

## Adaptation Strategies to Climate Variability by Pastoralists in Akko Local Government of Gombe State, Nigeria

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### Abstract

*Climate change has been threatening pastoral communities in Nigeria because their economy is mainly based on rain-fed agriculture. The study area Akko is one of the climate change prone areas affected by climate induced shocks. To reduce the adverse effects of climate change, pastoral households need to recognize the changes already happening in their climate and employ climate change adaptation measures. Therefore, the present study was conducted in Akko, LGA, Gombe State, Nigeria. The study intends to determine the perceived adverse impacts of climate change and variability, the perception of pastoral households on the patterns of climate change and variability, and identify the adaptation/coping strategies of pastoralists to climate change impacts. A household questionnaire survey was employed to collect primary data at a household level. A total of 150 pastoral households were sampled using random sampling. The data collected from household survey were analysed using SPSS (version 20). The trend line analysis of rainfall and temperature of the study area was done to ascertain the trend in rainfall and temperature. The findings indicate significant decreasing trend in rainfall and increasing trend in temperature. The perception of pastoral households on rainfall and temperature trends was in line with the results of the recorded meteorological data analysis of the present study. The results indicated that pasture and water availability became scarce (index=372, R1), pastoralists have to move longer distance for pasture (index=364, R2), there was decrease in forage availability (index=363, R3) and reduction in income from livestock (index= 360, R4). The most important strategies deployed by the pastoralists included destocking of livestock ( $\bar{x}$  =3.1), Herd migration ( $\bar{x}$  =3.1), Off-farm activities ( $\bar{x}$  =3.1), integrating livestock with crop production ( $\bar{x}$  =3.2), herd diversification ( $\bar{x}$  =3.2), use of crop residue ( $\bar{x}$  =3.0) and rain water harvest ( $\bar{x}$  =3.0). Therefore, the study recommends that the government should support and enhance household's indigenous adaptation strategies through the provision of access market. Provide early warning information. Provision of affordable credit facilities, and development of adequate water points.*

**Keywords: Adaptation, Climate variability, Gombe, Pastoralists, Strategies**

### INTRODUCTION

Climate variability manifestations through extreme temperature, frequent flooding and drought have become a continuing subject of dispute worldwide. However, there is a wide acceptance by stakeholders that climate change will affect all nations especially the developing ones like those in Africa (Nicholas *et al.*, 2012). Correspondingly, the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007) predicted that Africa is highly vulnerable to the various manifestations of climate change and had affirmed that reservations about climate change are inappropriate considering apparent evidences from

scientific observations of increases in global average air and ocean temperatures.

Climate variability is variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. It is therefore changes in climate which occur on shorter time periods. Variability may result from natural internal processes within the climate system (internal variability) or from variations in natural or anthropogenic external forcing (external variability) (IPCC, 2001). The persistent climate variations and the resultant increase in temperature have made some localities to experience excessive weather

conditions in the form of floods, droughts, and heat waves, with devastating effects on human existence, agricultural productivity and food security. (Ayoade, 1995; Olaniran, 2002).

The foremost impact of climate change on herders is the loss of livestock, which results in reduction in the food supply to the ever increasing population, especially in Africa (Clarke et al., 2012). Other studies have shown that the reductions in the number of cattle are due to death caused by lack of green pasture during extreme drought events, disease and starvation, as herders do not have enough fund to buy processed food for the cattle (Kabonesa and Kindi, 2013, Ojima et al., 2017, Roever et al., 2015). Nonetheless, the response of herders to climate change varies greatly due to differences in their adaptive capacities (Grothmann and Patt, 2005, Martin et al., 2008). Herders' responses to climate change are determined by many factors. It has been reported that farmers' experiences, level of education, lack of confidence on protective measures or perceived ability to carry out these measures, lack of adequate and timely information, available resources and innovation or costs of response actions are seen as the main important factors (Davies, 2016 and Ayanlade et al., 2017).

Nigeria, like many other parts of the world has witnessed many climatic anomalies with serious consequences on the environment and society. The Sudan-Sahel zone of northern Nigeria especially has suffered decrease in rainfall in the range of 30-40% or 3-4% per decade since the beginning of nineteenth century (Ojo, 1985; Adejuwon, Balogun, and Adejuwon, 1990). This semi-arid area besides has experienced inter-annual climatic variability, droughts and desertification since the 1960s and that this situation could be worsened by the expected decrease in rainfall (Sawa, 2010). Gombe State, like many other States in northern Nigeria, have histories of rampant clashes between pastoralists and sedentary farmers. These conflicts often occur in seasons when rainfall is very low and the graze lands are incapable of sustaining the population of livestock owing to shortage in pasture availability. There are many recent attempts to understand how communities are adjusting their livelihoods strategies to cope with this variability (Eriksen and Lind, 2009; Notenbaert et al., 2007; Stigter et al., 2005; Galvin et al., 2004).

To compensate for this deficiency in pasture, Fulani headsmen, move their livestock to farm land areas for grazing, which has resulted to violent conflicts between the headsmen and farmers. In addition, Gombe States presently are among the states has the incidence of cattle rustling in northeastern part of the country. Cattle rustling, the stealing of grazing cattle is commonly practiced by herders whose cattle have diminished in number due to adverse effects of climate extremes and have to go into rustling in order to make up for the loss. Hence, it is to be noted that in most African countries including Nigeria, a basic causal mechanism links climate change with violence. Hence, poor responses to climatic shifts create shortages of resources such as land and water. Moreover, inappropriate adaptive responses resulting in damage to crops and blocking of transhumant corridors have caused violent conflicts between crop farmers and pastoralists.

The aim of this research is to analyse the adaptation strategies to climate variability by pastoralists in Akko local government of Gombe State, Nigeria. However, the specific objectives are to assess the perception of the pastoralists on climate change and variability; analyse the trends of climate change and variability using observed data; assess the perceived impacts of climate change and variability on pastoralists and identify local adaptation strategies to climate change and variability.

The choice of the study area is informed by the high population of pastoralists, who constitute over 80% of the people and for their relatively large number of grazing reserves. Akko local government also serve as a transit zone for pastoralists migrating from neighboring local government and States. The frequency and scale of conflicts between farmers and herders in these State is highly alarming. Today, farmers-nomad conflict is second to *Boko-Haram* among dangers threatening Nigeria. These conflicts, which are triggered by climate fluctuations have resulted in loss of lives, properties and environmental degradation (Kehinde, 2014).

Therefore, studies that address climatic trends and pastoralists' activities in Nigeria and in particular the study area are justifiable. This is because of its peculiarity to the contemporary socio-economic activities going on in the study area. The findings and recommendations of this research will go a long way to assist the pastoralists in

understanding how to respond to the current upsurge in climate change. The information on the past and present climatic trends would be used to forecast future events so as to cope with the incidence of drought, flooding and other climate related hazards. In addition, the findings of this research would enrich the existing literature on the effects of climate change on development processes in the arid regions. In the same vein, they will assist the government and policy makers to reflect in the national policy or planning framework needs or issues critical to pastoral communities.

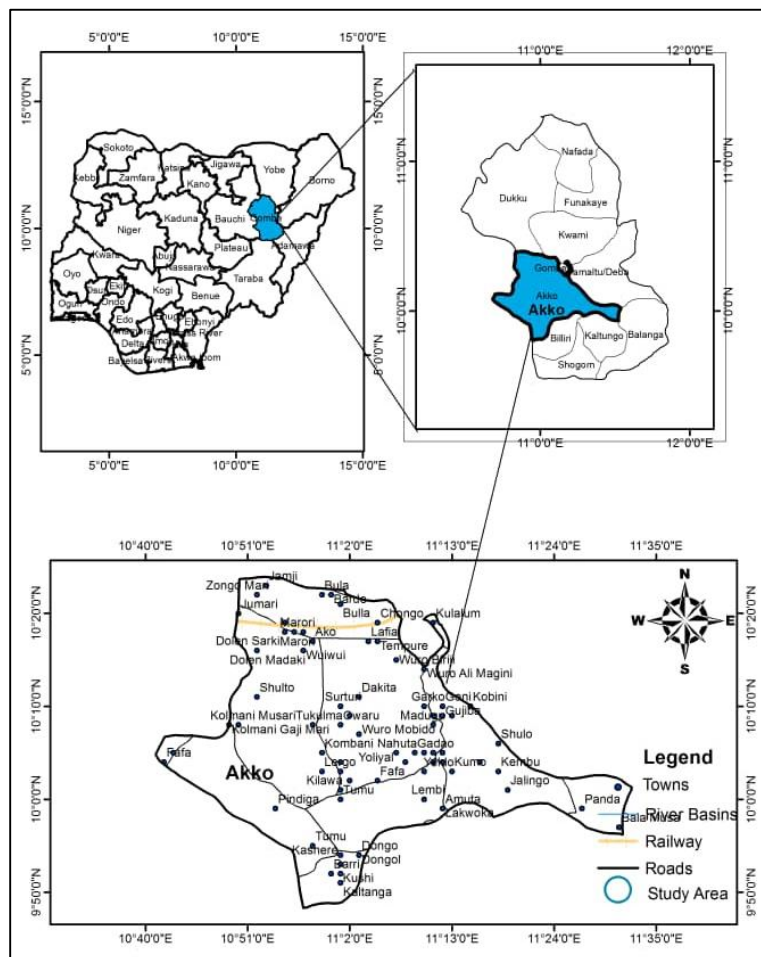
The study covered selected rural settlements in Akko local government area in Gombe State. The content scope is to analyze the adaptation strategies to climate variability by pastoralists. It covered rainfall and temperature records: temperature and rainfall intensity and variability, changes in the onset, cessation and

duration of seasons, the occurrence of extreme weather events such as flood and drought, pastoralists' perceptions and vulnerabilities to climate change and their mitigation practices and the effect of climatic variability on the socio-economic activities of pastoralists.

## MATERIALS AND METHODS

### Study Area.

Akko local government area is situated in the present of Gombe State of Nigeria. It lies south of Gombe between latitude  $10^{\circ} 17' 00''N$ ,  $10^{\circ} 58'00''E$  and longitude  $10^{\circ}28'33''N$   $10^{\circ}96'67''E$ . Akko local government area is bounded in the North by Gombe local government area, to the South by Billiri local government and Kaltungo local government area, to the west by Bauchi state (Figure 1)



**Figure 1** Akko Local Government Area, Gombe State

Source: GIS and Remote Sensing Unit, Department of Geography, Gombe State University

The topography of the study area is made up of mainly vast undulating plains stretching for several kilometres. This extensive plain land contains some prominent hills. The elevation of the land ranges between 300 to 340 meters above sea level. The vegetation is a grassland dotted with trees which are usually stunted with hard bark to reduce evaporation. Shrubs and herbs are common characteristics of this Vegetation. Trees include Neem, Acacia, Palm, Silk Cotton and Baobab trees. Most of the trees shed their leaves during the dry Season thus adapting to the hard conditions.

**Methodology**

Primary and secondary types of data were used in this study. Primary data were sourced via the use of questionnaire, personal interview and observations, while secondary data were sourced through literature from different sources, like journals, magazines, internet and newspaper, Nigerian Meteorological Agency (Nimet) etc. Multi-stage sampling technique was used for the study. Firstly, clustered sampling was used to divide Kumo into three based on geographical zones of North, Central and South respectively. Secondly, purposive sampling was used to select three wards already identified as having predominant herding activities i.e. one ward per zone. Thirdly, systematic sampling technique was employed to select actual settlements from which respondents would be drawn. Consequently, all settlements per ward were listed alphabetically and the first and second settlement from each ward were chosen to make a total of six communities (Table 1). The total population of selected communities in Kumo is 3,389 (NPC, 1991). The 1991 NPC census figures were used for the reason that it was given at the

localities level, which is required for this research, and the 2006 census report was inadequate because it was given at local government level. To obtain the sample size, population of the community was projected to 2020 using exponential formula with 3.2% inter-census growth rates for Gombe State (NPC, 2006). This gave a population size of 6,869 (Table 1). The population projection formula is given as:

$$P_n = r/100 \times P_o + P_z \dots \dots \dots \text{(Equation 1)}$$

Where:

$P_n$  = Population of year to be projected to (in this case 2020)

$P_o$  = Base year population (i.e. 1991 population which is given as 3,389)

$r$  = Inter census growth rate (i.e. 3.2% for Gombe State given by NPC 2006)

$P_z$  = Previous year (i.e. the year that precedes the year under consideration)

The sample size for this study was derived using Bless and Higson -Smith (2000) formula given as:

$$\text{Sample Size} = \frac{(Z\text{-score})^2 \times \text{Std Dev} (1\text{-StdDev})}{(\text{margin of error})^2}$$

Using 95 percent confidence level (equivalent to a z-score of 1.96), 0.5 Standard Deviation and a margin of error (confidence interval) of +/-5 percent (0.05), the sample size is calculated as 384.

The data collected through the structured questionnaires and other secondary data were analysed with the aid of descriptive statistics such as percentages, counts, arithmetic mean etc.

**Table 1** Selective settlements and distribution sample size by community

Division of Kumo Area	Selected ward	Selected community	Population 1991	Projected population 2020	Sample size
Kumo central	Garin Garba	GarinGarba	186	455	25
		Jalingo	153	374	21
Kumo North	Jauro Tukur	Kembu Kumo	343	839	47
		Lergo	1835	4,489	251
Kumo South	Mararraban Tumu	Panda	167	409	23
		Shabbal	124	303	17
3	3	6	3,389	6,869	384

Source: Author's compilation, 2022

## RESULTS AND DISCUSSION

### Socio-economic Characteristics of Respondents

The social and economic attributes of the respondents are presented in Table 2. These include gender, age, marital status and educational level of the respondent. Information on the gender of respondents is captured in Table 2. Results in the

Table shows that 215 respondents representing 56% are males and 169 respondents representing 44% are females. This means that males dominate the study. Hence, it can be deduced from the foregoing results that herding activity is controlled by men in the study area.

**Table 2** Socio-economic and demographic characteristics of the respondents

S/N.	Characteristics	Variables	Number	Percentage
1	Sex	Male	215	56
		Female	169	44
2	Age	Less than 25 years	77	20
		25 – 35 years	65	17
		36 – 45 years	88	23
		46 – 55 years	81	21
		56 and above year	73	19
3	Marital Status	Single	119	31
		Married	165	43
		Separated	69	18
		Widow	31	08
4	Education	Tertiary	31	08
		Secondary	58	15
		Primary	115	30
		Informal	180	47

Source: Field work, 2022

Again, Table 2 depicted information on the ages of respondents. Results indicated that 77 respondents representing 20% are below 25 years of age, 65 respondents representing 17% are between 25 – 35 years, 88 respondents representing 23% lies within 36 – 45 years, 81 respondents representing 21% ranges from 46 – 55 years and 73 respondents representing 19% are in the age bracket of 56 and above. This implies that majority of the respondents (61%) lies within the age bracket of 25 -55 years. This further shows that more than half of the pastoralists in the study area are in their active years and hence capable of carrying out herding activities which require hard labour.

Moreover, Table 2 presents information on the marital status of respondents in the study area. Results indicates that majority (43%) of the respondents are married, 31% are single, 18% are separated and 8% are widowed. This by implication shows that a greater percentage of the pastoralists are married indicating that there is enough labour force to cope with herding activities since married people are expected to give birth to children and herding occupation is labour intensive.

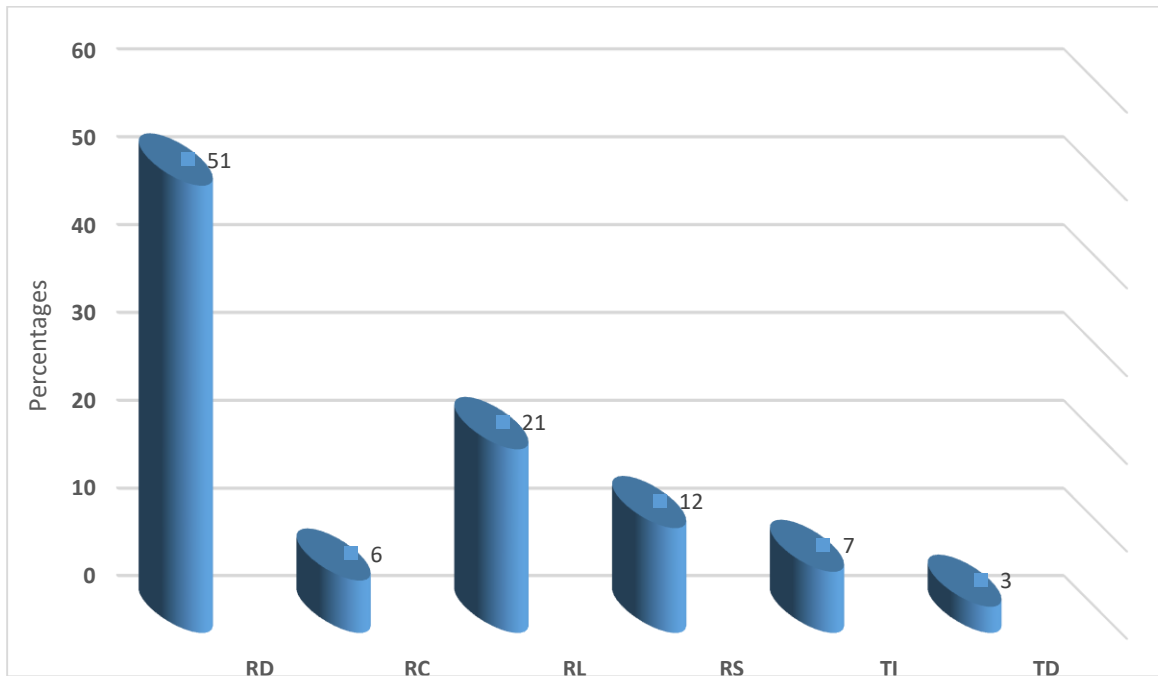
In addition, information on respondents' level of education is depicted in Table 2. Results revealed that a greater percentage (47%) of the respondents had informal education, 30% attained primary education, 15% obtained secondary education and 08% had tertiary education. This implies that pastoralists in the study area are literate to varying degrees. The predominance of informal education most probably Islam is not unconnected to the fact that the study area is Muslim dominated and Fulani are devotees of Islamic religion.

### Pastoralists' Perception on Climate Change and Variability

Table 4 presents information on pastoralists' perception of climate variability and change in the study area. Perceptions of pastoral households were assessed on the trends of rainfall and temperature three decades ago. Results revealed that 51% of the respondents perceived that the rainfall has declined; 6% noted that rainfall comes early now than three decades ago, 21% observed that rainfall comes late and 12% alleged that rainfall ceases short from the normal rainy season. In addition, 7% of the

respondents purported that temperature has increased while 3% of the respondents claimed that the temperature has decreased. It is important to note that the rising temperature and decrease in

rainfall is in agreement with the findings of the observed data analysis. Thus, pastoralists' knowledge indicated a good match with the scientific knowledge.



**Figure 2** Pastoralists' perception of climate variability and change

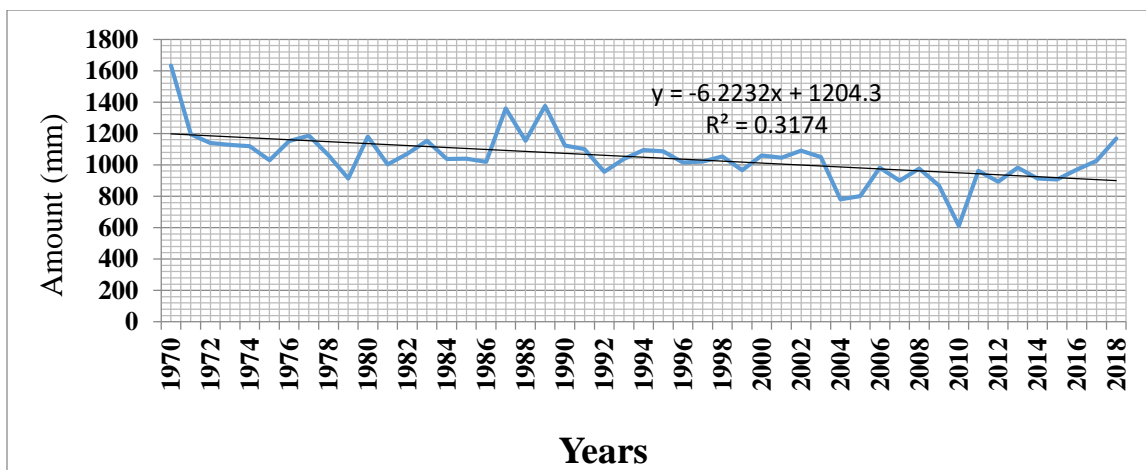
Source: Field work, 2022.

**RD-** Rainfall has declined as compared to three decades ago; **RC-** Rainfall comes early now than three decades ago; **RL-** Rainfall comes late now than three decades ago; **RS-** Rainfall ceases short from the normal rainy season; **TI-** Temperature has increased now than three decades ago; **TD-** Temperature has decreased now than three decades ago.

**Trends of Rainfall and Temperature**

Trend Analysis of Gombe state has been done

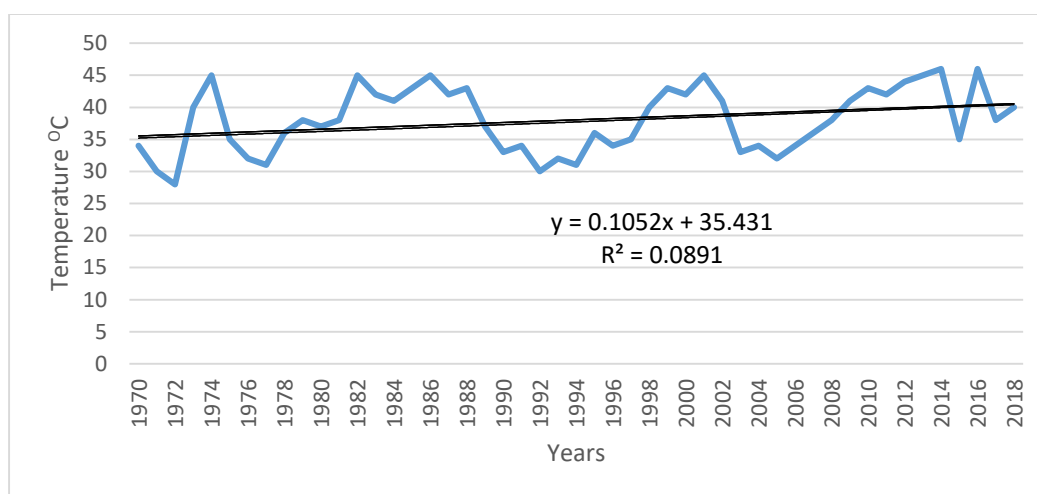
with over 40 years' temperature and rainfall data from 1970-2018 (Figure 3 and 4).



**Figure 3** Trend Mean Annual Rainfall for Gombe (1970-2018)

Source: Authors Analysis 2022

The trend line graph revealed an increasing pattern of temperature in all the zone. The mean temperature for the study period revealed an increasing rate of 0.0352°C, 0.0031°C and 0.0281°C. The annual rainfall revealed a decreasing trend at the rate -0.957mm, -2.74mm and -0.87mm.



**Figure 4** Trend Mean Temperature for Gombe(1970-2018)  
Source: Authors Analysis 2022.

### Perceived Impacts of Climate Change and Variability

The respondents were asked to choose from a three-point continuum (High, Medium and low) the major impacts of climate change on their economy and their responses are summarized on Table 3. From the impact index analysis in Table 3, the impact with the highest index (index=372) is drying up of water points. Hence, it is ranked number 1. This is followed by moving longer distance for pasture (index=364, R2), decrease in forage availability (index=363, R3) and reduction in income from livestock (index= 360, R4) respectively. This

implies that pastoralists have been impacted negatively on their livelihood activities owing to climate change and variability in the study area. The above analysis is in agreement with Mwakaje (2013), who reported that over 48% of the livestock have died due to drought over the past 10 years, that due to climate change there has been an increase in the prevalence of pests and diseases, implying increased expenditure on drugs to treat livestock and on preventive measures. The sale of weak animals as a strategy to avoid complete loss from death has resulted in very poor earnings due to low selling prices.

**Table 3** Perceived impacts climate change and variability

S/no	Impacts	High (3)	Medium(2)	Low (1)	Impact index	Ranking
	Decrease in the number of livestock	70	55	25	345	7
2	Reduction in animal performance	83	43	24	359	5
3	Decrease in forage availability	77	59	14	363	3
4	Drying up of water points	91	40	19	372	1
5	Moving longer distance for Pasture	89	36	25	364	2
6	Increased severity of livestock diseases	79	45	26	353	6
7	Reduction in Income from sale of livestock	69	72	9	360	4

Source: Field work, 2022. Note: II= Impact Index = (High X 3 + Medium X 2 + Low X 1)

### Adaptation Strategies of Pastoralists

The major adaptation strategies of pastoral households to cope with adverse effects of climate variability and change are indicated on Table 4. These are destocking of livestock, Herd migration, Off-farm activities, integrating livestock with crop production, herd diversification, use of crop residue

and rain water harvest. It is obvious from Table 4 that the adopted strategies to cope with the adverse impact of climate change and variability are effective. This is because all the developed strategies had mean above the standard mean of 2.5 indicating that they are all effective in combating climate change and variability.

**Table 4** Pastoralists' adaptation strategies

STRATEGIES	Very Effective (4)	Effective (3)	Less Effective (2)	Not Effective (1)	Mean	SD
1 Destocking/ selling of livestock	65	45	23	17	3.1	1.8
2 Herd migration / livestock mobility	73	31	27	19	3.1	1.8
3 Petty Business/ Off-farm activities	67	39	28	16	3.0	1.8
4 Integrating livestock with crop production	81	32	21	16	3.2	1.8
5 Herd Diversification	79	31	27	13	3.2	1.8
6 Use of crop residue	69	35	26	20	3.0	1.8
7 Rain water harvest	59	42	32	17	3.0	1.8

**Source:** Field work, 2022.

### CONCLUSION

The study affirmed that long-term reduced trend of rainfall, rainfall variability and increased temperature along with household's poor access to basic services adversely affected pastoralists. Pastoralists have lost a large number of cattle and agricultural productivity has declined. There have been attempts to adapt to the effects of climate change. These include herd migration. However, migration has had an adverse impact on pastoralists' children, who, instead of attending school, are forced to remain at home to take care of the cattle. Attempts to diversify livelihoods by establishing permanent settlements and engaging in farming as well as moving cows to other regions in search of water and grazing pastures have led to conflicts over resource use to the point of fights taking place between farmers and pastoralists, sometimes resulting in killings.

Pastoralists have also been diversifying their livelihoods through engaging in petty trade, mainly the selling of cattle, in order to buy necessities like cereals. However, the cattle that are weak due to climate change have been fetching very low prices,

and so this has not been a help in mitigating the impact of climate change.

### Recommendations

Based on the findings of the study, the following are recommended:

Government and other development organizations should invest in the multiplication of indigenous cattle that have proved to be adaptable to climate change

The keeping of goats and sheep, including dairy goats, should be promoted by the government as they are more adaptable to the effects of climate change than cattle.

Rainwater harvesting should be promoted among the pastoralist community and the country at large.

The government should improve the infrastructure to facilitate market interactions as this would enable pastoralists to earn more income.

Early warning information on climate change should be provided using different strategies so that the information is effectively communicated to pastoralists.



- vi. Formal/customary land tenure should be provided to protect pastoralists' communal resources from other land users and investors.

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