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Effects of Climate Change among Smallholder Farmers in Bade Local Government Area of Yobe State, Nigeria

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Abstract

This research studied the effects of climate change in Bade Local Government Area of Yobe State. A quantitative method was used to gather data in this study. A questionnaire was administered to the smallholder farmers (household heads) in the study area. Data collected was analysed using descriptive statistics and results show that 77.5% of the farmers agree that the temperature in the study area is increasing, 83% agree that there is an increase in drought, 76% agree that flood is increasing during the rainy season, 66% agree that there is an increase in crop infestation and diseases, 68% agree that there is excessive de-vegetation, 82.5% are of the opinion that forest resources are declining, 66.5% said that the cost of food crops is increasing, 75% agree that there is change in the livelihood of people, whilst 77.5% agree that there is rural-urban migration. The research therefore recommends that farmers in the study area be enlightened about the prospects of adaptation strategies by agricultural institutions. Finally the study suggests that effective policy measures should be taken to promote the adoption of climate change adaptation strategies.

Keywords: Effects, Climate Change, Adaptation, Strategies, Smallholder farmers.

INTRODUCTION

Climate change continues to be a threat to global economic development, and it may have an impact on different aspects of domestic life, such as agricultural productivity and food security (Ogundeji, 2022). Even though the impacts of climate change on crop yields are probably going to differ extraordinarily from one district to another, expected changes are supposed to have large and expansive impacts particularly in tropical areas of developing countries with rainfall routine ranging from semiarid to moist (Gukurume, 2013). Dangers include increased drought in semiarid regions, flood increase for low-lying regions, and unnecessary rise in temperature, all of which can restrict crop development and yields.

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In its fourth evaluation report (IPCC, 2007) the Intergovernmental Panel on Climate Change (IPCC) cautions that warming by the year 2100 will be more serious than expected previously, with a likely temperature increase of 1.8^0C to 4^0C and a possible increase of up to 6.4^0C. As temperatures keep on rising, the effects on farming will be critical (Hague et al, 2012). These effects are now being experienced by numerous communities in nations on the southern side of the equator. There will likewise be an expansion in dry spells and heavy rainfall occasions, which will further harm crops through soil erosion, flooding and crop failure (Danso-Abbeam et. al., 2021). An expansion in intense tropical cyclone activities will cause crop harm in coastal regions, while a rise in sea level will diminish cropping areas and will salinize coastal aquifers (Lamichhane et. al., 2022). These phenomena are already affecting large deltas and Pacific islands. Unfortunately, vulnerable to these impacts of environmental change are peasant farmers of developing nations due to their complete reliance on agriculture, low income, geographic exposure and restricted ability to look for other livelihood alternatives.

Increase in temperature, drought, loss of biodiversity, sea level rise, and assimilation of carbon dioxide by seas are the significant impacts of climate change (Mortimore, 2010; Mustapha, Undiandeye and Gwary, 2012; Antwi-Agyei, Stringer, and Dougill, 2014; Harvey et al., 2018). Research conducted by Odjugo (2010) discovered rising temperature and lower amount of precipitation in Nigeria somewhere between year 1901 and 2005. Temperature increment of 1.1^0C was recorded in Nigeria for 105 years while precipitation decreased by 81mm. While precipitation is decreasing generally in Nigeria, the coastal area of the nation has been encountering slightly rising precipitation since the mid-1970s (Odjugo, 2010). Three thousand four hundred square kilometers of the coastal area of Nigeria has been flooded by a rise in sea level while arable land is being reduced by 1-10km per year in the northern region of the country by desert encroachment (Odjugo, 2010). Climatic projections insinuate that an extended and more extreme drought is probably going to make Sub-Saharan Africa (SSA) drier (Kalele et al., 2021; Cavatassi et al., 2011). Mustapha et al. (2012) opined that environmental change could adversely affect a portion of the wild plant species that give food, medication and income, for example the Adansonia digitata (baobab tree) which is ordinarily utilized by farming communities.

Harvey et al. (2018) anticipated a general decrease of 10% in the production of maize in the year 2055 in Latin America and Africa, equal to $2 billion every year, affecting 130 million poor farmers in Sub-Saharan Africa and other 40 million in Latin America. These yield misfortunes will escalate as temperatures rise and precipitation is less conducive to the production of maize. As a result of the changing climate Africa will encounter increased water stress, reduced yield, malnutrition and food insecurity due to over-reliance on rain-fed agriculture (IPCC, 2014a).

Worldwide research (Boko et al., 2007; Lobell et al., 2011) proposes that Africa is especially powerless against climate variability and change. This weakness has been credited to the limited adaptive capacity of the continent, its high poverty level, low economic and institutional capacity as well as its dependence on rain-fed agriculture (Kalele et al., 2021). A Study conducted by Naess (2013) recommends that food production and related occupations will be excessively impacted by climate change and fluctuation in Sub-Saharan Africa (SSA). Moreover, Africa is probably going to experience significant climatic changes with a slight rise in rainfall in the tropics and warming and drying in many subtropical areas. According to Medugu et al. (2011) areas across Africa will encounter average temperature rise between three to four degrees in all seasons.

In addition, anticipated changes in the environment are probably going to impact the survival of crops and yield (Stringer et al., 2009). In the same vein, research has revealed that rise in temperature may lead to reduction in the stretch of growing season, and the yield of many crops is expected to decrease by 10% with places like the Sahel region suffering excessively (Harvey et al., 2018). Antwi-Agyei et al. (2014) predicted that yields from rain-fed farming-the prevalent type of farming in Africa - could be diminished by half by 2020. Climate change is expected to alter pest and disease outbreaks, by increasing the speed and stages of development of some microbes, resulting in changes in the physiology of host-microorganism relationships and alter host resistance (Jamshidi et al., 2019). Besides, as temperatures increase, many researchers have inferred that insect pests will commonly turn out to be more plentiful through various interrelated processes, including over-wintering, migration, increased rates of population growth and range extensions (Harvey et al., 2018).

In the past 30 years climate change has unfavorably impacted both biological and physical and organic systems in many continents throughout the world. As per Rosenzweig and Hillel (2008), over the past few decades, climate change has affected agricultural production globally causing it to decline by 1-5% each ten years. Its impacts are likewise anticipated to manifest in serious consequences for the agricultural sector globally, particularly in sub-tropical and tropical areas.

The effects of environmental change are especially serious in Sub-Saharan Africa where the economies of most of the countries are to a great extent driven by the agricultural sector. The uncertain and rapid changes in precipitation patterns and temperature in the subcontinent worsen the vulnerability of the farming systems particularly food production (Jamshidi et al., 2019). With the support of international cooperation, governments have intensified their endeavour to strengthen the farming sector to adjust to environmental change both at local and national levels.

In Nigeria, Northern Yobe is among the driest savannah areas. It is one of the most exposed and vulnerable regions to variability and climate change where the rising number of bush fires and drought adversely affect humans and nature. Therefore millions of poor small-scale farmers are at the receiving end of these impacts of climate change because of their total reliance on single and modified rainy seasons. They are poor people with minimal livelihood alternatives who greatly depend on nature for income and food (Medugu et al., 2011). Small-scale farmers are one of the weakest groups to environmental change, however endeavours to help them adapt to climate change are prevented by the absence of data on the impacts of climate change as well as a dearth of information on climate change adaptation techniques being utilized by farmers (Majeed and Kruse, 2017).Therefore, more data is required on how various small-scale farmers differ in their responses to climate change and how to fashion adaptation programs to various small-scale farmer contexts. This research was therefore motivated by the need to fill in the above gap in knowledge by providing data (empirically tested) on the effects of climate change among smallholder farmers in Bade local government area on which the study area's future climate change adaptation policies could be based.

The main aim of this study is to identify and examine the effects of climate change in Bade Local Government Area (LGA) of Yobe State. This study will provide authorities responsible for planning agricultural climate change adaptation in the study area such as Yobe State Ministry of Agriculture with vital information. For example, the ministry may decide to implement the recommendations of this study. It will also provide information to environmental management stakeholders like the Yobe State Ministry of Environment which

may affect its plans. More so, this study will serve as baseline information for researchers who wish to continue from where this study stops, or for those who may conduct similar research in the study area.

METHODOLOGY

Area of the Study

Bade Local Government Area (LGA) is situated in the semi-arid region of northern Nigeria in the present-day Yobe State. Gashua which is the headquarters of Bade LGA is 186km away from Damaturu, the state capital of Yobe State. It lies approximately between latitude $12^{0}30^{1}$N to $12^{0}52^{1}$N and longitude $10^{0}35^{1}$E to $11^{0}13^{1}$E as can be seen in Figure 1 below. It shares a border with Bursali L.G.A. to the East, Nguru and Karasuwa L.G.As to the North, Hadejia L.G.A. of Jigawa State to the southwest, and Jakusko L.G.A. to the southeast. Bade local government covers an area of about 1,122 square kilometres with a population of 198, 400 according to the 2016 population projection. The topographical relief of Bade L.G.A. can generally be described as flat. The most important geographical feature of Bade L.G. is its famous river (River Yobe), from which the state derived its name. The greater part of the local government is covered by a number of rivers which usually flood the area and empty into the main River Yobe which itself empties into Lake Chad (Suleiman, 2007).

Types and Sources of Data

A quantitative (survey questionnaire) method was used to gather information in this study. The questionnaire was administered to the smallholder farmers (household heads) in the study area.

Population and Sampling Procedure

The population for this research was household heads in Bade LGA above the age of thirty-five years; therefore a purposive sampling was used. This group of people was targeted because they are the ones that have stayed long enough to notice any changes in the environment. There are ten wards in the study area namely:

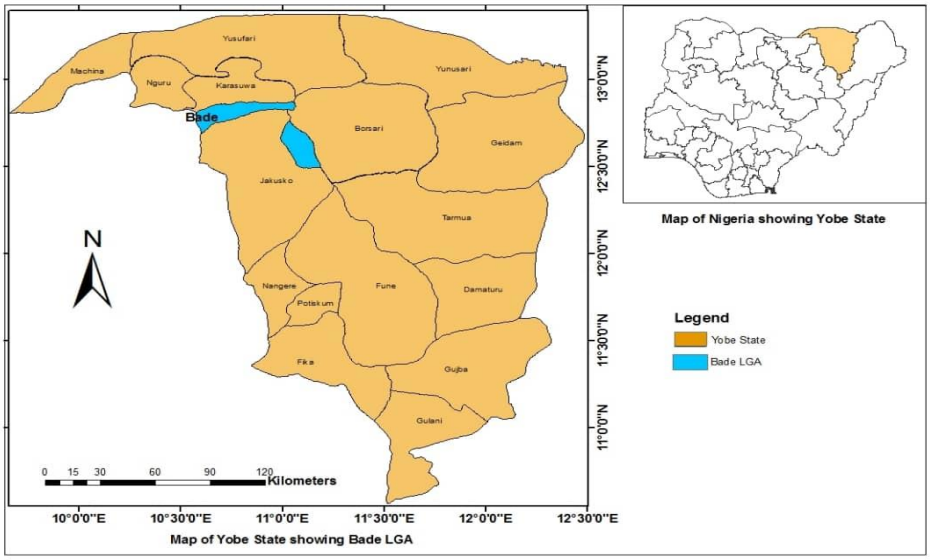

Figure 1: Map of Yobe State showing the study area.
Source: Pantami, (2020)

Dagona, Gwiyo Kura, Katuzu, Lawan Musa, Lawan Fannami, Sabongari, Sarkin Hausawa, Sugum-Tagali, Usur-Dawayo and Zango.

Out of these, four wards were purposively sampled because they are located in villages where almost each and every household engages in one farming activity or the other. The remaining six wards are located within Gashua town where a majority of its residents do not engage in any farming activity. Fifty households were then randomly selected from each of the four wards whose people engage fully in farming. The four wards purposively selected include: Dagona, Gwiyokura, Sugum-Tagali and Usur-Dawayo ward

Data Collection Procedure

A questionnaire was used to gather data in this study. Fifty (50) copies of the questionnaire were distributed to each of the four settlements purposively selected. This means that a total sum of two hundred (200) copies of the questionnaire was distributed in all four wards. The number of questionnaires for each ward (50) was arrived at by adopting the 10% sampling size formula recommended by Pamela Alreck and Robert Settle (2004) and Ronan Conroy (2016). Each of the four wards was estimated to have five hundred household heads, thus 10% of 500 is 50.

Data Analysis

Data collected was analysed using frequencies and percentages and the results were presented in charts.

RESULTS AND DISCUSSION

Effects of Climate Change in Bade LGA

The findings of this research revealed that the effect of climate change in the study area include an increase in temperature, crop infestation and diseases, drought increase, excessive de-vegetation, increase in flood during the rainy season, the decline in forest resources such as fire wood, increase in the price of food crops, change in the livelihood of people, as well as rural-urban migration as can be seen in Figures 3.1 to 3.9.

Rise in temperature in the study area

Results for temperature rise in the study area indicate that 61% strongly agree that the temperature is rising, 16.5% agree, 8.5% are neutral, 12.5% disagree, and 1.5% strongly disagree as can be seen in Figure 3.1.

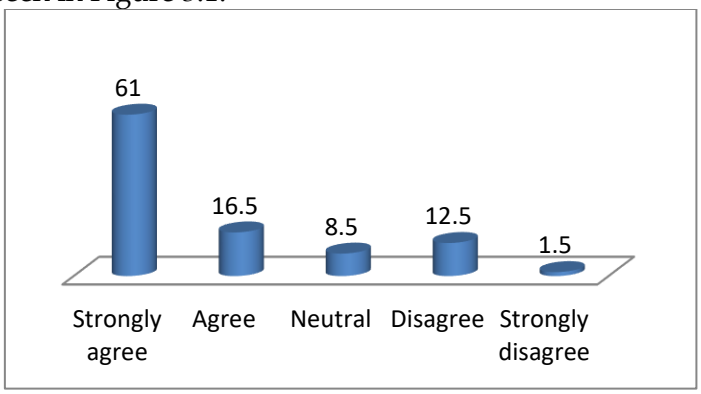

Fig. 3.1: Temperature Rise in the study area
Source: Fieldwork, 2023.

Increase in drought in the study area

The results for an increase in drought in the study area indicates that 69% of the farmers strongly agree there is an increase in drought, 14% agree, 10% neutral, 5% disagree, and 2% strongly disagree as can be seen in Figure 3.2.

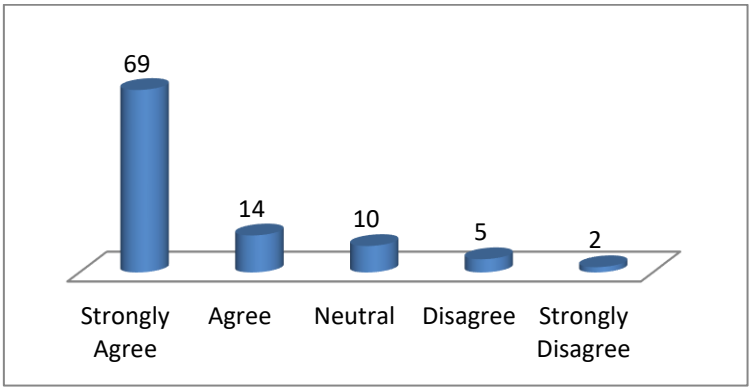

Fig. 3.2: Increase in drought in the study area
Source: Fieldwork, 2023.

Increase in flood in the study area

The result for an increase in flood in the study area indicates that 63.5% strongly agree that there is an increase in flood, 12.5% agree, 9.5% are neutral, 8.5% disagree, and 6% strongly disagree as can be seen in Figure 3.3.

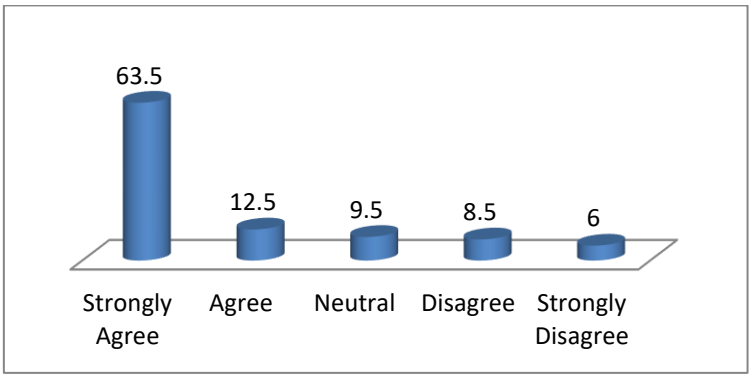

Fig. 3.3: Increase in flood in the study area
Source: Fieldwork, 2023.

Increase in crop infestation and diseases in the study area

Results for an increase in crop infestation and diseases in the study area indicate that 50% of the farmers strongly agree that there is an increase in crop infestation and diseases, 14% agree, 17% are neutral, 12% disagree, and 5% strongly disagree as can be seen in Figure 3.4.

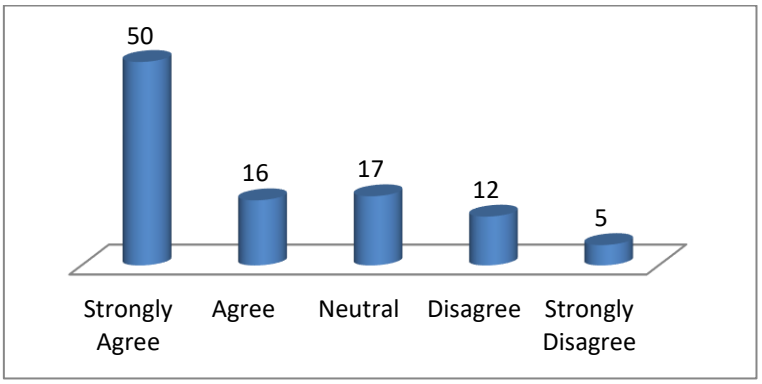

Fig. 3.4: Increase in crop infestation and diseases in the study area
Source: Fieldwork, 2023.

Decline in forest resources in the study area

Results for the decline in forest resources in the study area indicate that 69% of the farmers strongly agree that there is a decline in forest resources, 13.5% agree, 5.5% are neutral, 7.5% disagree, and 4.5% strongly disagree as can be seen in Figure 3.5.

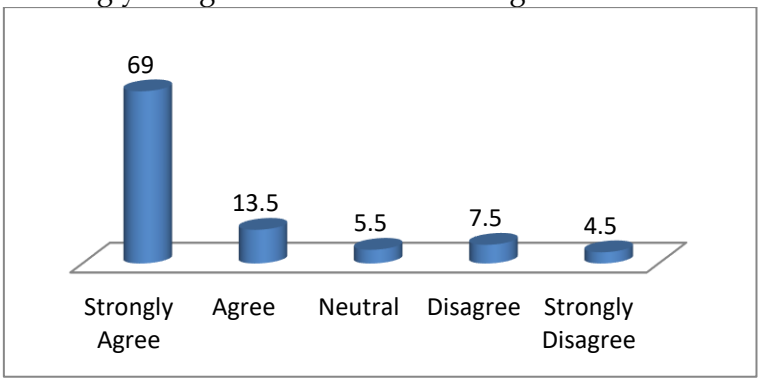

Fig. 3.5: Decline in forest resources in the study area
Source: Fieldwork, 2023.

Increase in the cost of food crops in the study area

Results for increase in the cost of food crops in the study area indicate that 26% of the farmers strongly agree that there is an increase in the cost of food crops, 40.5% agree, 14.5% are neutral, 13.5% disagree, and 5.5% strongly disagree as can be seen in Figure 3.6.

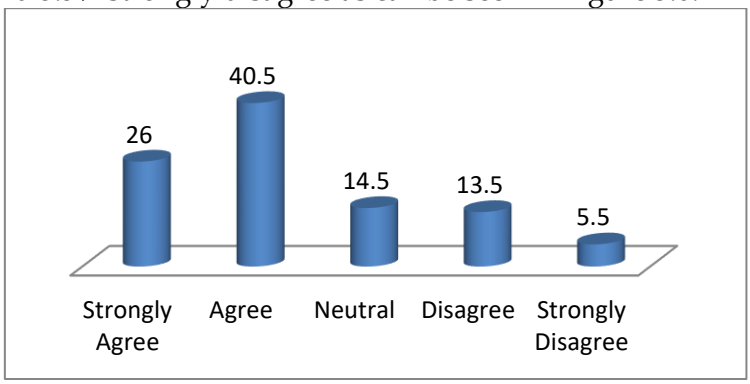

Fig. 3.6: Increase in the cost of food crops in the study area
Source: Fieldwork, 2023.

Change in livelihood in the study area

Results for change in livelihood in the study area indicate that 35.5% of the farmers strongly agree that there is a change in livelihood, 39.5% agree, 13% are neutral, 4.5% disagree, and 7.5% strongly disagree as can be seen in Figure 3.7.

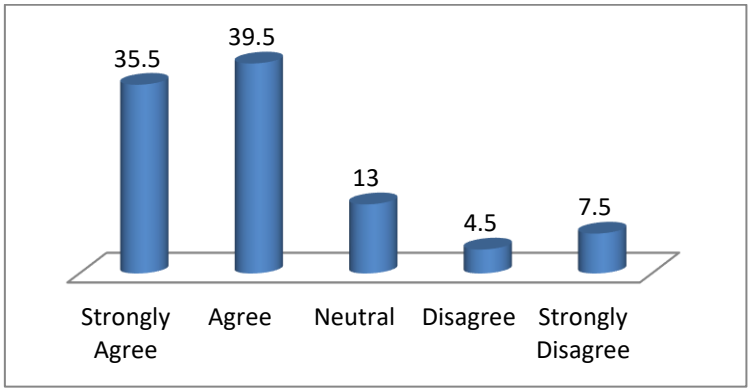

Fig. 3.7: Change in livelihood in the study area
Source: Fieldwork, 2023.

Increase in rural-urban migration in the study area

The results for increase in rural-urban migration in the study area indicate that 26.5% of the farmers strongly agree that there is an increase in rural urban migration, 51% agree, 12% are neutral, 8.5% disagree, and 2% strongly disagree as can be seen in Figure 3.8.

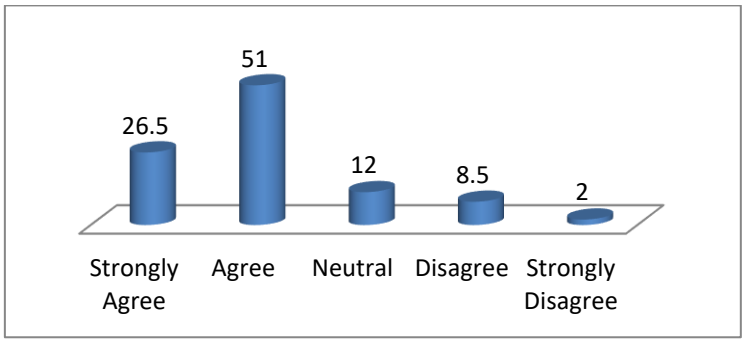

Fig. 3.8: Rural-urban migration in the study area
Source: Fieldwork, 2023.

DISCUSSION

The increasing temperature and drought in the study area conform to many predictions, projections, models and results of previous researches. For example, a study carried out by Odjugo (2010) discovered rising temperature and lower amount of precipitation in Nigeria somewhere between year 1901 and 2005. Temperature increment of 1.1^0C was recorded in Nigeria for 105 years while precipitation decreased by 81mm. While precipitation is decreasing generally in Nigeria, the coastal area of the nation has been encountering slightly rising precipitation since the mid-1970s. The popular August break (a short dry season) is now being observed more in July instead of August. Three thousand four hundred square kilometres of the coastal area of Nigeria has been flooded by rise in sea level while arable land is being reduced by 1-10km per year in the northern region of the country by desert encroachment (Odjugo, 2010).

Moreover, the Intergovernmental Panel on Climate Change (IPCC) (2014a) revealed that as a result of the changing climate Africa will encounter increased water stress, reduced yield, mal-

nutrition and food insecurity due to over-reliance on rain-fed agriculture. Consequently, adaptation to climate change is necessary for sustainable economic development and food security. Climatic projections insinuate that an extended and more extreme drought is probably going to make SSA drier (Kalele et al., 2021; Cavatassi et al., 2011). Rising yearly mean temperatures will intensify evapotranspiration losses bringing about a reduction in moisture content of the soil. The study area is part of SSA and 83% of the farmers agree that drought is increasing.

As for temperature increase, 77.5% of farmers in the study area agree that it is rising as estimated by Medugu et al. (2011) who predicted that areas across Africa will encounter an average temperature rise between three to four degrees in all seasons. Harvey et al (2018) also anticipated a reduction in rainfall and an increase in temperature which could lead to a general decrease of 10% in the production of maize in the year 2055 in Latin America and Africa, equal to $2 billion every year, affecting 130 million poor farmers in sub-Saharan Africa and other 40 million in Latin America. These yield misfortunes will escalate as temperatures rise and precipitation becomes less conducive to the production of maize. Also, Mortimore (2010) predicted that due to temperature increase, there will be a fall in-farm revenues in 11 African countries.

Seventy-six percent (76%) of the population of this study agree that flood is increasing during the rainy season. Again this consents with Odjugo's result in 2010 where Sea-level rise was seen to have flooded thirty-four thousand square kilometres (3400km^2) of Nigeria's coastal area between year 1901 and 2005. The IPCC predicted in 2007 that global warming will result in a variety of physical effects including thermal expansion of sea water, along with partial melting of land-based glaciers and sea-ice, resulting in a sea level rise which may range from 0.1 to 0.5 metres by the middle of the next century. The flood is more serious in three wards of the study area namely: Dagona ward, Sugum/Tagali ward and Usur/Dawayo ward. These three wards are affected because the river Yobe, which is the source of the flood, passes through them. Almost every year farms are being flooded by water leading to great losses in farm produce. In addition, the IPCC (2014a) projected that a sea level rise could pose a threat to agriculture in low-lying coastal areas, where impeded drainage of surface water and groundwater, as well as the intrusion of sea water into estuaries and aquifers, might take place.

As regards crop infestation and diseases, Mortmore (2010) projected that with a warmer climate weeds, diseases and pests are probably going to become more significant in Nigeria. Likewise, models on diseases of plants demonstrate that environmental change could affect the speed and stages of development of some microbes, resulting in changes in the physiology of host-microorganism relationships and alter host resistance (Jamshidi et al., 2019). Besides, as temperatures increases, many researches have inferred that insect pest will commonly turn out to be more plentiful through various interrelated processes, including over-wintering, migration, increased rates of population growth and range extensions (Harvey et al., 2018). These researches support the 66% of farmers in the study area who agree that there is an increase in crop infestation and diseases.

On the issue of excessive de-vegetation, Mustapha et al. (2012) opined that environmental change could adversely affect a portion of the wild plant species that give food, medication and income, for example, the Adansonia digitata (baobab tree) which is ordinarily utilized by farming communities. This research discovered that 68% of farmers agree that there is excessive de-vegetation of not only Adansonia digitata, but also other trees like Acacia seyel,

Balanite aegyptiaca, Azadiracta indica, Faidherbia albida, Tamarindus indica, Hyphaene thebaica and Anogeissus leiocarpus.

As researchers predicted that climate change and variability will adversely affect food production and related livelihoods in SSA (Naess, 2013), so is the case in this study where 75% of farmers agree that there is a change in the livelihood of the people leading to migration out of the study area. Similarly, Sissoko et al. (2011), suggested that by year 2100 net crop revenues will be reduced by ninety percent (90%) due to climate change, which is likely to exacerbate underdevelopment and poverty in most countries and culminate into significant migration both locally and globally. In addition, anticipated changes in the environment are probably going to impact the survival of crop and yield (Stringer et al., 2009). In the same vein, research has revealed that a rise in temperature may lead to a reduction in the stretch of growing season, and the yield of many crops is expected to decrease by 10% with places like the Sahel region suffering excessively (Harvey et al., 2018). Antwi-Agyei et al. (2014) predicted that yields from rain-fed farming- the prevalent type of farming in Africa - could be diminished by half by 2020.

Conclusions

Based on the findings of this research it is concluded that effects of climate change in the study area include an increase in temperature, crop infestation and diseases, drought increase, excessive de-vegetation, increase in flood during the rainy season, decline in the forest resources such as fire wood, increase in the price of food crops, change in the livelihood of people, as well as rural-urban migration. Among these, an increase in drought recorded the highest percentage while an increase in crop infestation and diseases scored the lowest percentage. This suggests that agricultural activities are impacted negatively and that livelihoods and food security in general are at threat.

This research therefore recommends that farmers in the study area be enlightened about the prospects of adaptation strategies like the use of improved crop varieties that can withstand drought, pests and diseases; crop diversification, early planting of crops, etc. Finally the study suggests that effective policy measures should be taken by relevant stakeholders such as the Yobe State Agricultural Development Program and the Ministry of Environment to promote the adoption of climate change adaptation strategies.

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