Gombe Journal of Geography and Environmental Studies (GOJGES)

Vol. 3 No.1 Dec. 2022

e-ISSN: 2714-321X

p-ISSN: 2714-3201

http://www.gojgesjournal.com

Gombe Journal of Geography and Environmental Studies (GOJGES) Vol. 3 No.1 Dec. 2022, e-ISSN: 2714-21X; p-ISSN: 2714-32

ASSESSMENT OF FARMERS' ADAPTATION STRATEGIES TO CLIMATE CHANGE IN KALTUNGO LOCAL GOVERNMENT AREA, GOMBE STATE, NIGERIA

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Abstract

The study assessed climate change adaptation strategies in Kaltungo LGA of Gombe state. The study adopted structured questionnaire. A total of 400 copies were administered to eight (8) wards in the study area using purposive sampling. These wards are Awak, Bule/Kaltin, Kamo, Tula-Yiri, Tula Baule, Tula Wange, Tungo and Ture). Descriptive and inferential statistics were employed to analyze data gotten from the field. The result revealed that most (90%) farmers are men that are married, aged 30-49 years and earn ₦21000 - ₦40000 monthly. Furthermore, 92% of the farmers are aware of climate change but majority (41%) of the farmers consider climate change as an act of God, 31% opined that it is a natural phenomenon while 15% blamed climate change on neglect of traditional values on environmental protection and technological advancement. The farmers perception on climate change effects with high positive deviation above the mean include, increase in poverty, migration and clashes with herdsmen and villagers (4.34), decrease in grain yield (3.87), flooding of farmlands and residential areas (3.54) and insufficient/shortage of food supply in recent years (3.37). It was also observed that 45.07% of the farmers in the study area never practice the climate change adaptation strategies outlined. The most practiced adaptation to climate change in the study area is early planting/late planting (86.25%), mixed farming (61.25%) and accessing loans, grants or subsidies. Students t-test revealed that there was significant variation in climate change adaptation strategies in Awak, Kamo, Tula Baule, Tungo and Ture. The implication of this result is that farmers in these wards are more aware and employ most of the climate change adaptation strategies outlined and assessed. The barriers to climate change in the study area are unavailability of improved seed varieties, lack of access to water for irrigation and ignorance of current knowledge on adaptation strategies as deduced from a relative importance index of 0.70, 0.68 and 0.62 respectively. The study therefore recommended a sustainable framework where farmers in the study area can assess climate sensitive seeds and increased sensitization on improved climate change adaptation measures while ensuring that traditional climate change adaptation strategies are significantly modified and sustained.

Keywords: Adaptation Strategies, Awareness, Climate Change, Farmers.

1. Introduction

The Intergovernmental Panel on Climate Change [IPCC] (2007) defined climate change as a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and /or the variability of its properties, and that persists for an extended period typically decades or longer. Although the length of time it takes the changes to manifest matters, the level of deviation from the normal and its impacts on the ecology are most paramount).

IPCC (2001) refers to climate change adaptation strategies as the practice of identifying options or methods to adapt to climate change and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency and feasibility. Tschakert and Dietrich (2010) stated that, this characterization is highly

debatable, after all, adaptation can also be used to describe natural, involuntary processes by which organisms, populations, ecosystems and perhaps even socio-ecological systems evolve after the application of certain external stresses. However, for the purposes of differentiating climate adaptation and climate resilience from a policymaking standpoint, one can contrast the active, actor-centric notion of adaptation with resilience, which would be a more systems-based approach to building social-ecological networks that are inherently capable of not only absorbing change, but utilizing those changes to develop into more efficient configurations.

Agricultural activities in Nigeria owe their sustenance to the impact of climate change as postulated by several studies. The IPCC (2008) report highlighted that climate has been causing serious environmental hazards ranging from erosion, droughts and high temperatures in agrarian rain fed areas of Nigeria especially in the northern parts of the country. Their report reiterated that resource poor farmers will be unable to cope with climate change as a result of poverty and low technological development. The West African Network for Peace-building Nigeria study research (WANEP, 2017) stated that climate change could decrease Nigeria's economic productivity by up to 11 percent by 2020, and up to 30 percent by 2050.

According to the Food and Agricultural Organization [FAO] (2005; 2007) report, agricultural productivity is projected to decline by 10 to 25 per cent by 2080, and by up to 50 per cent in some northern regions of the country with the increasing threat of desert encroachment rapidly reducing surface water amount, flora and fauna resources and leaving resourceful poor farmers of the regions the most improvised in the world, faced with the prospects of tragic crop failures, reduced agricultural productivity, increased hunger, poverty, malnutrition and diseases (Obioha, 2008, 2009; Zoellick and Robert 2009).

The United Nations institutions and processes have long been highlighting the importance of strengthening resilience in order to support smallholder livelihoods and long-term food security under a changing environment faced with volatile market (De Schutter, 2008; FAO, 2008; United Nations, 2015). Currently, climate resilience efforts encompass social, economic, technological, and political strategies that are being implemented at all scales of society especially in crop production. From local community action to global treaties, addressing climate resilience is becoming a priority, although it could be argued that a significant amount of the theory is yet to be translated into practice. Despite this, there is a robust and ever-growing movement fuelled by local and national bodies alike geared towards building and improving climate resilience especially in grain production (Tschakert and Dietrich, 2010; Collins, 2012; Ciani and Romano, 2013).

Several studies have been conducted in Nigeria to assess farmers adaptation strategies to climate change. Some of them are assessed in order to put this study in proper perspectives. Odjugo (2010) examined the adaptation and resilience strategies to climate change among several states in the semi-arid region of Nigeria. The study purposively selected Sokoto, Zamfara and Yobe states as study areas. Rainfall and temperature data for 70 years were used. The results showed that the change in climatic condition has impacted negatively on crops grown in the selected States which has led to shortage of food in the area. Based on adaptation strategies, the farmers adjusted their choices of crops produced to suit the prevailing climatic conditions occasioned by climate change. The farmers were forced to shift the cultivation of sorghum as their best crop to millet followed by maize (2-3 months duration). This study only mentioned shift in crop production as adaptation to climate change.

Shuaibu et al., (2014) highlighted adaptive strategies among farmers in different locations (Ethiopia), Coastal Orissa area (India), Gaza Province (Mozambique), Ondo (Nigeria) and two districts in Eastern Zimbabwe. It was noted that the coping mechanisms adopted by farmers suggest that actions changed with different situations. Furthermore, it was noted that the sustainability of most of these coping strategies is questionable due to overdependence on the use of natural resources. It was thus suggested that for greater sustainability of the strategies, there is an urgent need to find sustainability livelihood strategies of life. This would only be possible through materialization of existing policies and programmes allocation of resources and building capacity of farm households.

WANEP (2017) report conducted in Kebbi and Adamawa States tried to compare adaptive strategies of farmers to climate change in two extreme parts of the north. The research noted that the climate change saga has brought additional uncertainty and risk to Nigeria's largely small-scale food system. It stated that the expanding desert belt caused by deforestation have reduced the amount of land available for farming, adding that decline in rainfall at a rate of 3 to 4 mm percent per decade has negatively impacted crop yields.

The fact that rural communities in the dry lands of Africa have survived till date with fast population growth rates indicates that they have developed certain strategies that reduce their vulnerability and enhanced resilience to adverse climate stress especially on crop production (Nelson et al., 2017). However, the durability of these strategies has become questionable with the advancement in science and technology. Adger (2003) reported that there is widespread interest of the impacts of climate change on agriculture in sub-Saharan Africa and on the most effective investments to assist resilience and adaptation to these changes, yet the scientific bases for estimating production risks and prioritizing investments has been quite limited.

Kaltungo LGA have remained a farming community that have been responsible for the production of food crops and livestock that are sold in the neighboring city of Gombe town and environs. There has been a steady decline in this productive capacity down the years as a result of climate change. Most examined literatures, apart from been conducted outside the north-east where climate change effects are more pronounced, there is a growing concern in the evolution of climate change adaptation strategies by these farmers. However, whether the farmers in Kaltungo LGA are aware of climate change and modern climate change adaptation measures is a question left unanswered. This is the essence of this research using Nafada LGA as the spatial focus. The specific objectives are to assess the climate change effects in the study area, farmers adaptation strategies to climate change and barriers to farmers adaptation strategies.

2. Study Area

Kaltungo LGA of Gombe State is located between latitude 9º45′48″N to 9º53′38″N of the equator and between longitudes 11º18′32″E to 10º37′35″E of the Greenwich Meridian. Its headquarters is in the town of Kaltungo (Figure 1). It has a landmark area of 881Km^2. The population of Kaltungo is 183,000 (NPC, 2016). Kaltungo LGA is located within the sub-Sudan climatic zone, experiences the influence of north easterlies and south westerlies air masses. These two air masses determine the weather conditions of the study area which gives rise to distinct seasons of the year. The north easterlies air masses are prevalent from October to March and the influence of the south western air-masses from April to September. The study area receives an average precipitation between 900-1,000mm in 7 months per year (Omotosho et al., 2000). There are monthly and daily rainfall variations all over Kaltungo LGA. The rainfall is concentrated between April/May to October with a single maximum in August or September. The dry season covers November to early March and April, which are usually the hottest months. The mean maximum monthly temperature of 37ºC was recorded in April and March, while the

minimum monthly temperature was about 21ºC around December and early February which is considered as tropical wet and dry type coded "Aw" according to Koppen's classification system.

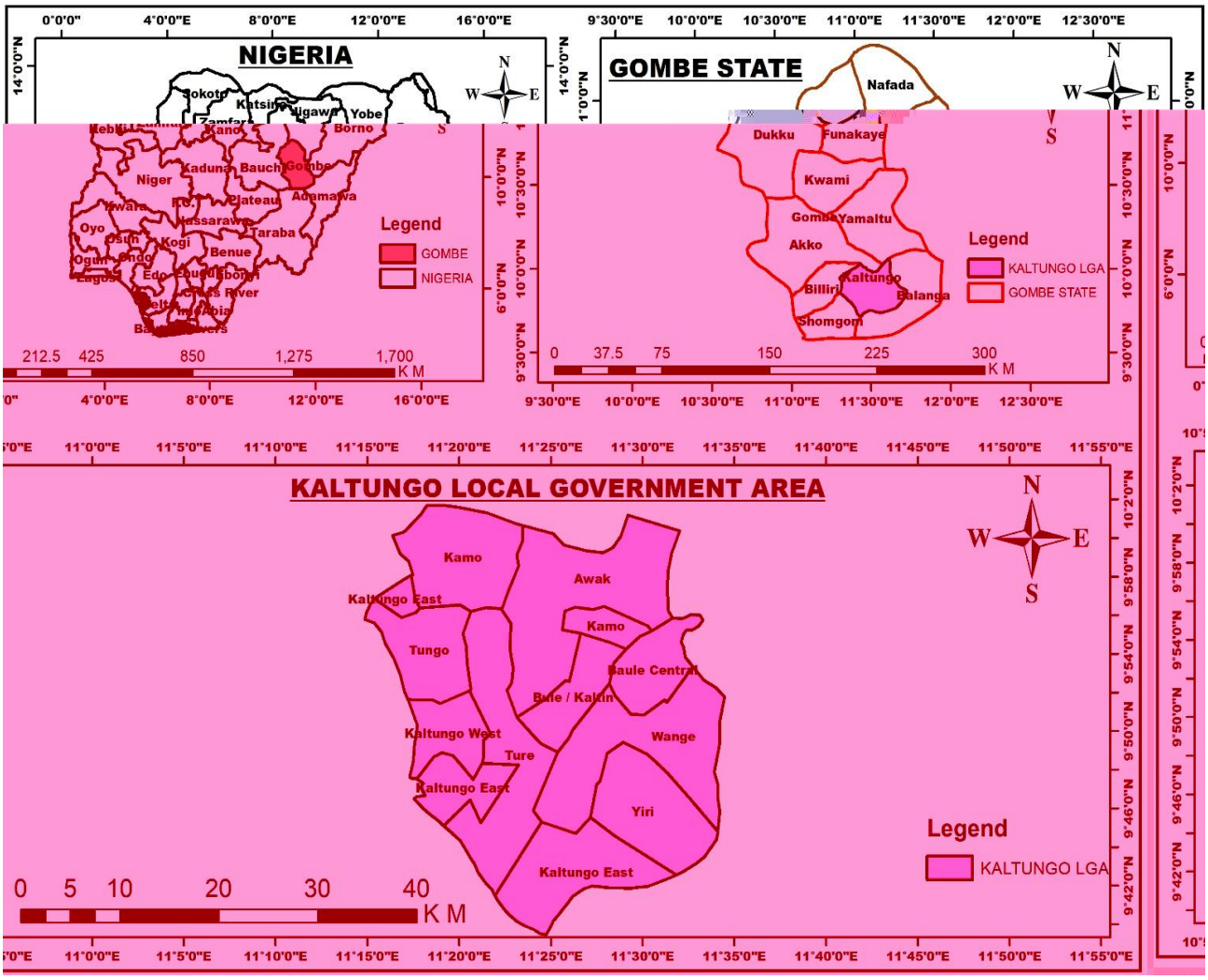

Figure 1: Map of Kaltungo LGA.
Source: Adapted from the Administrative Map of Gombe State, 2023

The vegetation of Kaltungo falls within the Sudan Savanna and the trees are measured up to three meters where some are in groups and others are isolated (Udo, 1981). Gombe state falls within three (3) distinctive Agro Ecological zones namely; Southern Guinea Savannah (SGS), Northern Guinea Savannah (NGS) and Sudan Savanna (SS)

Kaltungo LGA is characterized by moderate to high relief which stands out within the general elevation, among which is the popular Tangale peak. The topography of the area rises from 402 meters to 702 meters above mean sea level. The area is drained by the River Kaltungo which flows from the north east towards the southwest. The population of the area is about 183,000 (NPC, 2016), and the people are predominately farmers, and animal rearers. Most residents in the area use pit latrines and indiscriminate disposal of waste is carried out, these practices could be

responsible for degradation of ground water quality, and thus renders it unsuitable for human consumption.

3. Methodology

The data used for this study include data on farmers awareness of climate change, causes of climate change, effects of climate change and adaptation strategies of farmers to climate change. The study used data from both primary and secondary sources. The primary source involved the use of questionnaire in eliciting information on climate change awareness, adaptive capacity and resilience. The secondary data were obtained from record office of the Nigerian Meteorological Station (NIMET) Gombe state. The information collected from these sources gave background to the basic foundation of this study.

The study adopted structured questionnaire containing opened-ended and close-ended questions that was administered to the farmers in the study area. The sampling frame for this research is the population of Kaltungo. The total population of the study area is 183,000 people (NPC, 2016). Taro Yamane sample size determination method was adopted for this study. The formula is given below

$$n = \frac{N}{1+N(e)^2}$$

Where n =sample size
N = population size
e = error of sampling

This study allows for error of sampling on 0.05, hence the sample size is shown as follows;

$$n = \frac{183{,}000}{1+183{,}000 \quad (0.05)2}$$

$$n = \frac{183{,}000}{457.5}$$

$$n = 400$$

Therefore, a total of 400 copies of questionnaire was used for this study. The study area has 10 wards (Awak, Bule/Kaltin, Katungo East, Katungo West, Kamo, Tula-Yiri, Tula Baule, Tula Wange, Tungo and Ture). However only 8 were selected and administered questionnaire (Table 1). This selection was done according to farming outputs from the wards.

Table 1: List of Wards in Kaltungo LGA and Selected Wards (n=400)

Wards	Selected Wards	No of Questionnaire Administered
Awak	Awak	50
Bule/Kaltin	Bule/Kaltin	50
Katungo East		
Katungo West		
Kamo	Kamo	50
Tula-Yiri	Tula-Yiri	50
Tula Baule	Tula Baule	50
Tula Wange	Tula Wange	50
Tungo	Tungo	50
Ture	Ture	50

Source: Author's Analysis 2023

In order to ensure fair representation, equal number of copies of questionnaire was administered to these eight (8) selected wards using simple random sampling technique. The of the 8 selected districts.

questionnaires were distributed to farmers during the farming season. Therefore, a total of 50 copies of questionnaire was administered to each

4. Data Analysis

Data collected through questionnaire survey was analyzed using frequency tables and percentages. In order to achieve the objectives of this study descriptive statistics in form of tables and charts was used. Mean ranking of responses from the farmers were collected. Effectiveness of Farmers' Perception on Climate Change Effects Weighted Value (EFPCCEWV) developed by Saaty (1993) in Ajiboye (2015) after modification was used to know which of the responses is most severe effect of climate change in the study area. Relative Importance Index (RII) was used to ascertain the greatest barrier to climate change adaptation in the study area. Students t-test was then used to ascertain whether there is significant variation in climate change adaptation strategies across the selected wards.

5. Results and Discussions

5.1 Demographic and Socio-Economic Characteristics of Respondents

The demographic characteristics of the farmers assessed as shown in Table 2 revealed that men are more (90%) when compared with their female counterparts (10%). This is because farming is quite a tedious activity that may not be fitting for females. This is in addition to the cultural and religious factors limiting female involvement in farming which is typical of the Hausa dominated Muslim communities in northern Nigeria. The marital status of respondents revealed that 63% are married, 24% are single, 7% are divorced/separated while 6% are widowed. This means that most farmers in the study area are married which is connected to the aforementioned culture of the people that allows early marriage. This assertion is confirmed by the finding of Oladokun and Ishola (2010) where the researchers opined that most regions in Northern Nigeria have higher population which is a product of early marriage

.

Table 2: Demographic and Socio-Economic Characteristics of Respondents

Sex	Frequency	Percentage
Male	359	90
Female	41	10
Total	400	100
Marital status		
Married	254	63
Single	94	24
Divorced/Separated	27	7
Widow/Widower	25	6
Total	400	100
Age (Years)		
20-29	52	13
30-39	89	22
40-49	114	29
50-59	96	24
60 and above	49	12
Total	400	100
Highest Educational Level		
No formal education	41	10
Primary school	147	37
Secondary school	194	48
Tertiary	18	5
Total	400	100
Monthly Income		
Less than ₦20000	32	8
₦21000 - ₦40000	166	41
₦41000 - ₦60000	119	30
₦61000 - ₦80000	44	11
₦80000 and above	39	10
Total	400	100

Source: Authors Survey, 2023

It was also revealed that 51% of the respondents were of the age ranges of 30-49 years, followed by those of age range of 50-59 years (24%) while the least were those of 60 years and above with 12%. This is an indication that most farmers in the study area are adults. The advantage of having these age group is that most respondents will probably have adequate knowledge of the subject matter. According to Amin (1994) and Ali (2004), age is one of the factors that affects the ability of people to independently and efficiently provide solutions to problems.

The socio-economic characteristics revealed that majority (48%) of the farmers have completed their secondary education, 37% have primary school certificates while 10% have no formal education. From the distribution here, it implies that the population used in this study are quite

literate and should be able to respond well and provide the study with adequate information. This finding is supported by Odeleye and Oyekanmin (2013) who stated that educational level is very important as it increases an individual's ability to obtain, analyze and interpret information and use their resources efficiently.

Indeed, income is a major socioeconomic index because it determines the standard of living of the farmers. Most (41%) of the respondents earn ₦21000 - ₦40000 monthly, 30% earn ₦41000 - ₦60000 while 8% earn less than ₦20000. The low income is tied to the low educational level of the farmers. Although, most of the respondents earn slightly above the minimum wage of ₦30000, however, considering the current economic realities, this income level is quite low. This result is in consonance with Ali (2004) who reported that fishing, farming, marketing, petty trading, transportation and hand crafts are some of the informal sectors whose return is considered very low.

5.2 Climate Change Effects in the Study Area

Awareness of Climate Change

Climate change awareness is the conditions of being aware or conscious and able to understand what is happening as regards to changing climate within an environment. The awareness of climate change as an environmental challenge determines to a great extent the actions and inactions of persons exposed. Figure 2 shows that 92% of the farmers are aware of climate change while 8% are unaware

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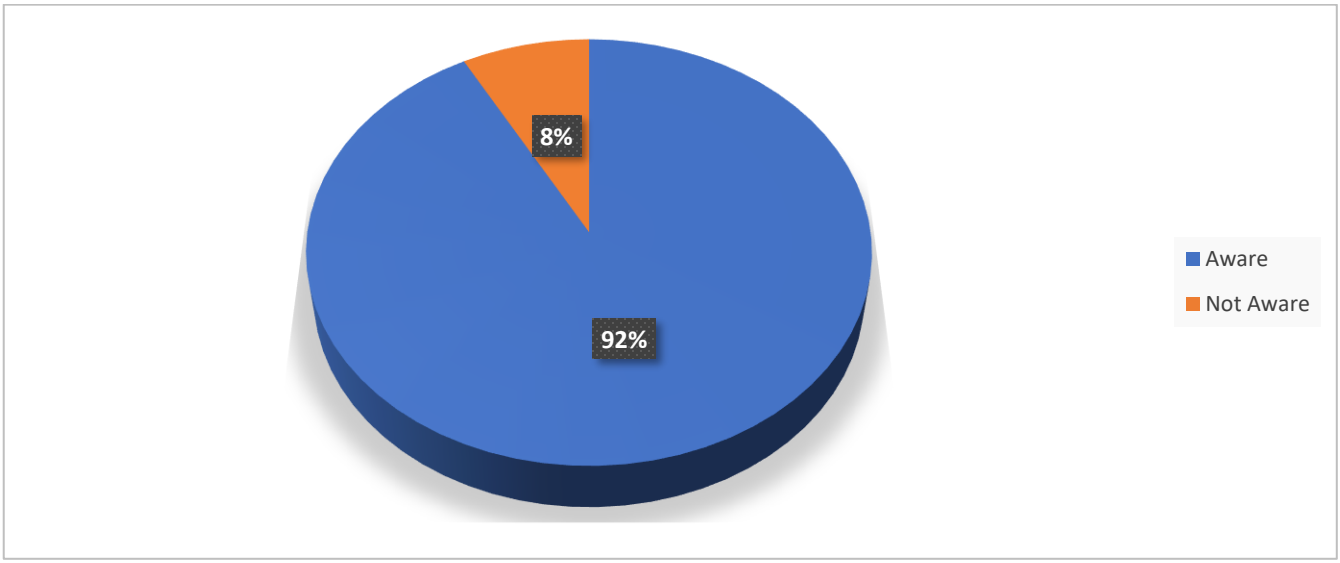

Figure 2: Awareness of Climate Change in the Study Area
Source: Authors Survey, 2023

Furthermore, Figure 3 shows that majority (41%) of the farmers consider climate change as an act of God, 31% opined that it is a natural phenomenon while 15% blamed climate change on neglect of traditional values on environmental protection and technological advancement. The least cause of climate change as revealed by the farmers is human activities, especially deforestation and bush burning as opined by 6% of the respondents

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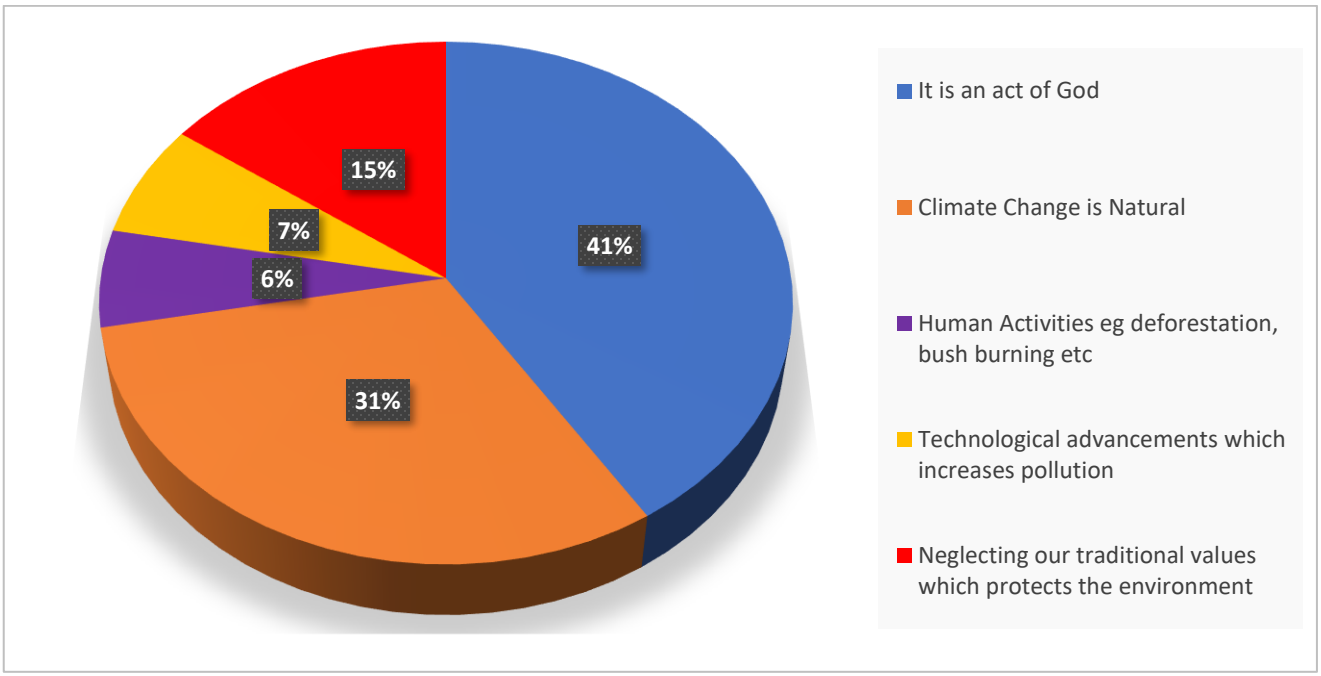

Figure 3: Causes of Climate Change in the Study Area
Source: Authors Survey, 2023

The perceptual assessment of causes of climate change as revealed by farmers in the study area contradicts the work of Umar et al., (2015) where the researchers observed that human activities was the major cause of climate change as identified by farming households in Dutsin Ma and Ajiwa in Katsina state.

5.3 Effectiveness of Farmers Perception to Effects of Climate Change in the Study Area

In order to ascertain the effectiveness level of farmers' perception to climate change effects in the study area, Likert scale was used. This was explained using eight (8) indicators classified as highly aware (5), aware (4), neutral/undecided (3), unaware (2) and highly unaware (1). Table 4 reveals that the highest mean ($\bar{X}$) is 4.34, while the least is 2.29. The average mean is 3.16. The range of Effectiveness of Farmers' Perception to Climate Change Effects Index (EFPCCEI) variable is 2.05.

Table 4: Effectiveness of Farmers' Perception to Climate Change Effects

Indicators of Climate Change Effects	Ratings					EFPECCWV	EFPCCEWV /Total Respondents (X)	Mean ($\bar{X}$)	$X - \bar{X}$	$(X - \bar{X})^2$
	5	**4**	**3**	**2**	**1**					
Insufficient/shortage of food supply in recent years	131	82	51	76	60	1348	3.37	3.16	0.21	0.0441
Agricultural drought and insufficient water for irrigation and domestic uses in recent years	113	61	48	79	99	1210	3.01	3.16	-0.14	0.0196
Increase in crop infestation by pests and diseases	67	67	18	106	142	1011	2.52	3.16	-0.64	0.4069
Shift in crop(s) cultivated	81	35	17	54	213	917	2.29	3.16	-0.88	0.7744
Flooding of farmlands and residential areas	109	152	21	81	37	1415	3.54	3.16	0.39	0.1521
Migrating sand dunes burying arable lands	41	52	33	141	133	927	2.32	3.16	-0.84	0.7056
Increase in poverty, migration and clashes with herdsmen and villagers	241	102	24	18	15	1736	4.34	3.16	1.18	1.3924
Decrease in grain yield	189	101	31	28	51	1549	3.87	3.16	0.72	0.5184
Total							**25.26**			**4.0135**

EFPECCWV = Effectiveness of Farmers' Perception on Climate Change Effects Weighted Value (EFPCCEWV)

Mean ($\bar{X}$) = ($\sum = \frac{\text{EFPCCEWV}}{\textit{Total Respondents}}$) ÷ Number of Indicators

Source: Author's Analysis, 2023

The farmers perception on climate change effects with high positive deviation above the mean include, increase in poverty, migration and clashes with herdsmen and villagers (4.34), decrease in grain yield (3.87), flooding of farmlands and residential areas (3.54) and insufficient/shortage of food supply in recent years (3.37). On the other hand, the farmers perception on climate change effects with negative deviation are agricultural drought and insufficient water for irrigation and domestic uses in recent years (3.01), increase in crop infestation by pests and diseases (2.52), migrating sand dunes burying arable lands (2.32) and shift in crops cultivated (2.29).

The implication of this result is that farmers considered the factors with positive deviations as the major effects of climate change in the study area while the factors with negative deviations were the least effects of climate change in the study area. The result corroborates the work of Odjugo (2010) where the researcher opined that flooding, farmer-herders clashes and reduced grain yield were the major effects of climate change in Nigeria. However, it contradicts the work of Sawa (2010) where the researcher revealed that farmers only consideration of climate change effects is mostly in relation to rainfall onset and cessation.

5.4 Farmers Adaptation Strategies to Climate Change in the Study Area

Climate change adaptation strategies is the practice of identifying options or methods to adapt to climate change and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency and feasibility. Therefore, in order to examine the climate change adaptation strategies adopted in the study area, farmers were asked to identify measures they practice from a list of ten (10) likely actions (each respondent picked more than one choice). This is shown in Table 5. From Table 5, it was deduced that 45.07% of the farmers in the study area never practice the climate change adaptation strategies outlined, 39.65% always practice the strategies while 15.28% sometimes practice these strategies. Furthermore, most farmers never practice reforestation/afforestation, soil conservation/use of irrigation system and changes in timing of their land preparation as affirmed by 85.25%, 78.75% and 72.5% of the respondents respectively. The most practiced adaptation to climate change in the study area is early planting/late planting (86.25%), mixed farming (61.25%) and accessing loans, grants or subsidies. On the other hand, farmers sometimes make use of chemicals (insecticides and herbicides) and climate sensitive seeds as opined by 41.75% and 31% of the respondents respectively.

Table 5: Farmers Adaptation Strategies in the Study Area

Farmers Adaptation Strategies	Never Practiced	Sometimes Practiced	Always Practiced	Total
Early and late planting	25 (6.25%)	30 (7.5%)	345 (86.25%)	400 (100%)
Changing the timing of land preparation	290 (72.5%)	82 (20.5%)	28 (7%)	400 (100%)
Soil conservation/use of irrigation system	315 (78.75%)	10 (2.5%)	75 (18.75%)	400 (100%)
Use of climate sensitive seeds	185 (46.25%)	124 (31%)	91 (22.75%)	400 (100%)
Reforestation/Afforestation	341 (85.25%)	19 (4.75%)	40 (10%)	400 (100%)
Increased use of chemicals like herbicide, insecticide	79 (19.75%)	167 (41.75%)	154 (38.5%)	400 (100%)
Increase weeding frequency	210 (52.5%)	18 (4.5%)	172 (43%)	400 (100%)
Mixed farming practices	101 (25.25%)	54 (13.5%)	245 (61.25%)	400 (100%)
Use of organic manure/inorganic fertilizer	175 (43.75%)	33 (8.25%)	192 (48%)	400 (100%)
Loans, grants and subsidies	82 (20.5%)	74 (18.5%)	244 (61%)	400 (100%)
Total Frequency	1803	611	1586	4000
Relative Percentage	45.07%	15.28%	39.65%	100%

Source: Authors Survey, 2023

Generally, it can be seen that farmers have higher non-compliance with climate change adaptation strategies as most of the farmers never practice them. Possible explanation for this is the ignorance of the importance of these practices, the expensive nature of some adaptation measures, their perception on the causes of climate change as aforementioned and the dependence on indigenous methods birthed by the farmers such as local rainfall prediction methods, among others.

5.5 Test of Significance of Variation in Climate Change Adaptation Strategy in the Study Area

Students t-test was used to test whether there was statistical evidence to show that there was significant variation in climate change adaptation strategies employed by farmers in the study area and the results are presented in Table 6. Generally, if the calculated P-value is greater than 0.05, it

This result corroborates the work of Nelson et al., (2017) where the researchers observed that most farmers do not comply to climate change and other environmental extremes adaptation strategies. Rather what is obtainable is that farmers evolve indigenous techniques to survive episodes of climate variabilities as they occur. However, in comparison with the study area, there is a measure of compliance with climate change adaptation strategies with 39.65% always practicing these strategies.

therefore indicates that there is no significant statistical evidence to show variation in climate change adaptation strategies between the different wards in the study area. Table 6 revealed that there was significant variation in climate change adaptation strategies in Awak, Kamo, Tula Baule, Tungo and Ture. The implication of this result is that farmers in these wards are more aware and employ most of the climate change adaptation strategies outlined and assessed.

Table 6: Students t-test Result for Variation in Climate Change Adaptation Strategies in Selected Wards in the Study Area

Wards	t-value	P-Value (0.05 Level of Significance)	Remarks
Awak	-4.791	0.005	Significant
Bule/Kaltin	-8.328	0.067	Not Significant
Kamo	-1.265	0.011	Significant
Tula-Yiri	-1.053	0.293	Not Significant
Tula Baule	-5.038	0.041	Significant
Tula Wange	-2.042	0.298	Not Significant
Tungo	-7.941	0.041	Significant
Ture	-2.606	0.000	Significant

Source: Author's Analysis (2023)

On the other hand, there was no significant difference in variation in climate change adaptation measures in Bule/Kaltin, Tula-Yiri and Tula Wange. This means that although farmers are aware of the different climate change adaptation strategies, there is no statistically significant evidence in these wards to show that they employ most of these measures

5.6 Barriers to Farmers Adaptation to Climate Change in the Study Area

The barriers to climate change in the study area are numerous. However as revealed by Table 7, unavailability of improved seed varieties is the most prevalent barrier to climate change adaptation in the study area as revealed by a relative importance index of 0.70. This is closely followed by lack of access to water for irrigation and ignorance of current knowledge on adaptation strategies with a relative importance index of 0.68 and 0.62 respectively. The least barrier to climate change adaptation in the study area is lack of access to land with a relative importance index of 0.27.

The implication of this result is that most farmers consider the unavailability of improved seeds as the major hinderance to climate change adaptation. Possible reason for this is the ability of these climate sensitive seeds to adjust to climate extremes such as long dry spells and intense rainfall. This is in addition to the higher productivity of these seeds. The farmers also considered lack of access to land as a negligible factor because land is easily accessible to most farmers either by inheritance, lease or purchase.

Table 7: Barriers to Farmers Adaptation to Climate Change in the Study Area

S/No	Indicators	Ratings					Total	Total Likert Analysis	Relative Importance Index
		5	4	3	2	1			
1	Unavailability of improved seed varieties	41	254	19	27	59	400	1391	0.70
2	Lack of access to water for irrigation	96	32	211	56	5	400	1358	0.68
3	Ignorance of current knowledge on adaptation strategies	30	214	23	23	110	400	1231	0.62
4	Unavailability of proper information on weather records	19	41	304	18	18	400	1225	0.61
5	Lack of support in the form of loan, grants, subsidies from the government and non-governmental organization	51	61	144	49	95	400	1124	0.56
6	Inadequate farm extension workers services	25	41	3	102	229	400	731	0.37
7	Lack of storage facilities for harvested produce	35	29	6	20	310	400	659	0.33
8	Unstable/uncertain prices of agricultural produce	8	14	21	142	215	400	658	0.33
9	Over reliance on traditional knowledge	20	15	21	33	311	400	600	0.30
10	Lack of access to land	9	11	23	17	340	400	532	0.27

Source: Authors Survey, 2023

This result agrees with the work of Umar, et al., (2015) where the researchers observed that the major challenges faced by farmers in the north eastern region of Nigeria in their quest to adjust to climate change is shortage of water for irrigation farming and the unavailability/cost of acquiring climate sensitive seeds.

6. Conclusion

Generally, farmers in Kaltungo LGA are aware of climate change. This has greatly impacted in their productivity, hence the need to evolve adaptation strategies. The farmers perception on climate change effects revealed that climate change has increased poverty, migration and clashes with herdsmen and villagers and decreased grain yield.). Despite these obvious effects, 45.07% of the farmers in the study area never practice climate change adaptation strategies, 39.65% always practice while 15.28% sometimes practice. Although, the student's t-test revealed that there was significant variation in climate change adaptation strategies in Awak, Kamo, Tula Baule, Tungo and Ture, implying that these wards are more aware and employ most of the climate change adaptation strategies outlined and assessed. However, most farmers consider the unavailability of improved seeds as the major hinderance to climate change adaptation in the study area.

7. Recommendations

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

i. There should be a sustainable framework where farmers in the study area can assess climate sensitive seeds as this will boost their productivity.

ii. Since most farmers in the study area do not employ most of the climate change adaptation strategies assessed, there should be increased sensitization on improved climate change adaptation measures while ensuring that traditional climate change adaptation strategies are significantly modified and sustained.

iii. Since Bule/Kaltin, Tula-Yiri and Tula Wange wards showed insignificant awareness on climate change adaptation measures, there should be an awareness campaign in these areas to ensure that farmers here are not only aware but also employ cutting-edge climate change adaptation strategies.

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