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IMPACT OF TEMPERATURE VARIABILITY ON FARMING ACTIVITIES IN YOLA NORTH LOCAL GOVERNMENT AREA OF ADAMAWA STATE

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Abstract

This study examined the impact of temperature variability on farming activities in Yola North Local Government Area (LGA) of Adamawa State. Data for this study was obtained through the administrations of structured questionnaires to the sampled farmers (respondents) in the study area during the 2014 raining season with the aim of obtaining information on; the impact of temperature change on farming activities as well as the adaptation strategies on managing temperature change. Such information was presented using simple statistical technique such as tables, frequencies and pie charts. Results of the study revealed that, as the temperature decreases, the yield of crops increases. Adaptation strategies in managing temperature change include; adjustments of planting dates, planting of early maturing and improved varieties and irrigation system of farming among others. Weather observation stations should be established and personnel should be trained on how to observe and manipulates the climatic data and that information should be made available to local farmers. The development of supplementary irrigation system i.e. farming practice that would supply water to crops during growing stage, especially during intra-seasonal dry spell is recommended

INTRODUCTION

The ultimate source for the earth atmosphere is the solar radiation, once absorbed by either the earth or the atmosphere; it is partly converted into a sensible heat or other form of energy. The degree of conservation of this heat represents what is known as temperature (Oyediran *et al.*, 2001). The most important influence of radiation is its effect on temperature. Theannual, seasonal and diurnal basic changes of temperature usually reflect on increase or decrease in radiation (Faniran and Ojo, 1990).

Climatic elements such as radiation, evaporation, wind, humidity and cloud covers influence temperature. However, these factors that influence surface temperature and its distribution in both space and time are entirely controlled by movement of earth and which vary therefore with latitude (Nieuwolt, 1998).Other elements that affect temperature are; latitude, continentality, types of surface such

as vegetation, land and water, all have difference in absorption and transmission of these sensible heat.

Recently and especially over the past three to four decades, the issue of global climate change is increasing due to greenhouse effects which includes global warming, rises in sea level and other human impact globally, regionally and locally.Temperature is not equal from place to place. It also varies with season and over the years. In general, the annual, seasonal or diurnal rhythms of temperature reflect the increase or decrease in solar or net radiation although with time. Therefore, the distributions of temperature basically follow the same pattern.

As climate is the single major limiting factor in crop production in the time of sowing, scheduling of irrigation, timing of fertilizer application, using of pesticides, etc. climatic conditions such as temperature significantly influence crop production.

Variability in temperature and rainfall is expected to result in change of climates in Africa, which will result to more frequent flood and drought and larger runs of wet and dry years, Adebayo (2010). With large annual and diurnal variation, the temperature distribution generally show increase from morning to afternoon and from summer to winter. Temperature of more than 6^0C occurs during summer while the lowest temperature (less than 4^0C) occurs during winter, in USSR (Faniran and Ojo, 1980).

The main effects of change in variability of temperature and precipitations have been evaluated through simulation, modeling a diurnal and inter annual variability and moisture can result to substantial change in the mean variable of yield. Doubling of the temperature variability, results in greatly reduced average yield and increase variability of yields growth primarily as a result of failure (Kolawole, 2011).

Agriculture is extremely vulnerable to climate change which is already harming food crop production and these impacts are projected to increase over time, with potentially devastating effects. Ayoade (2002) pointed out that most of the problems facing agriculture and indeed crop production particularly in the tropics are climate related. According to him, agriculture is sensitive to weather and climates at all stages of production from land clearing and preparation, through crop growth and management to harvesting, storage, transportation and marketing of agricultural products. This means that weather and climates have profound influence on all the stages of agricultural production in the tropics. Thus, climate variability, fluctuation and indeed climate change constitute major limiting factors in agricultural productivity in the region.

Roderick (2012) explained that, for a disease to occur, there essential components are required simultaneously; a virulent pathogen, a susceptible host and a favorable environment often referred to as the ‘disease triangle’.Rising temperature and variations in humidity affect the diversity and responsiveness of agricultural pests and diseases and are likely to lead to new and perhaps unpredictable epidemiology. Climate change as well as fulfilling the last link of that triangle can also drive evolutionary change in pathogen populations by forcing changes in reproductive behavior.

Changes in cropping systems can lead to the development of new pathogen, for example, through inter-specific hybridization between introduced and endemic pathogens; and history has shown how devastating such events can be to food security.

However, Adger (2007) also identified that in sub-tropical and other humid or semi-arid area, the increase productivity and water use efficiency due to high CO_2 would tend to increase ground cover, countering the effect of higher temperatures. In temperate climate, minor increase in total rainfall will be expected to be largely taken up by increased evaporation of vegetation or crops at the expected temperatures, so that net hydrologic or chemical effects on the soils might be small (IFPRI, 2009).

The aim of this work is to assess the impact of temperature variability on farming activities in Yola North LGA, of Adamawa State, Nigeria.

Methodology

Study AreaLocation

Jimeta is situated along the bank of River Benue and is the headquarter of Yola North LG A, Adamawa State. It lies between latitude 09^0 15'N to 09^0 20'N and longitudes 12^0 25'E to $12^0$29' with an elevation of 135m above sea level. It covers a land area of about 109km2 (Adebayo, 1999). It is a gap town which is situated at a point where the Benue River carves its valley through the eastern highlands. Jimeta is one of the two settlements that form the capital of Adamawa States. The word "Jimeta" meaning a shrine compared to other ancient towns like Borno, Kano, Ile- Ife and Oyo. Jimeta is relatively new in the British rule in Nigeria as a center for colonial administration (Adamawa State Official Diary). Jimeta is bounded by Demsa (LGA) in the east and Yola South LGA in the South.

Climate

Jimeta-Yola falls within the tropics, hence experiences tropical climate. It has monthly mean sunshine temperature hours of about 220 from January to April (Adebayo, 1999), this decrease to a mean value of 207 hours between May and September due to increasing cloudiness. The mean sunshine hours increases again to about 255 from the period between October and December. Approximately, 2750 hours is the average sunshine hours for Jimeta-Yola.

Temperature in Jimeta is generally high almost throughout the year. The weather is marked by a gradual increase in temperature from January to April due to increasing receipt of solar radiation. The temperature reaches its maximum by April with over 45^{0-}C (Zemba, 2010) but the beginning of the raining season temperatures drop due to effect of cloudiness. At the end or cessation of rainfall around October, slight increase in temperature is usually experienced before the harmattan dust comes from December. (Zemba, 2010) reported that the minimum temperature value for the area can be as low as 15^0C between December and January.

Socio – Economic Activities

The urban nature of Yola and Jimate districts of the study area being the seat of Adamawa State Government where all the Ministries, Boards and Parastatals are found has resulted in the stimulation of

commercial activities. Trading in various items such as manufactured goods; food, cash crops and agricultural products are taking place. Apart from that, many financial institutions such as Banks and Insurance houses are found. Also there are some appreciable numbers of both small and medium scale manufacturing industries in the study area with a large number of people engaged in production of various items such as consumer goods, furniture etc. These have indeed promoted commercial activities in the study area.

Agriculture has been the most important economic activities in the study area. Many people are found engaging in the agricultural activity especially irrigation activity which is found along the banks of River Benue and around Lake Gerio. The dominant crops grown are vegetables such as Amarantus, okro, tomatoes, onions, pepper, lettuce etc. Some cereal crops such as rice, maize etc are also grown in the area. Few people are seen engaging themselves in fishing. Animal husbandary is also very prominent in the study area especially cattle rearing as well as fuel wood selling as a source of energy and other non-timber forest products.

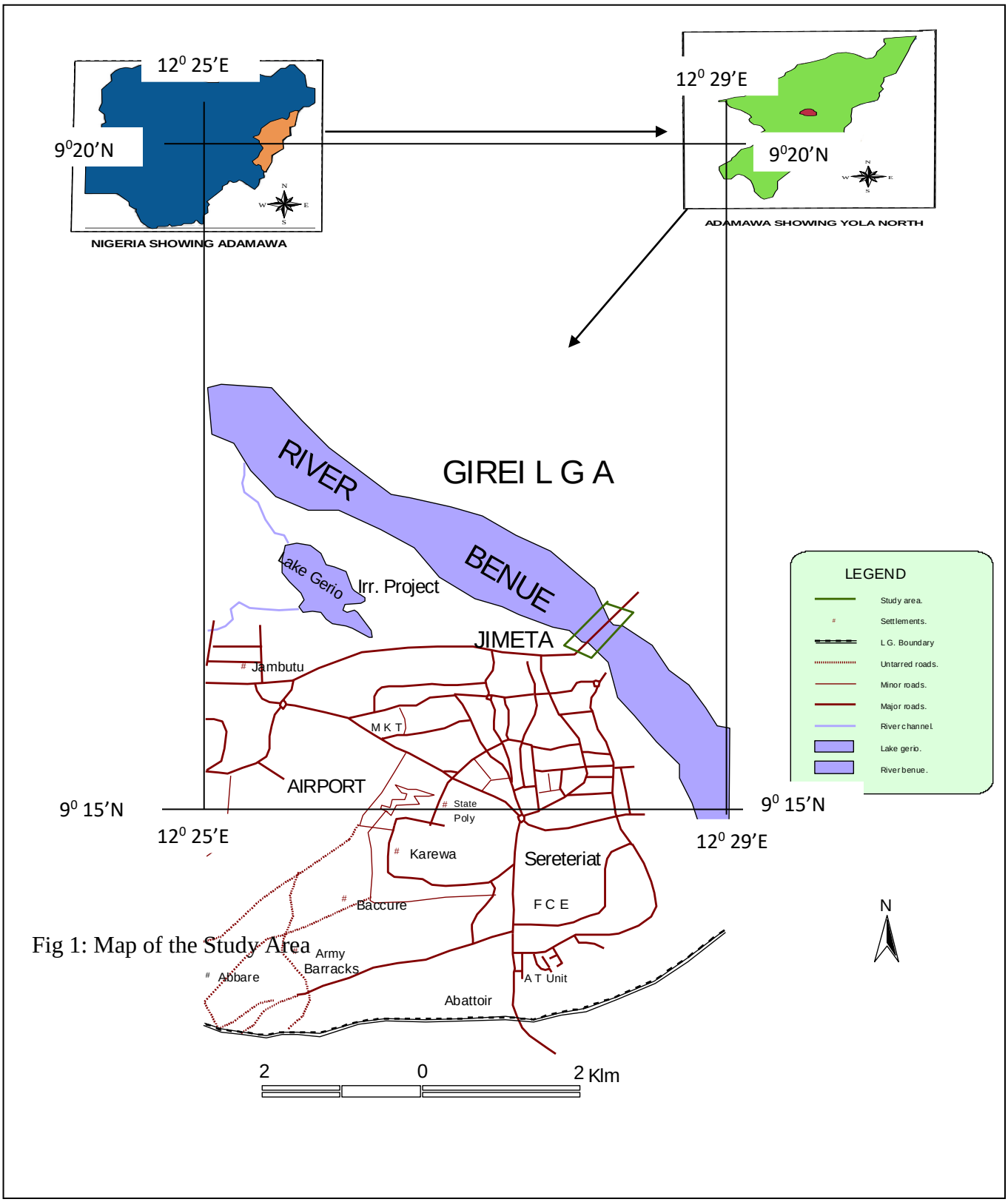


Fig 1: Map of the Study Area

Types and Sources of Data

This study obtained its data in two major ways in order to achieve the set objectives and present a reliable result. These include primary and secondary sources.

Primary-data was derived through personal interview (using focus group discussion), questionnaires and field survey. Data that obtained from this source include; data on the age of the respondents, educational level, socio-economic activities, impact of temperature change on farming activities, farmers perception on temperature change and farmers adaptation on temperature changes. Data on the maximum and minimum temperature were obtained from the Upper Benue River Basin Development Authority (UBRBDA) for the period of 10 years (2004-2013).

The secondary data was sourced from books, journals, internet, maps and some published and unpublished research works relevant to the study.

Sampling Techniques

The study area (Yola North LGA) consists of 11 ward namely, Yelwa, Limawa, Ajiya, Demsawo, Alkalawa , Gwadabawa, Luggere, Jambutu, Nasarawa, Doubeli, Karewa. The respondents for the study comprise of both rainfed and irrigation farmers within the eleven ward of the study area. However, five wards were selected out of the eleven wards using simple random technique. This has been done by writing the names of the eleven wards on paper and putting them in a container and letter shuffling them. A paper was taken after each shuffling until the required number is obtained (five wards). Twenty (20) farmers were randomly selected from each of the five wards using simple sampling technique. This gave a total of 100 respondents used in this study.

Data Collection

Data were collected by the use of questionnaire and interview through Focus Group Discussion (FGD). The questionnaire has been divided into four sections, Section A deals with the personal information of the respondents such as sex, age, educational background, occupation and marital status among others. Section B deals with the information on how the farmers perceive temperature change. Section C deals with the impact of temperature change on farming activities and Section D deals with adaptation strategies by farmers, in managing temperature change.

The questionnaires were administered to the respondents which comprised of only close ended and open questions where the respondent were required to thick one of the alternatives provided and make a comment in the open space provided.

Data Analysis

Based on the aim and objectives of the research work, the collected data were analyzed using descriptive statistics such as tables, frequency, percentage and pie chart which explains farmers response to the questions administered. Line graph was also used to analyzed the trends in mean annual temperature (max. and min. temperature).

RESULTS AND DISCUSSION

Farming Activities in the Study Area

Years in farming activities

In terms of the number of years being in farming activities, 15-29 years have the

highest percentage of 47%, 1-14 years recorded 40%, 30-44 (15%) and 45 years and above comprises of 3% of the respondents as indicated in Table 1. It is therefore assumed that those who spent more years in farming may have relatively more experienced in temperature change.

Types of farming adopted

The dominant type of farming system is dry season farming accounting for 55% as shown in Table 2. While raining season farming accounted for 45%. This result shows that, more than half of the respondents engage in dry season farming in the study area. This is because of the availability of water in River Benue Basin that encourages irrigation farming.

System of crop cultivation

The result obtained from table 3 shows that, most of the respondents (70%) have adopted mono-cropping than the system of mixed cropping which accounted for only 30% of the total respondents.

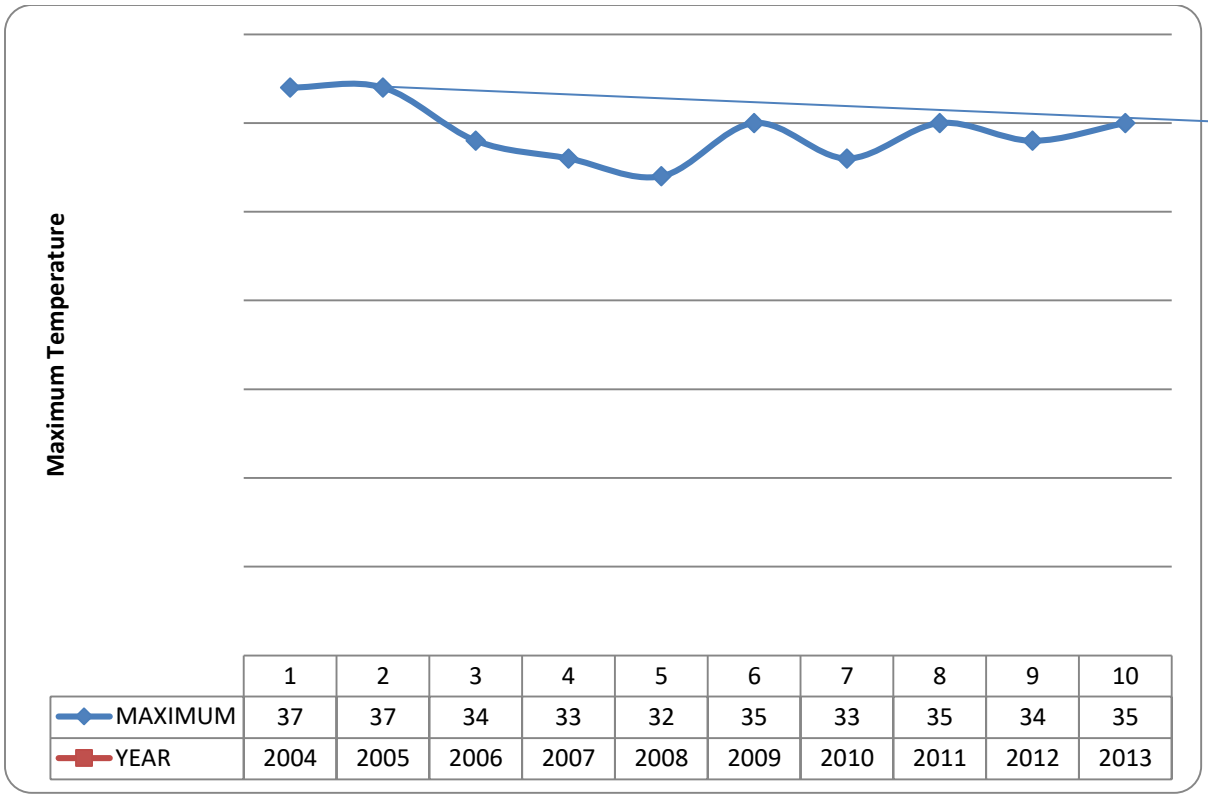
Types of crop cultivation

Table 4 below showed the types of crops cultivated in the study area. From the table, 30% of the respondents cultivated maize, 40% cultivated rice, 10% cultivated sorghum and 20% cultivated vegetables. From the table it is obvious that most of the farmers cultivate rice simply because rice can easily adopt high temperature than other crops.

Trend of average annual maximum and minimum temperature of the study area (2004-2013)

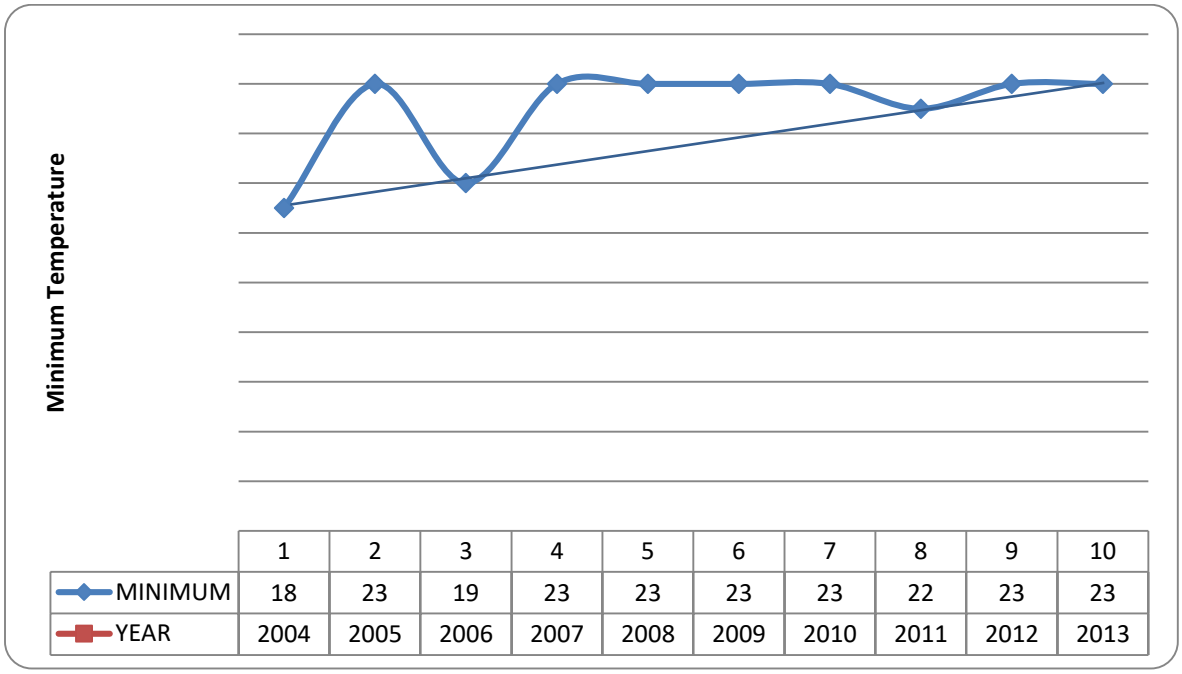
Figure 4.1 below shows the trend in annual maximum temperature. The highest mean maximum temperature of 37^0C was recorded in 2004 and 2005 and lowest of 32^0C in 2008. In figure 4.2, thelowest mean minimum temperature was 18^0C recorded in 2004, and highest of 23^0C in 2005, 2007, 2008, 2009, 2010, 2012 and 2013 respectively.

Generally, the maximum mean annual temperature shows a slight decrease in the range. The linear trend in figure 2 and 3 below shows the variations in both the annual maximum and minimum temperature of the study area.



	1	2	3	4	5	6	7	8	9	10
MAXIMUM	37	37	34	33	32	35	33	35	34	35
YEAR	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013

Figure 2: Trend of Maximum Temperature



	1	2	3	4	5	6	7	8	9	10
MINIMUM	18	23	19	23	23	23	23	22	23	23
YEAR	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013

Figure 3: Trend of Minimum Temperature

The Impact of temperature change on farming activities

Table 5 below showed the impact of temperature change on farming activities. From the table, 74% of the respondents are of the view that, temperature change affects the rate of their production, while 26 respondents said that, the temperature change did not affect their rate of crop production. 45% of the respondents have experienced stunted growth of crops due to temperature change, while 55% of respondents did not experienced stunted growth of crops. Therefore from this result, we would observed that most of the farmers have experienced stunted growth as a result of changes in the temperature trend as shown in figure 2 and 3.

Also from table 5, 45% of the respondents experienced cases of spread of pest and diseases on crops, while 55% do not experienced cases of spread of pest and diseases. 43% of the respondents also experienced the cases of drying of seedling after germination while 57% did not. From the table, 54% of the respondents experienced increased in the yield of their crops, 35% experienced decreased in the yield and 11% responded experienced no effect on yield. Therefore, in general, temperature change affects the crop production byincreasing its yield.This mean that, as the temperature decreases, the yield of the crop increases.

The Main Causes of Temperature change

Figure 4 gave us insight on what the farmers think were the main causes of temperature change. From the figure below, 42% suggested deforestation as the main cause of temperature change, 12% suggested bush burning,34% suggested increased in population and also 12% went for the other factors.

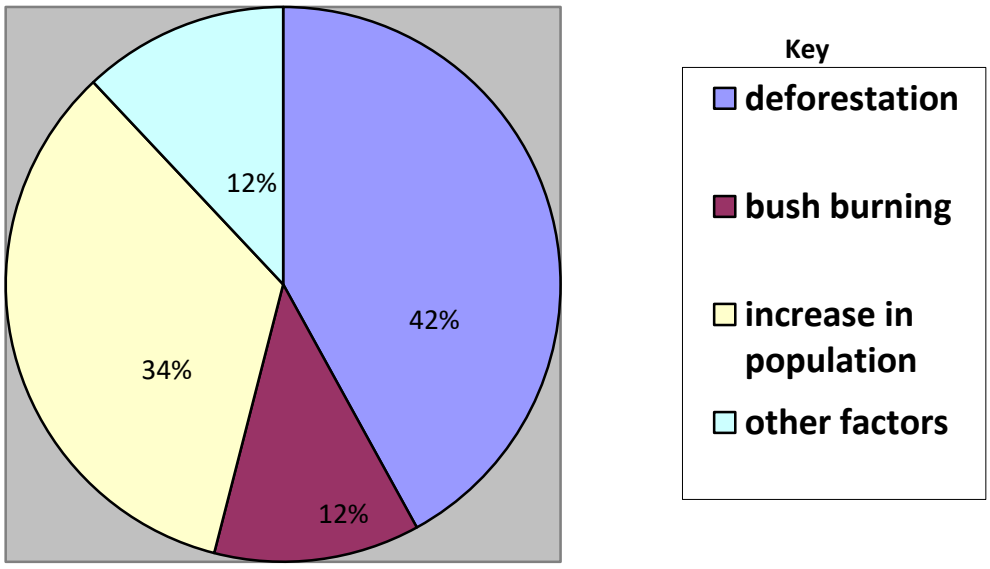


Figure 4: Causes of temperature change

Adaptation strategies by farmers in managing temperature change

Table 6 below shows the indigenous measures suggested by the farmers to cushion the harmful impact of temperature change on farming activities. The measures suggested include: adjustment of planting dates, practicing of mixed farming and use of wetland/ river valley, movement to different site and irrigation system of farming. Other adaptive methods include: use of fertilizer, planting of improved varieties, prayers to God and gods, planting of early maturing crops, and increase in water supply. The most strategy adopted by the farmers is the irrigation system of farming which all the farmers agreed to it as a good method to be used. In the course of the research the farmers suggested other strategies like planting of improved variety (62%), prayers to God and gods (4%), planting of early maturing crops (9%), use of fertilizers (15%) and increase in water supply (10%).

CONCLUSION

The study examined the impact of temperature variability on farming activities in Yola North local government area of Adamawa State. So as to assess the knowledge and response of local farmers on temperature change, its effects on farming activities and the adaptation strategies on managing climate change.

Both primary and secondary were employed. The primary data include; The used of structured questionnaires which were administered to 100 sampled respondents(farmers).The data were analyzed using descriptive statistics as in tables, percentages, pie chart and mean.

Base on framer's response in the study area, deforestation, increase in population, bush burning, over grazing and agriculture are the main causes of temperature change. As the temperature decreases, the yield of crops increases.

The adaptation strategies adopted by them in managing temperature change include; planting early maturing crops, planting resistant crops to pest and drought, prayers to God and gods, movement to new land, mixed farming, used of fertilizer and change in planting dates. However, difficulties faced towards adapting climate change in the study area include inadequate knowledge on how to cope with adaptation strategies,limited access to improved varieties of crops, lack of access to weather information, inadequate storage facilities for water and crops, high cost of fertilizer and lack of financial resources are the main problems faced by the framers in the study area.

As a result, the impact of temperature change on farming activities has made the farmers to suggest some strategies that would helped them cope with the changes in temperature and likewise the major constraints that militates against the use of adaptation measures by the indigenous farmers.

Yola North Local Government Area is blessed with vast and fertile arable land. However, based on the results obtained, temperature variability in Yola North does occur. The rate of temperature changes and its impact on farming activities differs in spatial and temporal variations. As the

temperature decreases, the yield of crops increases. Despite the changes in temperature, the farmers have their strategies of adopting the changes in temperature.

Recommendations

The following recommendations were proposed based on the findings:

1. Government should improve knowledge and skills of extension service personnel about temperature change and adaptive management strategies. Also, increasing extension farmers' ratio, and making extension services more accessible to farmers, which might be the key components of successful adaptation programme.
2. Weather observation stations should be established and personnel should be trained on handling and management of data, also, information should be made available to local farmers.
3. The development of supplementary irrigation system, i.e farming practice that would supply water to crops during growing stage, especially during intra seasonal dry spell.
4. The following farmers support should be introduced to promote adaptation.
    - Establishment of rural service centre to provide technical advice and information on viable agricultural water management options and other services to farmers.
    - Micro credit/revolving grant should be made available to farmers especially to women who form the back bone of small holder farming system in the rural areas.
    - Crop insurance, where applicable to reduce farmers risk to crop failures
    - Value addition (processing and storage) and marketing infrastructure.
    - Crop diversification, i.e introduction of valued crops for irrigated lands.

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Table 1: Years in Farming Activities.

Years of farming	Frequency	Percentage (%)
1-14	40	40
15-29	47	47
30-44	15	15
45+	3	3

Source: Field work, 2014.

Table 2 : Type of Farming Adopted by Farmers

Type of farming	Frequency	Percentage (%)
Dry season	55	55
Rainy season	45	45

Source: Field work, 2014.

Table 3: System of crop cultivation

System of cropping	Frequency	Percentage (%)
Single cropping	70	70
Mixed cropping	30	30

Source: Field work, 2014

Table 4; Types of Crops cultivated

Crops Cultivated	Frequency	Percentage (%)
Maize	30	30
Rice	40	40
Sorghum	10	10
Vegetables	20	20

Source: Field work, 2014

Table 5: Effect of Temperature Change on farming activities

Effect on production	Frequency	Percentage (%)
Yes	74	74
No	26	26
Experienced stunted growth of crops		
Yes	45	45
No	55	55
Experience cases of spread of pest and diseases on crops		
Yes	45	45
No	55	55
Experiences cases of drying of seedling after germination		
Yes	43	43
No	57	57
Effect of temperature on crop yield		
Increase the yield	54	54
Decrease the yield	35	35
No effect	11	11
The comparism between previous yield and recent		
Increase	65	65
Decrease	18	18
No change	17	17

Source: Field work, 2014