

ISSBN: 2006 - 0378

Journal of Geography & Development



**Volume. 9 No. 1
December, 2019**

Journal of Geography & Development

Volume 9, No. 1, December, 2019

A Publication of
The Department of Geography,
Benue State University, Makurdi, Nigeria.

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ASSESSMENT OF FARMERS' RESILIENCE TO EFFECTS OF CLIMATE CHANGE IN ASA LOCAL GOVERNMENT AREA, KWARA STATE, NIGERIA

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ABSTRACT

Climate change affects agriculture through changes in temperature, rainfall and climate extremes (e.g. heat waves): changes in pests and diseases. The study assessed farmers' resilience to the effect of climate change in Asa local Government Area of Kwara State. The data used were climatic data which were gotten from NIMET office while 120 copies of questionnaires were administered in the study area using a purposive sampling technique method. Mean, simple percentages, pie charts, time series and correlation analysis were employed to analyze the data for the study. The findings of the study revealed that rainfall, relative humidity, maximum temperature and sunshine hours were on the increase in the area while minimum temperature fluctuated during the period of study. 73% of the farmers are full time farmers, majority of the farmers cultivate more than 5 plots of land, and 97% of the farmers were aware of climate change while extreme climatic conditions experienced in the area ranged from high temperature, flood, and long dry season among others. Effects of extreme climate on agriculture include food insecurity, flood, famine among others and this had led to low income. Majority of the farmers planted early maturing varieties of crops to adapt to climate change. It was concluded that change in climate has affected agriculture in the area negatively through reduction in yield, destruction of farmland among others. It was recommended that the government should subsidize resistant species of crops to farmers; this will enable Farmers to improve their food security and income level.

Key words: *Climate, Climate change, Farmers Agriculture, Resilience,*

INTRODUCTION

Weather is the day to day state of the atmosphere, and it is short term variation in minutes to weeks. People generally think of weather as the combination of temperature, humidity, precipitation, cloudiness, visibility, and wind (National snow and ice data center; NSIDC, 2019). Usually, climate refers to the average, or typical, weather conditions observed over a long period of time for a given area. Climate is the weather of a place averaged over a period of time, often 35 years. Climatic information includes the statistical weather information that tells us about the normal weather, as well as the range of weather extremes for a location (NSIDC, 2019). Therefore, climate, which results from the physical properties and motion of the atmosphere, varies at every conceivable time scale (Jackson, 2019).

Climate change can be defined as statistically significant variations in climate condition that persists for an extended period, typically for decades or longer. It is any change in climate,

caused by natural variability and direct or indirect human activities that alter the composition of the atmosphere (IPCC, 2001; IPCC, 2007; United Nation, 1998). It can also be referred to as climate variation or climatic fluctuation. It is periodic modification of Earth's climate brought about as a result of changes in the atmosphere as well as interactions between the atmosphere and various other geologic, chemical, biological, and geographic factors within the Earth system (IPCC, 2001; IPCC, 2007; United Nation, 1998). Agricultural production is directly affected by weather, climate and climate change. Climate change affects agriculture in number of ways through changes in temperature, rainfall and climate extremes (e.g. heat waves); changes in pests and diseases (Annex, 2014). Global food security relies on both sufficient food production and food access, and this is defined as a state when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life (Food and Agricultural Organization, 1996).

Climate change, due its volatile nature, could result in previously unseen combinations of changes to multiple factors of agriculture that include climatic, biotic, and soil-related components (Rotter and van de Geijn, 1999). In animals, heat stress induced from consistent warming due to climate change has a myriad of negative effects, including decreases in milk production, reproduction capabilities, and meat quality in dairy cattle, and mass deaths in housed poultry (Rotter and van de Geijn, 1999). All of these can potentially result in a plummeting market in animal agriculture. At the same time, agriculture especially intensive agriculture, characterized by monocultures and aimed at feeding farm animals is one of the sectors that generates the highest amount of emissions of CO₂ (the main greenhouse gas). Climate change is very likely to affect food security at the global, regional, and local levels. Climate change can disrupt food availability, reduce access to food, and affect food quality. For example, projected increase in temperatures, changes in precipitation patterns, changes in extreme weather events, and reductions in water availability may all result in reduced agricultural productivity. Increase in the frequency and severity extreme weather events can also interrupt food delivery, and resulting spikes in food prices after extreme events are expected to be more frequent in the future. Increasing temperatures can contribute to spoilage and contamination of food items. Internationally, these effects of climate change on agriculture and food supply are likely to be similar to those seen in the United States. However, other stressors such as population growth may magnify the effects of climate change on food security in developing countries. Any climate-related disturbance to food distribution and transport, internationally or domestically, may have significant impacts not only on safety and quality but also on food access. United States Environmental Protection Agency (USEPA, 2016).

The study Area

Asa Local government Area of kwara state lies between latitude 8.80° and 8.40° North of the Equator and between longitude 4.12° and 4.40° East of Greenwich meridian. It is bounded in the North by Moro local Government Area in the South by Oyun Local Government Area, Ilorin West local government area is to its East while boundary with Oyo North is to the West. It has a size extent of about 1,286kmsq (Kwara State Government, 2012). Asa LGA falls within the humid tropical wet and dry climate. It is located within the tropical hinterland region, with a region, with a recognizable wet season which extends from the month of May to October and a dry season which starts from the month of November to April. The total annual rainfall received ranges between 1000mm and 15000mm. The seasonal variation in the rainfall accounts for the temporal variation in volume of water available within the area. The

average monthly day time temperature ranges 24.6°C in wet season to 29.4°C . Temperature affects water viscosity thereby influencing the infiltration capability of the water. The vegetation of the area can best be referred to as Forest Savannah Mosaic. The area is characterized by the presence of thick trees, tall and luxuriant grasses. One major characteristic of this vegetation type is the cyclic change of the vegetation from the rainy season to the dry season.

Based on 2006 census figure National Population Commission (NPC, 2006), Asa local government Area has a population of 126,435 comprising 64,982 males and 61,453 females (Ajibade, 2008). Therefore using geometric growth rate of 2.8% model of population projection, the population of Asa in 2019 is 225,413. The geology of the study area consists of Precambrian basement complex rock numerous patches of undifferentiated metasediments. The study area is mainly occupied by farmers who produce food crops both at subsistence and commercial levels. Agriculture can be said to provide basic economic activities in and around the study area. The marketing of the farm produce is done in periodic markets and their sphere of influence include Ilorin, Gannu, Offa, Bode Saadu, Idofian, Adafila among others. The produce is sold mainly by market women through the various means of transportation in the study area.

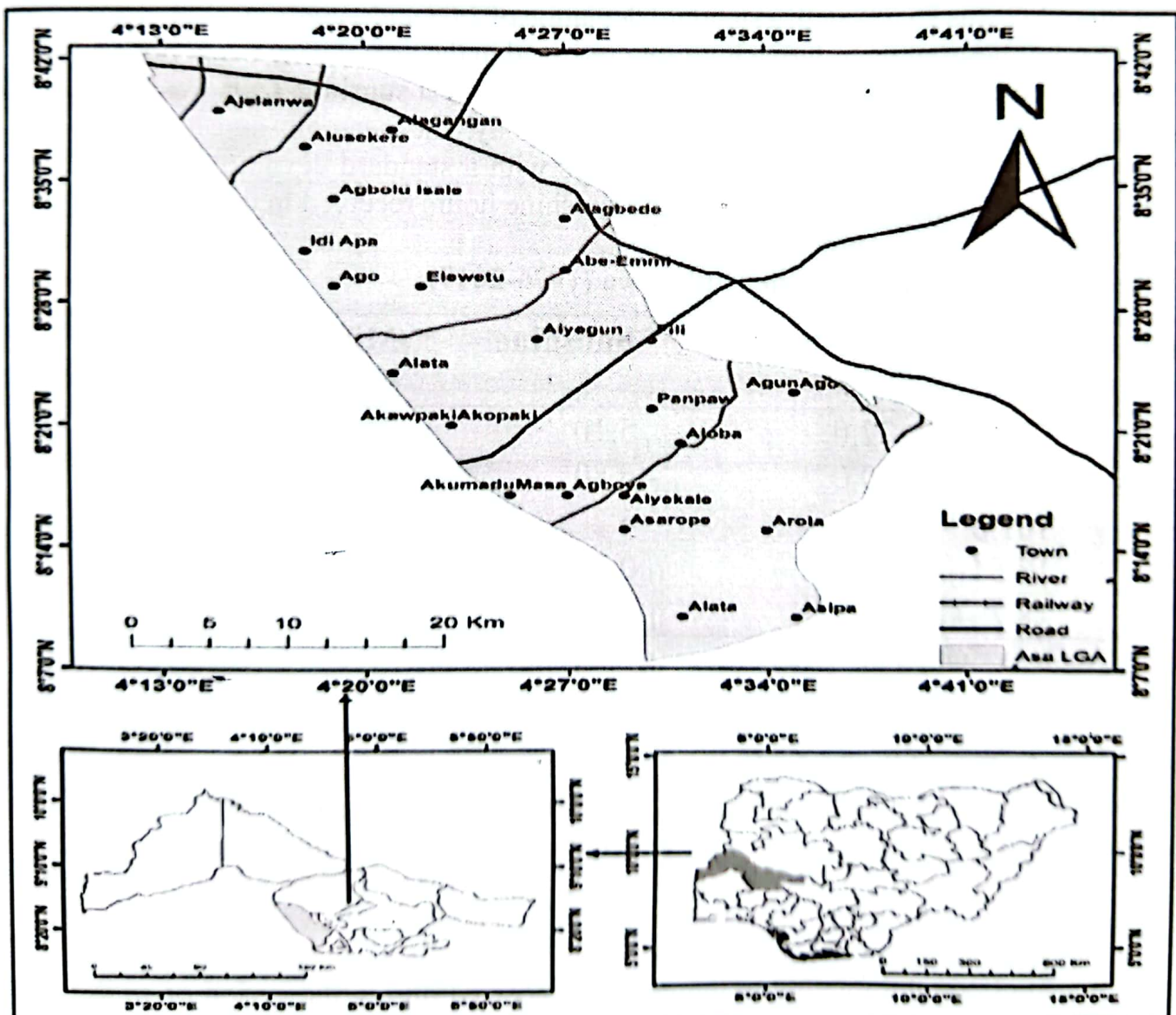


Figure 1.1: Asa Local Government, Kwara State, Nigeria

Source: Adapted from Kwara State Ministry of Land and housing 2019

Materials and Methods

The data required for this study are sourced both primarily and secondarily. The primarily data sourced are information about farmers' adaptive strategies (resilience) to climate change while secondary sourced data are; Maximum temperature, Minimum temperature, Rainfall amount, Sunshine hours and Relative Humidity between 1976 and 2017. The primarily sourced data were acquired through the administration of questionnaire while secondary data sources are from the Nigeria metrological agency (NIMET). In analyzing the data obtained for this study, both descriptive (mean, standard deviation, tables, and charts) and inferential (multiple regression and correlation) statistics were employed.

Results and Discussions**Pattern of Climatic Variables**

The climatic variables in the area during the study period are presented in Table 1. The lowest rainfall amount during the period of study was 58.1mm while the highest was 143.0mm. The mean rainfall for the study period was 101.8mm with a standard deviation of 18.54 and a coefficient of variation of 18.2%; meaning that the mean annual rainfall received in the area during the period of study is homogeneous. The result revealed that the lowest relative humidity during the period of study was 72.0% while the highest was 79.0%. The mean relative humidity was 75.7% with a standard deviation of 2.07 and a coefficient of variation of 2.73%. This implies that the relative humidity received in the area during the period of study was homogenous. The result in Table 1 shows that the lowest sunshine hour was 5.10 hours while the highest was 6.80 hours during the period of study. The mean sunshine hours received in the area during the study period was 6.2 hours with a standard deviation of 0.34 and a coefficient of variation of 5.5%; implying the sunshine hours received in the area during the period of study was homogenous.

Table 1: Climatic Elements in the study area (1976-2017)

Variable	Rainfall	R. Humidity	Sunshine	Min Temp	Max Temp
Lowest	58.10	72.0	5.10	20.7	30.8
Highest	143.0	79.0	6.80	22.3	33.4
Mean	101.8	75.7	6.2	21.5	32.3
STD	18.54	2.07	0.34	0.35	0.48
CV%	18.2	2.73	5.5	1.62	1.48

Source: Author's Computation (2019)

The result in Table 1 shows that the lowest minimum temperature recorded during the period of study was 20.7°C while the highest was 22.3°C. The mean minimum temperature was 21.5°C with a standard deviation of 0.35 and a coefficient of variation of 1.62%; meaning that the minimum temperature recorded in the area during the period of study was homogenous. The result revealed that the lowest maximum temperature recorded during the period under study was 30.8°C while the highest was 33.4°C. The mean maximum temperature during the period under study was 32.3°C with a standard deviation of 0.48 and a coefficient of variation of 1.48; meaning that the maximum temperature received during the period of study was homogenous. This implies that temperature was evenly spread and was steady during the period of study.

Socio Economic Characteristics of Respondents

Table 2 presents the socio economic characteristics of respondents. 97% of the respondents are male while 3% are females. This result shows that majority of the respondents are male, this means that majority of the people involved in farming in the study area are males. Males have more strength to engage in farming activities than women coupled with the fact that most males are bread winners that have to provide for their families. Furthermore, 7% are less than 18years, 18% within 18-30years, 16% 31-45years while 59% are above 45years. This result shows that majority of the farmers are above the age of 45years and are within the active working age. Furthermore, 10% of the respondents are single while 90% are married. Also, 50% of the respondents have household sizes less than 5 people, 33% household size is within 6-10people while 17% have household sizes above 10 people. Household size can determine the workforce of people on the farm and thus improve productivity and maximize profit.

Table 2: Socio Economic Characteristics of Respondents

Socio Economic Characteristics	Frequency	Percentage
Sex		
Male	116	97
Female	4	3
Total	120	100
Age of Respondents		
less than 18years	8	7
18-30years	21	18
31-45years	19	16
Above 45years	72	59
Total	120	100
Marital Status		
Single	12	10
Married	108	90
Total	120	100
Household Size		
less than 5people	60	50
6-10people	40	33
above 10people	20	17
Total	120	100
Religion		
Islam	116	97
Christianity	4	3
Total	120	100
Education		
No formal Education	88	73
Primary	12	10
Secondary	12	10
Tertiary	8	7
Total	120	100

Income

less than 20,000	20	17
20,000-40,000	30	25
40,001-60,000	38	32
above 60,000	32	26
Total	120	100

Source: Author's Field Survey (2019)

As depicted in Table 2, 97% of the respondents are Muslims while 3% are Christians; this implies that Islam is the dominant religion among farmers in the study area. Furthermore, 73% of the respondents have no formal education, 10% possess primary education, and 10% possess secondary school education while 7% have tertiary education. This result shows that majority of the farmers in the area have no formal education. Also, 17% of the respondents earn less than 20,000naira, 25% earn within 20,000-40,000naira, 32% earn within 40,001-60,000naira while 26% of the respondents earn above 60,000naira.

Farmers Vulnerability and Susceptibility to Climatic Extremes

Farmers in the study area were subjected to hard climate which affect the agricultural productivity.

Nature of Farming

Figure 4 presents the nature of farming practiced by the respondents. 73% of the farmers practice farming on a full time scale while 27% of the farmers practice farming on part time level. This result shows that majority of the farmers practice farming full time.

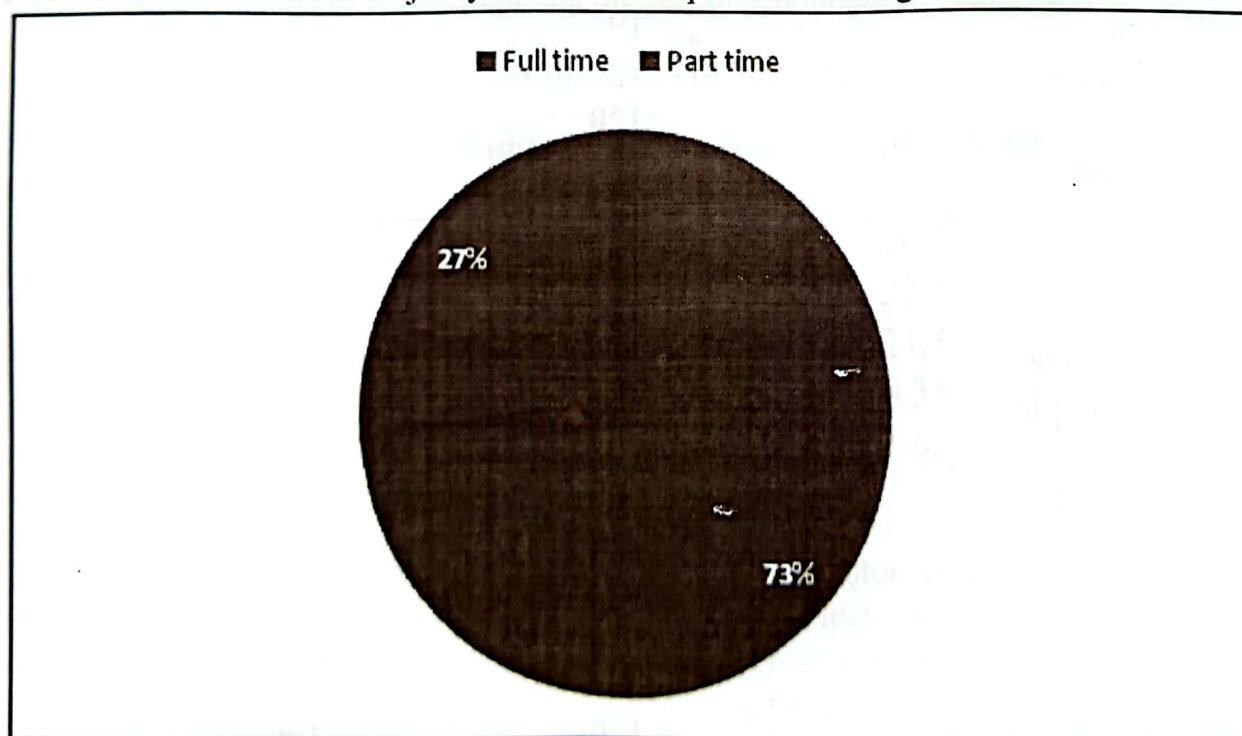


Figure 4: Nature of Farming

Source: Author's Field Survey (2019)

Area of Land used for Cultivation

The area cultivated by the farmers is presented in Table 4. 17% of the farmers farm on less than 5plots, 20% farm on land sizes within 6-10plots, 20% farm on land sizes of within 11-15plots while 43% farm on land sizes of above 15plots. Majority of the farmers farm on land sizes that are above 15plots. The size of the farm will determine the amount of produce by a farmer

which will determine the income level of the farmer.

Table 4: Area of Land Cultivated

Area of Land used for cultivation	Frequency	Percentage
less than 5plots	20	17
6-10plots	24	20
11-15plots	24	20
Above 15plots	52	43
Total	120	100.0

Source: Author's Field Survey (2019)

Farmers that farm on large land area earn more income than farmers that farm on small land area. This is because they engage in the use of Modern input, Hybrid seedling, large labour, mechanization and accessibility to capital.

Awareness to Climate Change

Figure 5 shows the awareness to climate change by the farmers. 97% of the farmers are aware to climate change while 3% are not aware to climate change. This result shows that majority of the farmers are aware of climate change.

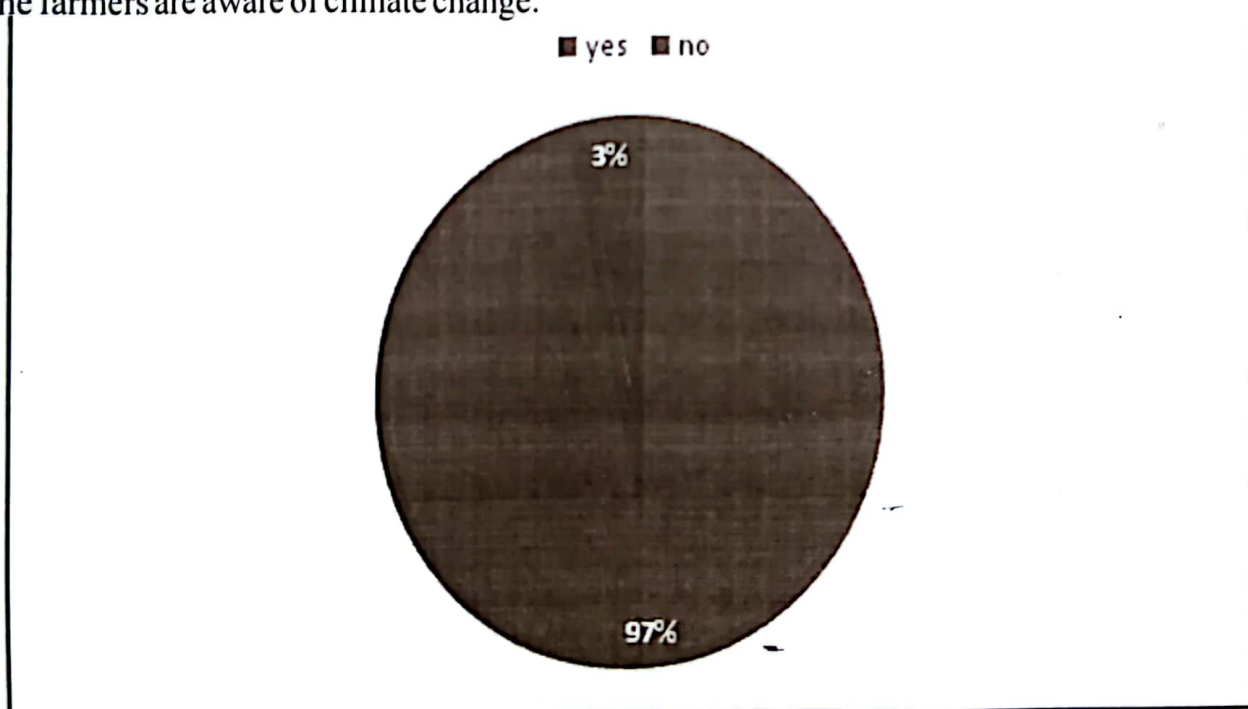


Figure 5: Awareness to Climate Change

Source: Author's Field Survey (2019)

Extreme Climate Condition Experienced

Extreme climatic conditions can affect agriculture in various ways. Flooding can destroy farmland washing away crops, high temperatures can affect growth of crops negatively, and erosion can wash away top soil making the soil barren. All these will have negative effect on the livelihood of farmers. Table 5 presents the responses of the farmers to extreme climate conditions. 33% of the farmers opined that high temperatures are experienced, 12% stated flood, 7% opined long dry season, 8% stated early cessation of rainfall, 27% opined decrease in rainfall, 2% opined seasonal drought while 11% stated erosion. This implies that most experienced climatic extreme is high temperature and this affect farming activities by making

farmers to select crops that could easily adapt to high temperature.

Table 5: Extreme Climate Conditions Experienced

Extreme Climate	Frequency	Percentage
high temperature	40	33
Flood	14	12
long dry season	8	7
early cessation of rainfall	10	8
decrease in rainfall	32	27
seasonal Drought	4	2
Erosion	12	11
Total	120	100.0

Source: Author's Field Survey (2019)

Effect of Extreme Climate Change on Agriculture

Climate change has adverse effect on agriculture. it can affect yield of crops. affect soil affect water resources among others. This will lead to poor yield of crops which in turn affect food security in an area.

Table 6 Effect of Extreme Climate on Agriculture

effect of extreme climate on agriculture	Frequency	Percentage
food insecurity	12	10
Flood	8	7
outbreak of disease and pest	6	5
Famine	12	10
low crop yield	52	43
loss of agricultural lands	30	25
Total	120	100.0

Source: Author's Field Survey (2019)

Table 6 presents the opinion of the farmers to the effect of climate change in agriculture. 10% of the farmers indicated food insecurity, 7% opined flood, 5% stated outbreak of disease and pest, 10% stated famine, 43% opined low crop yield while 25% stated loss of agricultural lands.

Effect of Climate Extreme on Socio Economic Status

Figure 6 presents the effect of climate extreme on socio economic status of the farmers. 97% of the farmers opined that extreme climate events have led to low income while 3% stated that extreme climate events had led to other causes. Flood can destroy farmlands which will affect the livelihood of the respondents. Also extreme temperature, erosion among others will affect the yield of crops adversely resulting to loss of livelihood.

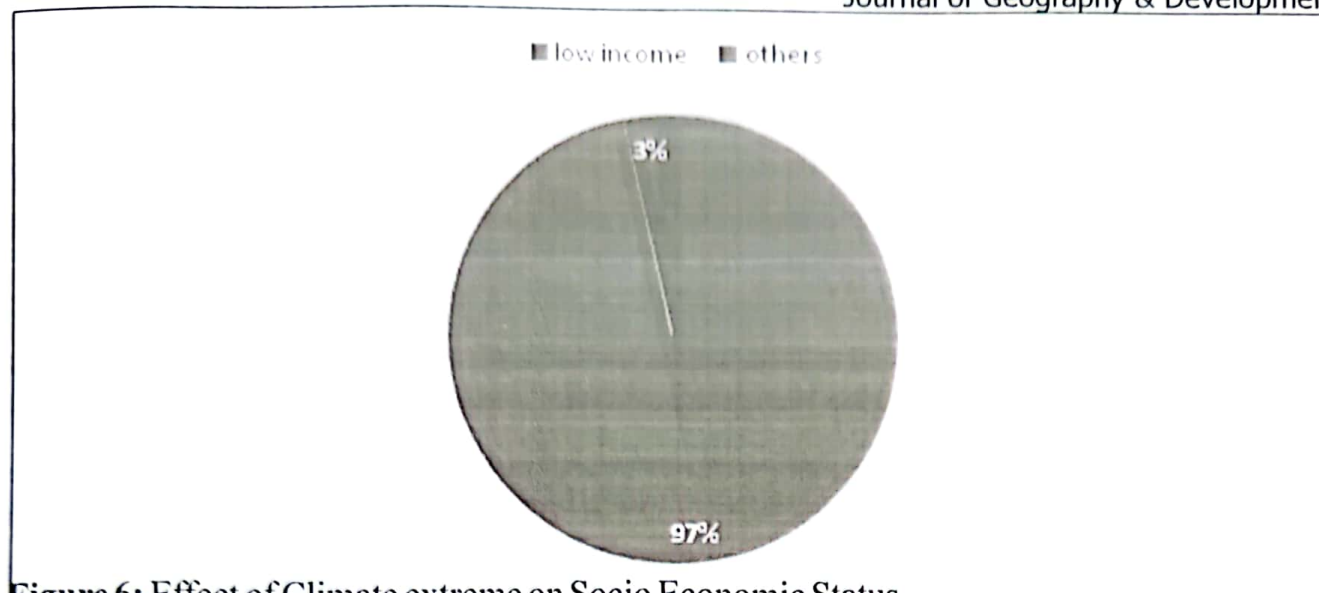


Figure 6: Effect of Climate extreme on Socio Economic Status

Source: Author's Field Survey (2019)

Coping Strategy to Adapt to Climate Change

The coping strategies employed by farmers to adapt to climate change is presented in Table 7. 50% of the framers stated that they plant early maturing varieties of crops, 17% stated that they engage in off farm work, 12% opined selling of livestock's, 1% stated migration, 1% stated food aid, 6% stated replanting, 1% stated switching to other occupation while 12% stated that they practice mixed farming.

Table 7: Coping Strategy to Adapt to Climate Change

Coping Strategy to Adapt to Climate Change	Frequency	Percentage
early maturing varieties	60	50
off farm work	20	17
selling of live stock	10	12
Migration	2	1
food aid	2	1
replanting	8	6
switching to other occupation	2	1
mixed farming	16	12
Total	120	100.0

Source: Author's Field Survey (2019)

Mitigation of the Effect of Climate Change

The methods employed by the farmers to mitigate the effect of climate change are presented in Table 8. 15% of the farmers stated that the employ irrigation method, 25% stated planting of cover crops, 45% stated planting of trees, 10% stated prevention of flood while 5% states sensitization of people.

Table 8: Ways to Mitigate the Effect of Climate Change

Ways to Mitigate the effect of climate change	Frequency	Percentage
Irrigation	18	15
planting of crops	30	25
planting of trees	54	45
prevention of flood	12	10
sensitization of people	6	5
Total	120	100.0

Source: Author's Field Survey (2019)

Respondents stated that they think planting of trees can mitigate the effect of climate change. Irrigation is used to supplement shortage of water required by crops, planting of cover crops helps protect the soil from erosion and exposure to direct rays of the sun, planting of trees provide shade for the soil. flood prevention strategies help prevent flood from washing away the top soil and destroying farm land.

Farmers Resilience to Climate Change

Quantity of Yield per Hectare

The quantity of yield per hectare is presented in Table 9. 15% of the farmers harvest 1 load of vehicle per hectare, 5% 3 loads of vehicles, 30% harvest 5bags, 5% 8bags, 15% 10bags, 5% 15bags, 15% 20bags, 5% 25bags while 5% stated that they harvest 50bags per hectare.

Table 9: Quantity of Yield per Hectare

Quantity of Yield Per Hectare	Frequency	Percentage
1 load of vehicle	18	15
3 loads of vehicles	6	5
5bags	36	30
8bags	6	5
10bags	18	15
15bags	6	5
20bags	18	15
25bags	6	5
50bags	6	5
Total	120	100.0

Source: Author's Field Survey (2019)

Number of Household on Agriculture

Table 10 presents the number of household members involved in agriculture. 5% of the farmers opined 1, 10% stated 4, 25% indicated 5, 5% opined 6, 10% stated 7, 25% opined 8, 5% stated 10, 10% opined 11 while 5% stated 12 members.

Table 10: Number of Household Involved in Agriculture

Number of Household on Agriculture	Frequency	Percentage
1	6	5
4	12	10
5	30	25
6	6	5
7	12	10
8	30	25
10	6	5
11	12	10
12	6	5
Total	120	100.0

Source: Author's Field Survey (2018)

How Seasons Affect Farming

Figure 7 presents the responses of the farmers to how seasons and climate change affect farming. 95% of the farmers stated that rainy season favors growth of crops while drought leads to reduction in yield while 5% stated that no effect.

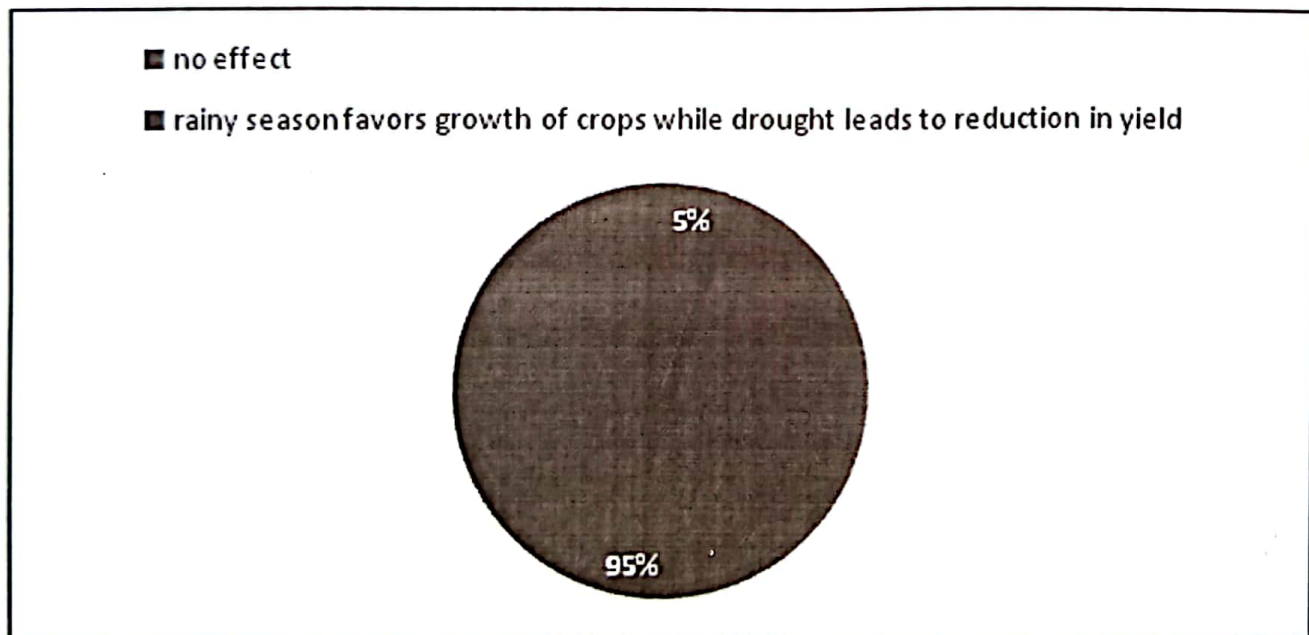


Figure 7: How seasons affect farming

Source: Author's Field Survey (2019)

Minimize the Impact of Extreme Climate

Table 11 presents the strategies employed by the farmers to minimize the impact of extreme climate. 15% stated that they practice fallowing method, 15% stated that they practice irrigation agriculture, 5% practice mixed cropping, 35% plant during favorable season, 25% planting resistant plant species while 5% plant when the climate is favorable.

Table 11: Minimizing the Impact of Extreme Climate

Minimize the Impact of Extreme Climate	Frequency	Percentage
Fallowing	18	15
Irrigation	18	15
mixed cropping	6	5
planting during favorable season	42	35
planting resistant specie	30	25
planting when the climate is favorable	6	5
Total	120	100.0

Source: Author's Field Survey (2019)

Vulnerability of Farm Activity to Climate Change

Table 12 presents the vulnerability of farm activities to climate change in the study area. 7% of the farmers stated that farm activities are extremely vulnerable to climate change, 78% opined very vulnerable, 14% stated vulnerable while 1% stated non-vulnerable. This result stated that majority of the farmers are of the opinion that farming is very vulnerable to climate change.

Table 12: Vulnerability of Farm Activities to Climate Change

Vulnerability to Climate Change	Frequency	Percentage
Extremely Vulnerable	8	7
very vulnerable	94	78
vulnerable	16	14
non-vulnerable	2	1
Total	120	100.0

Source: Author's Field Survey (2019)

CONCLUSION

Climate change affects agriculture in number of ways including changes in temperature, rainfall and climate extremes (e.g. heat waves); changes in pests and diseases. The effect of extreme climate on agriculture includes food insecurity, flood, famine among others. Extreme climate has led to low income while majority of the farmers plant early maturing varieties of crops to adapt to climate change. It is therefore concluded that climate change has led to increase in rainfall, sunshine hours, relative humidity and maximum temperature in the area. This increase has affected agriculture negatively through reduction in yield, destruction of farmland among others. Although, farmers in the area have adapted to climate change through planting of resistant specie of crops, use of irrigation method and practicing mixed cropping among others, yet the impact of climate change is still felt. Base on the findings of the study, NIMET should communicate information about trend in climate to farmers because this will enable the farmers to plan toward the coming weather events and prepare mitigation measures against extreme weather occurrences.

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