manure are also called “fertilizer trees. They fix nitrogen in the soil and are more permanent than other types of green manure. They help in mitigating climate change in that cover crops and green manure add carbon to the soils) and may also extract plant –available nitrogen unused by the preceding crop, thereby reducing N₂O emissions.
 - ii. **Relay cropping:** This involves planting temporary crops (cover crops) within the main crop before it is harvested in order to ensure the continuous use of land and the availability of organic materials while reducing vulnerability to soil erosion. The mitigation potential is 0.51-1.45 CO₂-eq/ha/yr.
 - iii. **Improved crop varieties:** They are crop varieties that have been developed through research and testing to have special qualities, such as fast-maturation rates, high yields, and pest and diseases tolerance. These are helpful for climate change mitigation in the following ways:
 - (a) Using improved varieties can increased soil carbon or residues that can be managed to store carbon in the soil for a long period of time. Plant improved crop varieties like hybrid maize, grafted mangoes, indigenous vegetables, mosaic resistant cassava, groundnuts and tissue culture bananas.
 - (b) Also, by reducing reliance on fertilizer, using improved varieties can reduce emissions.
- 3. Residue Management:** Residue management is the sound handling and utilization of plant and crop residues. It combines mulching, composting, integrative livestock and manure management and ideally leaves 30% or more of the soil covered with crop residues after harvest. This practice is helpful for mitigation climate change in that by avoiding burning of residues avoids emissions of aerosols and green house gases (GHGs) generated from fire. Burning of residues should be limited and carefully managed. A special form of residue management that is currently being promoted especially in the Kenyan context are “trash lines”, which are made from crop residues, grass and other organic materials collected from the field. They are constructed along the contour line in order to slow down surface runoff and reduce soil erosion and gradually accumulate soil leading to the building of terraces along the contour.

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, 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.
6. There should be establishment of Meteorological stations in some localities where necessary to help provide information on weather conditions to farmers to enable farmers use it and plan their farming activities.

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