

Rural Farmers' Perception of Climate Change and its Impact in Girei Local Government Area, Adamawa State, Nigeria

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Abstract

This study was designed to investigate the climatic characteristics and rural farmers' awareness, perception and impacts of climate change in Girei Local Government Area of Adamawa State, Nigeria. Forty-one years records of temperature and rainfall of the growing season were used for the study. This is in addition to the farmers responses regarding their perception on the impact of climate change. Descriptive statistics and time series analysis techniques were employed to analyze the data. Perception was assessed using 13-points farmers' descriptions of weathers parameters while impacts were determined with respect to statistical significance of 13-points impacts statements. The results of the findings show that the respondents are subsistence farmers, most of whom are within active population age of 30-61 years. They have mean household size of 7 persons and majority of them (74%) have attained some sort of formal education with weak income base (annual average of N100, 000). The climatic elements of the area are highly variable; revealing increase of about 1°C in temperature and decrease of 24.6mm³ in rainfall within the forty-one years of study period. The rural farmers' perception of the climate change was expressed in descriptions of weather phenomena such as rainfall and temperature effectiveness variables; increased temperature; frequent occurrence of floods, droughts and windstorms etc. The perceived causes of the change in climate were attributed to God's punishment for human disobedience as well as natural and human factors. The impacts range from decline in crops-yield, ranked 1st, to deaths of livestock (13th) with nine discovered to be statistically significant. It was recommended that government needed to give more attention to these rural poor by making farm inputs and access to credit facilities available. Required institutions such as healthcare, veterinary services as well as infrastructures like good roads, power supply etc. should be made accessible.

Keywords: Climate, Climate Change, Girei, Impact and Perception

Introduction

The United Nations Framework Convention on Climate Change (UNFCCC, 2007) refers to climate change as "a change in the state of climate which is attributed directly or indirectly to anthropogenic activities that alter the composition of the atmosphere, in addition to natural climatic variability observed over a comparable time period". However, despite some few sceptical views (Frank, 2008; Washington & Cook, 2011), there exists a widespread consensus among individual scientists and institutions (Stem, 2006, 2008; Mings, 2008; IPCC, 2007b; and the United Nations Development Program (UNDP, 2009) that climate change is real, likewise its impacts. Also common to these views, is that climate change is the greatest environmental threat to sustainable development in the century.

These changes in the atmospheric concentration of greenhouse gases (GHGs) and aerosol, land cover and solar radiation result in the altering of the energy balance of the climate system and are drivers of climate change. In this way, they affect the absorption, scattering and emission of radiation within the atmosphere and the earth's surface (IPCC, 2007a; Bello, 2008). The resulting positive or negative changes in the energy balance due to these factors are expressed as radiative force, which is used to compare warming or cooling influences on global climate (IPCC, 2007a).

Change in climate is perceived differently by individuals, groups or society. Perception to climate change, according to De Jonge (2010), refers to how people see and interpret their experience that lead to particular understanding. In this context, it refers to rural people's point of view towards climate change which influenced their long-time knowledge and experience with the biophysical and human environments. Hence, responses to all forms of mitigation and adaptation strategies that may be adopted to combat the impact of climate change, are long term adjustments of a system to moderate the impacts of climate change (Adger, Huq, Brown, Conway & Hulme, 2003).

With reference to the northern part of Nigeria, climate change impact varies, depending on locations and sectors but will be more severe where vulnerability to climate change is higher, stress factor is multiple and adaptive capacity is low (Abaje, 2015). Poor communities tend to be vulnerable especially when located in high risk areas, as they have lower adaptive capacity and depends more on local ecosystem services, such as water and agriculture (Ishaya & Abaje, 2009). Some of the most devastating adverse impacts of climate in this region include frequent drought and severe floods, altering both surface and underground water supply thereby affecting agriculture and food security (Abaje & Giwa, 2010; Sawa & Adebayo, 2011), increased infestation of crop by pests and diseases, increased rural-urban migration, increase biodiversity loss, declined in soil conditions, increase health risk and the spread of infectious disease, and changing livelihood systems (Ishaya & Abaje, 2015; Oladipo, 2010; Sawa & Adebayo, 2011).

Considering that climate change is real and level of impacts differs according to regions, this study was formulated to examine the existing situation in a typical rural setting in northern Nigeria. Adebayo, Mubi, Zemba and Umar (2013) has reported that climate change awareness is relatively high in Adamawa State. Zemba and Adebayo (2010) and Zemba, Dasin and Ishaku (2013) also stated that climate change impact was effective and deleterious to mostly the low-income groups of Adamawa State. However, this study focused mainly on the local farmers, who mostly practice subsistence agriculture.

Materials and Methods

Description of Study Area

Girei Local Government Area is one of the twenty-one (21) local government areas in Adamawa State. It is situated between latitude $9^{\circ} 13'$ and $9^{\circ} 37'$ North of the equator and longitude $12^{\circ} 16'$ and $12^{\circ} 42'$ East of the Greenwich (Figure 1). The area experiences two distinct seasons, dry season (November to March) and rainy season (April to October) with a mean annual rainfall of about 950mm^3 and average annual rain days of about 80 days (Zemba & Adebayo, 2010). The annual mean temperature of 28°C (Zemba 2004), coupled with rainfall, makes the area a good place for cultivation of variety of crops.

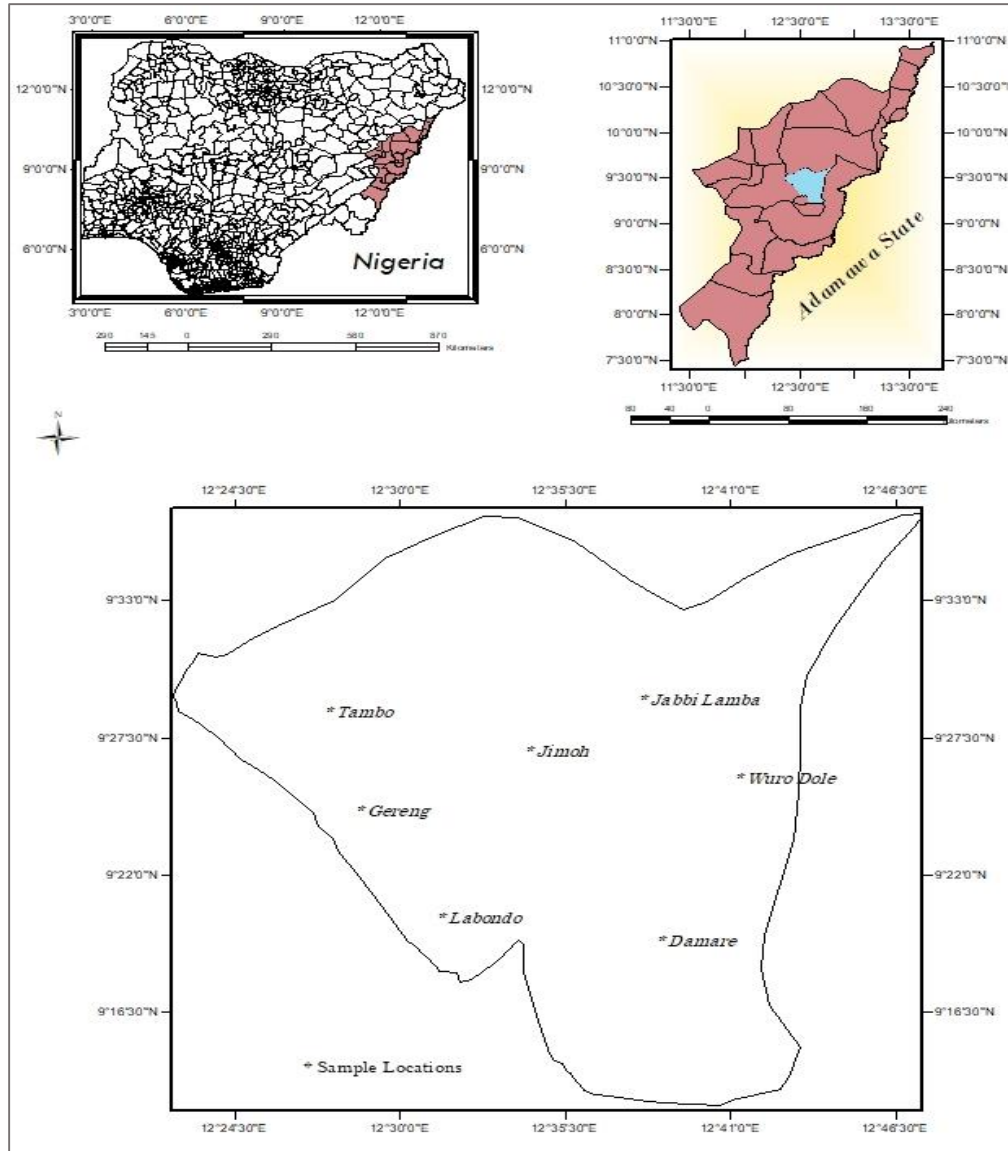


Figure 1: Study Area and Sample Locations

The presence of River Benue, which serves as boundary demarcation of the local government area in the Southern through Southwestern fringes provides extensive floodplain with great potentials for irrigation activities. About 85% of the inhabitants of Girei Local Government Area are farmers, who either undertake crops cultivation or livestock rearing, especially cattle. Rice cultivation is extensively practised along the River Benue floodplain. Modibbo Adama University of Technology, Yola is hosted in the local government and provides additional opportunity for agricultural-based researches that facilitates the healthy promotion of agricultural activities generally in the area.

Methods

Data Types and Sources

The data used for this study were majorly climatic data of annual rainfall and temperature obtained from the Nigerian Meteorological Agency, Yola. The data covered a period of forty-one years (1979-2019). Responses obtained from the rural farmers regarding their socio-economic characteristics as well as their perception and impacts of climate change constituted another important data obtained from questionnaire administration. In addition, supplementary data, which were sourced from observations, oral interviews and focused group discussion (FGD) were utilized in the work.

The study area’s population from 2006 census stood at 23, 358. This figure was projected to the year 2019 for the purpose of this study using the method of Mehta (2004) (equation 1):

$$p_n = p_0 (1+R/100)^n \text{----- (1)}$$

- Where: p_n = population in the current year
- p_0 = population in the base year.
- R = annual growth rate
- n = number of intermediary years.

Based on the above, the projected population of the study area for the year 2019 was 25,308 people. The study basically targeted rural farmers. In the whole of Girei LGA, only Girei, Sangere-FUTY and Vunoklang settlements had population of over 20,000 people (Zemba & Adebayo, 2010). Going by United Nations Economic Commission for Africa’s definition of rurality as having a population of less than 20,000, the three settlements above were eliminated. Seven settlements were then randomly selected from the remaining settlements including Damare, Gereng, Jabbi Lamba, Jimoh, Labondo, Tambo and Wurodole. 10% of the population of these settlements was used as sample for this study (Table 1).

Table 1: Sampling of the Respondents

| Settlement | 1991 Population | 2019 Population (Projected) | Sample size (10%) |
|-------------|-----------------|-----------------------------|-------------------|
| Damare | 1,336 | 2,895 | 29 |
| Gereng | 2,412 | 5,226 | 52 |
| Jabbi Lamba | 3,559 | 7,713 | 77 |
| Jimoh | 2,325 | 2,872 | 29 |
| Labondo | 867 | 1,878 | 19 |
| Tambo | 449 | 972 | 10 |
| Wurodole | 1,731 | 3,752 | 38 |
| Total | 23,358 | 25,308 | 254 |

Questionnaire design

Both closed and open-ended questions were used. The closed ended questions were in form of Likert Scale (LS) and fixed question format. The interview scheduled had five sections (A-E), eliciting information on the socio-economic characteristics of the correspondents (gender, age, literacy level, household size, income, among others); perceived climate change, causes and impacts. Survey questions for FGD was focused on a more comprehensive range of climate change issues such as impacts on livelihoods.

Trend analysis of temperature and rainfall

Trends in temperature and rainfall for the period 1979-2019 were analyzed. In this study, time series of rainfall totals for the months of April to October were used. These are the months during which the study area receives over 85% of its annual rainfall total (Zemba & Adebayo, 2010 and

Adebayo *et al*, 2013). To examine the nature of the trends in the temperature and rainfall series, linear trends and trend line equations were plotted and changes in the temperature and rainfall amount were determined.

To ascertain the nature of trends and measurement of variability of both mean rainfalls of growing season and mean temperature, the standard deviation, which provides the deviation from normal (average) was equally determined and plotted. From the plotted charts, extreme conditions were then detected.

Assessment of Rural Farmers' Perception of Climate Change

In order to assess rural farmers' perception of climate change in the area, questions asked on whether respondents had noticed long term change in temperature, rainfall, and the occurrence of extreme weather condition such as droughts and floods over the past 30 years among others were analyzed. Farmers' perceived causes of climate change were sought. This concerned issues like destruction of nature (e.g. deforestation and bush burning); land degradation due to cultivation, animal rearing, and increase in population among other questions; community's disobeying God etc. Three options including 'agree', 'undecided' and 'disagree' were to be chosen by the respondents.

Determining the impact of climate change

Impacts of climate changes were determined using a five-point Likert Scale (LS). Each respondent was required to respond by choosing any of the options namely: 'strongly agree', 'agree', 'undecided', 'disagree', and 'strongly-disagree'. Values assigned to these options were 5,4,3,2 and 1 respectively. The mean score of the respondents based on the scale was then computed as:

$$5+4+3+2+1 = \frac{15}{5} = 3.00 \text{ ----- (2)}$$

Climate change factors with mean score less than 3.0 were taken as those which experience less impact while those with score equal or above 3.00 were taken as having greater impacts of climate change

Results of the Findings

Characteristics of the Climatic Elements in the Study Area

The characteristics of the major climatic elements (mean annual rainfall of growing season and temperature) are presented in Table 2 and Figure 2. It is clear that there has been a significant decrease in rainfall at the rate of -0.5999mm^3 per annum, resulting to a total decrease of 24.5959mm^3 for the 41 years period under study. A significant variation in the records is also represented by a standard deviation of 138.20 for the period. On the other hand, an insignificant variation in temperature was observed as represented by a variance of 0.22 with a yearly trend of 0.0244. This translates to a total increase in temperature by 1.0004°C for the 41 years period of the study. It should be noted that the rainfall data used in the study represent only growing season values (April – October); that is, when rainfall is sufficient for cultivation and also represent about 90% of the total annual value.

Table 2: Statistics of Climatic Elements

| Variable | Range | Minimum | Maximum | Average | Standard Deviation | Variance | Trend (value/year) | Total Change (value/41years) |
|------------------|--------|---------|---------|---------|--------------------|----------|--------------------|------------------------------|
| Rainfall (mm) | 745.70 | 518.99 | 1264.69 | 821.55 | 138.20 | 19098.41 | -0.5999 | -24.5959 |
| Temperature (°C) | 2.08 | 34.24 | 36.33 | 35.15 | 0.47 | 0.22 | 0.0244 | 1.0004 |

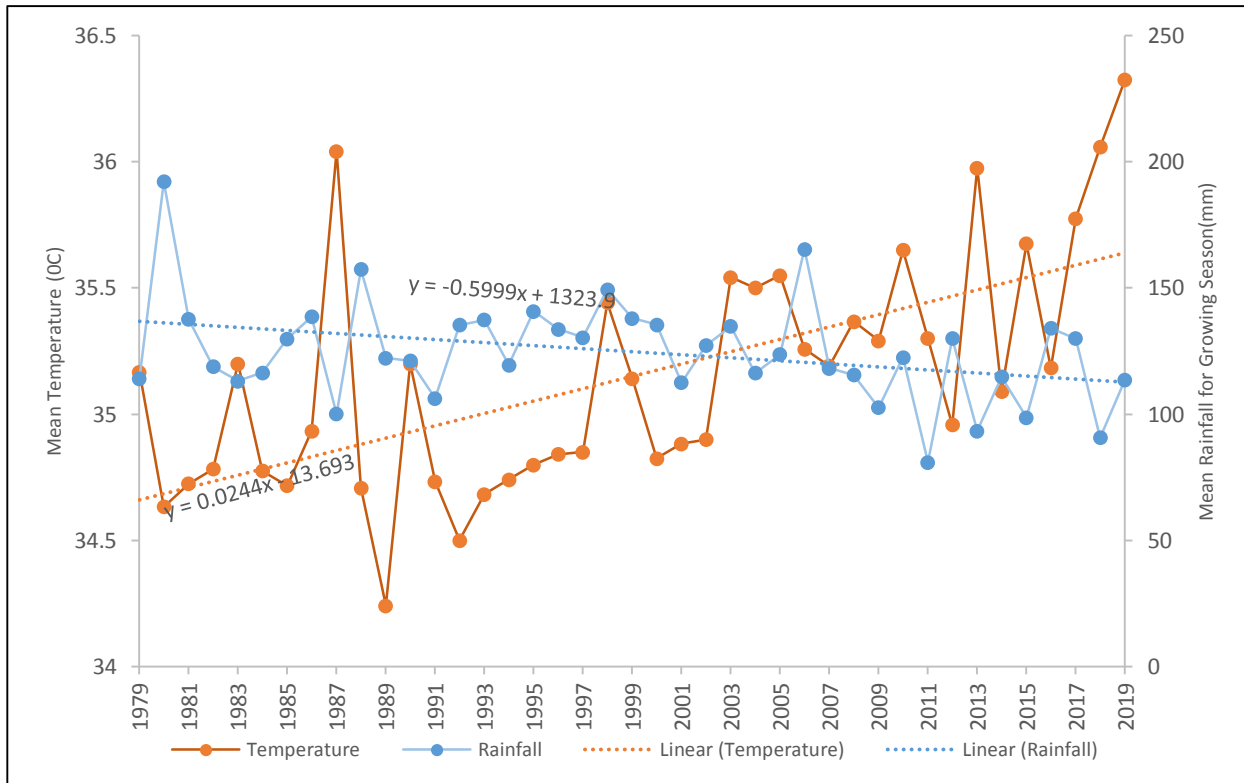


Figure 2: Mean Temperature and Rainfall of Growing Season

Socio-Economic Characteristics of the Respondents

The socio-economic characteristics of the respondents (Table 3) showed that about 89% are within an active population (30-61 years). Male constituted about 61% and mean household size of 7 persons was observed. About 70% of the inhabitants practice crops cultivation as the only occupation, an evidence of a typical rural farming communities. Majority of them (74%) attained formal education but they have weak income base (average of N100,000 per annum) (about USD 300).

Table 3: Socio-Economic Characteristics of the Respondents

| Socioeconomic variable | Frequency | Percentage |
|-------------------------------|------------------|-------------------|
| Age | | |
| 30-45 | 102 | 40.2 |
| 46-61 | 124 | 48.8 |
| 62+ | 28 | 11.0 |
| Total | 254 | 100 |
| Gender | | |
| Male | 168 | 66.1 |
| Female | 86 | 33.9 |
| Total | 254 | 100 |
| Marital Status | | |
| Single | 12 | 4.7 |
| Married | 150 | 59.1 |
| Divorced | 23 | 9.1 |
| Widowed | 69 | 27.1 |
| Total | 254 | 100 |
| Household Size | | |
| 2-4 | 45 | 17.7 |
| 4-7 | 96 | 37.8 |
| 8-10 | 82 | 32.3 |
| 10+ | 31 | 12.2 |
| Total | 254 | 100 |
| Occupation | | |
| Farming only | 176 | 69.3 |
| Farming and animal rearing | 26 | 10.2 |
| Farming and Business | 32 | 12.6 |
| Farming and civil service | 20 | 7.9 |
| Total | 254 | 100 |
| Educational Level | | |
| Primary | 81 | 31.9 |
| Secondary | 75 | 29.5 |
| Tertiary | 32 | 12.6 |
| Informal | 66 | 26.0 |
| Total | 254 | 100 |
| Annual Income (N) | | |
| > 50, 000 | 22 | 8.7 |
| 50 ,000 – 100, 000 | 89 | 35.0 |
| 101, 000 – 150, 000 | 82 | 32.3 |
| >150, 000 | 61 | 24.0 |
| Total | 254 | 100 |

Perception and Impact of Climate Change by Rural Farmers

An assessment of the perception of climate change among the rural farmers was conducted using thirteen items listed in Figure 3. Results clearly indicate that framers are generally aware of changes in climate in the area. Their perception of these changes was expressed in a range of statements (Figure 3). This involves their ability to, for instance, notice increase in temperature; observed changes in precipitation effectiveness and decrease in rainfall; experienced scarcity of water supply, increased windstorm events, frequent occurrence of weather extreme phenomena

etc. For instance, 52.2%, 39.3% and 55.8% reported that temperature is increasing; rainfall is likely to increase in future; and flood occurrence is increasing respectively.

Their perceived causes of these changes are attributed to three main factors as listed in Figure 4. These include disobedience to God as well as natural and human factors. However, it is interesting to note that the respondents attributed those changes less to natural than human factors as about 54.9% of them disagreed with the fact that climate change is caused by natural factors while 56.2 agreed that it is caused by human activities such as land cultivation, animal rearing, pollution from homes, industries, vehicular traffic etc.

Regarding the impacts of climate change, nine of the thirteen impact statements were proved to significantly impact on the lives and livelihood of the respondents (Table 4). This is based on 5-point score. They were ranked from ‘decline in crop yields’ (1st) with an average score of 3.51 to ‘increase in deaths of livestock’ (13th) with average score of 2.85. This is not surprising considering the fact that majority of the respondents are farmers, who expectedly, have a firsthand experience of the impacts in livelihood activities (farming). In fact, only crop infestation and diseases, frequent occurrence of floods, changes in livelihood system and increased deaths of livestock were found not to be statistically significant.

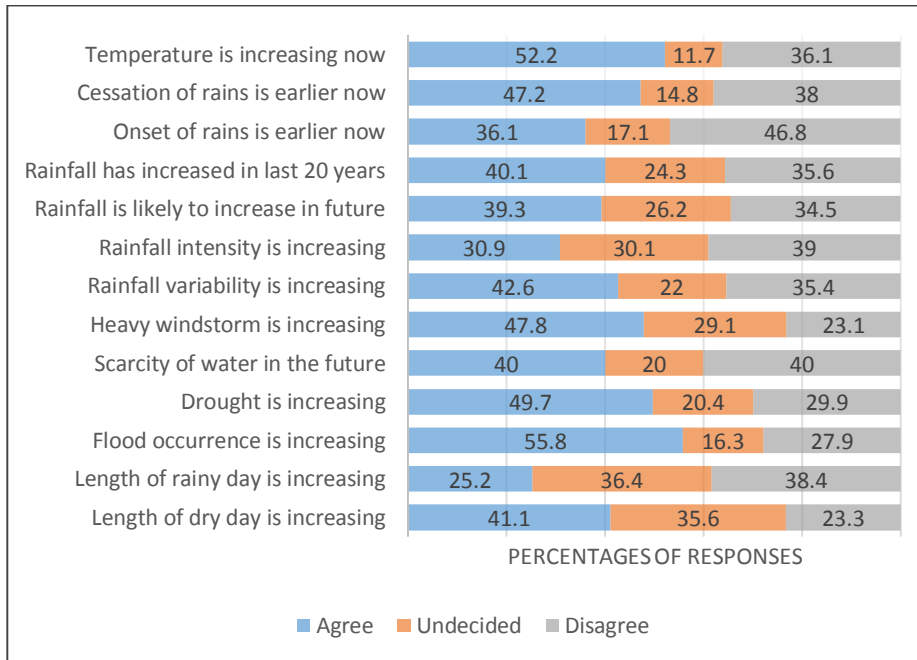


Figure 3: Peoples’ Perception of Climate Change

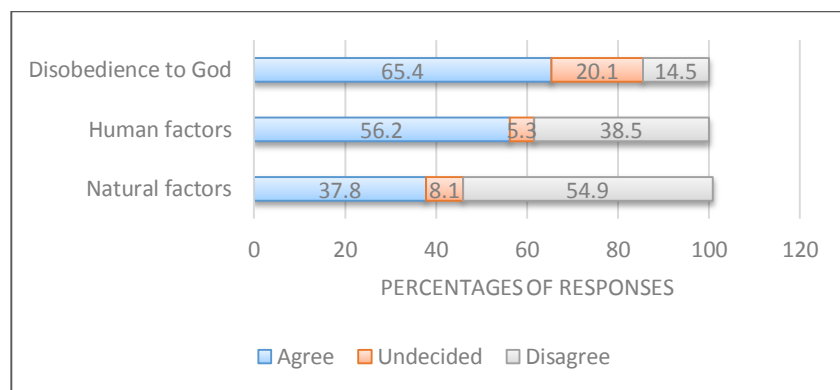


Figure 4: Peoples' Perception of Causes of Changes in Climate

Table 5: Perceived Impacts of Climate Change

| S/N | Impact Statement | Average score | Rank |
|-----|--|---------------|------|
| 1 | Decline in crop yields | 3.51* | 1 |
| 2 | Annual rains not supporting crops any longer | 3.46* | 2 |
| 3 | Crop infestation and diseases | 2.94 | 11 |
| 4 | Increase in costs of food crops | 3.44* | 3 |
| 5 | Rural-Urban migration of youths | 3.00* | 9 |
| 6 | Decline in forest resources | 3.03* | 8 |
| 7 | Frequent occurrence of floods | 2.91 | 12 |
| 8 | Frequent occurrence of droughts | 3.04* | 7 |
| 9 | Drying of water sources | 3.32* | 5 |
| 10 | Changes in livelihood system | 2.97 | 10 |
| 11 | Decrease in soil fertility | 3.11* | 6 |
| 12 | Increase in death of livestock | 2.85 | 13 |
| 13 | Increased sickness due to extreme heat | 3.41* | 4 |

* Significant impact

Conclusion

Climate change presents enormous risks to ecology and human existence in the world. Girei Local Government Area, the study area is not an exception. Results from the forty-one years climate data of the area revealed evidence of variations and change with temperature increase of about 1⁰C and rainfall decrease of 24.6mm³. The rural farmers, who are generally peasant, are aware of these changes as expressed in their statements such as 'increase in temperature and rainfall' 'change in precipitation effectiveness' 'frequent drought and floods' etc., which they attributed to natural and human factors as well as being a punishment for disobedient to God.

The impacts of climate change and here I had hit him in the online for them are were found to be statistically significant in the area as seen from impact statements of the respondents such as decline in crop-yields, reduction in rainfall, increase in costs of food crops, rural-urban migration, decline in forest resources, increased drought and flood occurrence, drying of surface waters, decrease in soil fertility, increased death of livestock. Most of these communities are highly vulnerable to climate change impacts.

Recommendation

Based on the findings of this study, the following recommendations are made:

- i. it was recommended that government should intensify efforts in providing credit facilities and farm inputs to aid the farmers in protecting their means of livelihoods.

- ii. There is need to also make provision for available infrastructural facilities such as good roads, power supply as well as provision of healthcare and veterinary services.

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