

Analysis of Pastoralists' Perception of and Response to Climate Variability in Malumfashi Local Government Area of Katsina State, Nigeria

Idoma Kim* and Yakubu Dan

Department of Geography, Gombe State University, Gombe, Nigeria

***Corresponding Author:** Idoma Kim, Department of Geography, Gombe State University, Gombe, Nigeria.

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Abstract

The study examined the perception of pastoralists towards climate change and variability. Data were collected via structured questionnaire administered to 200 pastoralists randomly selected from twelve communities in the study area. Trend analysis of temporal changes in rainfall and temperature covering a period of eighteen years (2000 - 2018) was conducted and compared with pastoralists' perception of climate variability. Descriptive statistics was employed to analyze the data obtained from the survey using a 5-point Likert Rating Scale. The results showed that 56% of the respondents perceived an increase in temperature and 46% observed a decrease in rainfall volume and a change in the timing of rains. Poor performance of animals and physical growth (24%) as well as reduction in forage yield (40%) were identified as major consequences of climate change. The pastoralists identified deforestation, overgrazing of farmlands and act of God as the causes of climate change. The pastoralists responded to these changes through increased nomadism, improvement of fodder production and preservation, boring of more wells and livelihoods diversification. Their local intelligence and indigenous knowledge also come to play in dealing with these environmental challenges. It is apparent that the pastoralists have a role to play on issues of climate change. Therefore, designing feasible adaptation programmes such as advanced pasture preservation practices, enhanced water harvesting development, monitoring, dissemination, and publishing of climate data periodically would enhance the adaptive capacity of pastoralists to the negative impact of climate change in the study area.

Keywords: *Adaptation; Agriculture; Climate; Pastoral; Perception*

Introduction

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global and/or regional atmosphere and which is in addition to natural climate variability observed over comparable time periods". In other words, the UNFCCC uses the term climate change to mean only those changes brought about by human activities. In recent usage, the term "climate change" often refers to changes in modern climate which according to the IPCC [1] are 90 - 95 percent likely to have been in part caused by human action.

According to various sources, Africa is one of the world's most vulnerable regions due to the fragility of its economies. The report of the Intergovernmental Panel on Climate Change [2] confirmed that in the 21st century, global warming would be more intense in Africa than in the rest of the world. Such changes will affect natural resources and all related production systems, including livestock (Gordon, 2010). Thus, the current climate variability and extreme events are adversely affecting the livestock sector, directly and indirectly by aggravating the prevalence of diseases, distorting production and minimizing the sector's profitability [3].

Therefore, individuals, communities and nations have coped with and adapted to climate variability for centuries, but the new changes may be of a magnitude and speed that overstretches traditional adaptive capacities [4]. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2001). Common adaptation methods in pastoral economies include use of new livestock species that are better suited to drier conditions, herd splitting, building up herd sizes as a buffer against shocks and loans or redistribution of livestock and other assets to family or community members [5,6].

However, pastoralism is a system that tends to exploit wild and semi-wild ecosystems to benefit domesticated animals. The most remarkable characteristic of pastoralism is movement of animals in search of pastures, and repeatedly water after feeding. Based on the pattern of movement of the livestock, pastoralism is commonly categorized into nomadic, semi-nomadic, settled (sedentary) and semi-settled (semi-sedentary) [7]. Nomadic pastoralists migrate all the time with their livestock without any permanent settlement. Semi-nomadic pastoralists spend more than half their time annually herding animals away from home or cultivated settlements. On the other hand, semi-sedentary (semi-settled) pastoralism is a system where the pastoralists settle (live in houses) during part of the year while part of the household moves with livestock to pasture. In sedentary (settled pastoralism), the pastoralists live in villages all year round while taking livestock out to pasture every day, sometimes hiring shepherds [7].

The pattern of movement for nomadic pastoralists is random, non-directional. Movement of semi-nomadic and especially semi-settled or semi-sedentary can be transhumant. This is a directional or regular back and forth movements between fixed locations, e.g. from mountains to the warmer valleys in winter and back to the mountains when it becomes warmer and frost has ceased [8].

Previous studies have investigated farmers' and pastoralists' perception of climate change and variability, and their adaptation practices in the Sudanian and Sahelian zone of Nigeria [9-11]. Though, past studies have indicated substantial diversity in awareness level of rural producers, but information on perceptions and coping strategies were hardly disentangled for different livelihood groups such as crop farmers and pastoralists. Hence, it is important to note that these groups of rural producers face divergent socio-economic circumstances, are differently vulnerable to, probably perceive, and react differently to variations in climate and weather conditions. To effectively use indigenous knowledge and to develop practical and realistic adaptation strategies to climate extremes, it is crucial to understand the perceptions of pastoralists about the existence of climate variability and its causes and consequences on their livestock system. Consequently, this study seeks to address this knowledge gap by evaluate the understanding of climate change and variability and their implications for pastoralists' livelihoods in Malumfashi Local Government Area of Katsina States.

The study documents pastoralists' perceptions of climate change and adoption of coping strategies by addressing the following research questions:

- What are the pastoralists' perceptions of climate change?
- What are the pastoralists' perceptions of causes of climate change?
- To what extent do pastoralists understand the consequences of climate variability on their livelihood activities?
- In what ways are the pastoralists responding to climate change.

Methodology

Study area

The study area of this research is Malumfashi LGA located between Latitude 7° 29' and 7° 55' North of equator and Longitude 12° 22' and 12° 52' East of Greenwich Meridian. It was created since 1976. Musawa Local Government by the North, Kankara Local Government

by the West, Gwarzo Local Government (Kano State) by the East, and Bakori Local Government by the South bound the Local Government. Malumfashi LGA has area coverage of 674km² and population of 263,762 persons/km² (The 2018 projected figures of 2006 population census). There are two seasons: the rainy season and the dry season. The rainy season lasts for five months i.e. May to September with the wettest month in August (254 mm of rainfall), while the dry season extends from November to March accompanied by dry, cool and dusty wind called harmattan.

The relative humidity falls considerable during the harmattan; with the maximum day temperature of about 33.1°C and a minimum of 19.2°C. Generally, the climate is hot and dry for many months of the year due to longitudinal location of the town, its location away from sea [12]. The Local Government is endowed with agricultural potentialities, and the People are predominantly farmers and herders. During the dry season, they engage themselves in dry season farming and petty trading to sustain their livelihood. The common animals reared in the area are cattle, sheep, goats, horses, mules, donkeys, and poultry. Both crops and animals are sources of food and cash income as well as a symbol of wealth to the inhabitants of Malumfashi LGA [13].

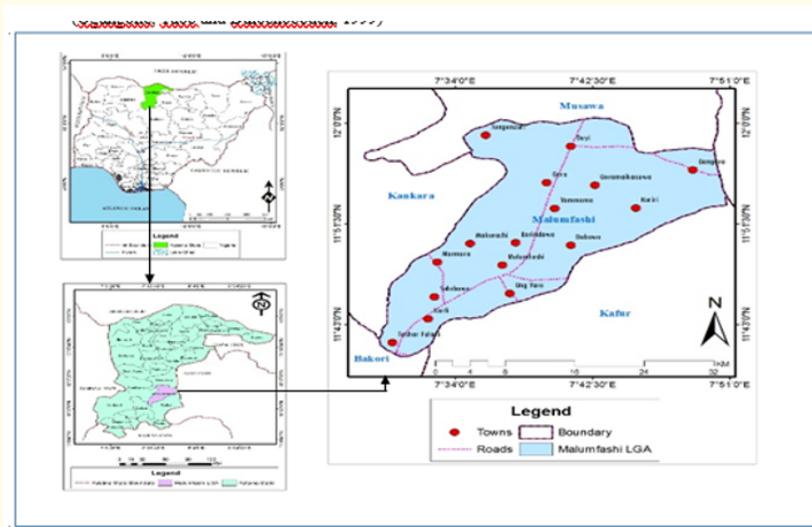


Figure 1: Study Area.

Source: GIS Laboratory, Department of Geography and Environmental Management A.B.U.,Zaria.

Sample size and sampling techniques

The choice of the study area is based on the following criteria:

- High population of pastoralists (who constitute over 80% of the people).
- Availability of grazing reserves e.g. Runka reserve of Katsina.
- Transit zone for pastoralists migrating from Jigawa, Kano, Sokoto etc. and the Niger Republic towards central and south-western Nigeria in search of greener pasture at the end of the wet season.

- Consist of mostly arid/semi arid lands that have suffered severe climate variability as well as increasing drought periods and unpredictable rainfall [11].

A list of all pastoralist communities in the local government was obtained from the secretary of the Association of Cattle Owners (Miyyeti-Allah) Malumfashi Chapter, and 12 communities were selected based on physical accessibility and availability of population data (Table). However, to obtain the sample size for the study, Yamane (1969) technique of sample size determination was employed. The 2018-projected population of sampled communities from Malumfashi LGA was 124,133 persons per square kilometers (Table). The 1991 Census Figures were projected for 2018 for the reason that the population of LGAs was disaggregated into localities according to the 1991 census. The projection of sampled localities' population was based on Katsina State population growth rate of 3% using the formula: $P_{t+n} = P_t e^{r \cdot n}$; Where, P_{t+n} = Future population (2018), P_t = Base year (1991), e = exponential, r = Growth rate (3%), n = Interval between future population and base year population (2018 - 1991 = 27years). A simplified formula provided by Yamane (1967) was used to obtain the sample size of 204 for the study based on 95% confidence level and error limit of 7%.

Selected Community	1991 Population Census	2018 Projected Population	Allotment of questionnaires
Danzaki	808	1816	3
Dansarai	1537	3455	6
Lamuntanni	787	1769	3
Goran	1224	2751	5
Malumfashi	42,415	95345	155
Jakwallawa	1055	2372	6
RuwanSanyi	2594	5831	10
Karfi	2202	4950	8
UnguanGambo	660	1484	2
Tashar	534	1200	1
Rereji	627	1409	2
Unguan Ari	779	1751	3
Total	55222	124133	204

Table: Selected communities and allocation of questionnaire.

Source: Fieldwork, 2018.

Data collection and analysis

The study was based on a field study carried out from January to December 2018 in the twelve purposively selected villages in Malumfashi LGA. Hence, 204 copies of semi-structured questionnaire were designed and allotted to each of the selected villages based on 2018-projected population. The questionnaire aimed at discovering the knowledge and level of awareness of individual herders on climate change and its possible impacts on herders' adaptation options and the perceived barriers to adaptation choices. In addition to the individual interviews, focus group discussion was held at LGA headquarters with a group of herders, which were selected based on their local reputation for being knowledgeable and experienced. The discussants answered the same questions posed in the individual interviews. They also provided detailed information on general concepts, perceptions, and opinions related to climate change. However, 200 copies of questionnaire were retrieved representing 98% response rate. Data collected was analyzed using descriptive statistics such as frequencies, counts, percentages etc. and presented using tables and graphs. However, Climate Change Adaptation Index (CCAI) was

used to evaluate pastoralists' responses to climate variability in the study area. The index was constructed using a 3-point continuum. The three points scales were weighted in order of importance from commonly = 2, Occasionally = 1 and not all = 0. In addition, meteorological data consisting of maximum temperature, minimum temperature and rainfall data from 1975 to 2018 were collected from National Meteorological Agency (NMA), Katsina to determine the trends of temperatures and rainfall in the study Area.

Results and Discussions

Socio-economic characteristics of respondents

It is important to note that the study of the perceptions of respondents about the existence of climate variability and attendant consequences necessitates full grasp of their level of education, annual income, family size, sex and age. This enables us to understand how socio-economic and demographic differences lead to varying perceptions on climate change and variability. Information in table 1 portrays the socioeconomic characteristics of respondents in the study area. The results of the finding indicate that males (84%) predominates pastoral activities in Malumfashi LGA. This finding is in line with the investigation of Rashid (2012) and Veena [14] which noted that cattle herding is a male dominated enterprise in pastoral economy. According to Aemro, Jemma and Mengistu [15] females are more occupied with domestic chores; this gives male-headed households an edge in terms of farming experience and information on diverse adaptation measures and what is required to be done in response to the climate change and variability.

Variables	Category	No.	%	
Gender	Male	167	84	
	Female	33	16	
Age (Years)	30 - 34	30	15	
	35 - 39	34	17	
	40 - 44	56	28	45
	45 - 49	48	24	
	> 50	32	16	
Marital Status	Single	52	26	
	Married	76	38	
	Divorced	42	21	
	Widowed	30	15	
Level of Education	Primary	27	14	
	Secondary	47	24	
	Tertiary	42	21	
	Adult Education	22	11	
	No Education	62	30	
Household Size	≤ 5	60	30	
	6 - 10	62	31	16
	11 - 15	36	18	
	16 - 20	24	12	
	21 - 25	14	7	
	≥ 26	4	2	

Occupation	Farming	91	46	
	Livestock production	40	20	
	Artisan	14	7	
	Civil Servant	22	11	
	Trading	20	10	
	Others	13	6	
Income per annum	< 100000	92	46	
	100000 - 200000	73	36	
	201000 - 300000	17	9	
	301000 - 400000	12	6	
	> 400000	6	3	
Years living in the area	30-34	70	35	
	35-40	90	45	43
	41-50	30	15	
	≥ 51	10	5	

Table 1: Socio-economic characteristics of respondents (n = 200).

Source: Fieldwork, 2014.

Table 2 reveals further that out of the 200 respondents, 11.00% had adult education, 14.00% went to primary school, 21.00% had tertiary education, and 24.00% had secondary education, while 30.00% had no education at all. This suggests that pastoralists in Malumfashi LGA are literate to varying degrees, which makes them receptive to innovations. Williams (1997) and Penin and Brummer [16] reported that farmers' adoption of improved technology is influenced by their level of education. Thus, respondents' level of education will assist them to seek information on climate variation, thereby increasing their allocative and technical efficiency.

Climate change	Number	Percentage
Perception of Temperature Variability		
Increase in temperature	115	56
Decrease in temperature	47	24
No change in temperature	10	5
No idea	23	12
No response	5	3
Perception of Rainfall Variability		
Increase in rainfall	75	38
Decrease in rainfall	93	46
No change in rainfall	12	6
No idea	7	3
No response	13	7

Table 2: Perception of changes in climate (n = 200).

Source: Field study, 2018.

The average age of the respondents is 45 years. 80% are between 30 - 40 years while 20% are 41 years and above. Age of household head represents experience. This implies that the respondents had useful information and experiences of variation in climate with coping mechanisms as it affects their pastoral practices and production. Accordingly, Penin and Brummer [16] opined that age may likely endow the farmers with the requisite experience that will enable them make better assessment of the risks involved in climate change adaptation investment decisions. Similarly, Enete, Nweke and Tollen (2002) noted that older farmers have more experience and are able to take healthier production decisions than younger ones.

Table 1 has further revealed that majority of the respondents (38.00%) are married; and the average household size is 16. This finding indicates a large family size with the implication that more family labour will be readily available. Igben (1988) reported that large household size was an obvious advantage in terms of labour supply. The average annual income of the respondents is N150, 000 (Table 1). This implies that they are small-scale headers who operated at small-scale level with the consequent low-income level. The farm income of the households has impacts on adaptation strategies. With limited income (poverty), the acquisition of necessary facilities such as improved crop varieties, soil and water conservation techniques, and crop diversification will be difficult (Enete and Onyekuru, 2011).

Pastoralists' perception of long-term changes in temperature and precipitation

The surveyed households were asked questions about their observations in the patterns of temperature and rainfall over the past 30 years (Table 2). The results indicate that 56.00% of the respondents have observed increasing temperature, 24.00% of respondents perceived a "decrease" in temperature volume, 5.00% of respondents perceived "no change" in temperature volume, 12.00% respondents did not have any idea about the trend of the temperature, and 12% of the respondents refused to give their opinion on the issue.

On the other hand, 38.00% of the respondents felt an increase in rainfall intensity, 46.00% of the respondents perceived a decrease in rainfall intensity; 6.00% of the respondents claimed no change in rainfall intensity; 3.00% of the respondents did not have any idea about the rainfall intensity trend; and 7.00% of the respondents failed to respond. This suggests a high level of awareness of the subject matter in the area of study. The awareness of climate problems and the potential benefits of taking action is an important determinant of adoption of agricultural technologies (F.A.O 2000). Maddison [18-20] argued that farmers' awareness of change in climate attributes (temperature and precipitation) is important to adaptation decision making (Table 3).

Trend and variability of rainfall and temperatures

Conventionally, scientists and ordinary people assert that there is a noticeable variability in the amount of rainfall and temperature over the years. Yet, empirical figures on the actual change in the amount and distribution behaviour of rainfall and temperature are highly aggregated to national, continental and international level. This study has analyzed the trends and variability of rainfall and temperature in Katsina, to assess the extent to which pastoralists' perceptions agree with actual climatic variability and to provide local specific phenomenon of climate situation in ways that can inform the design and development of local coping and adaption mechanisms. The analysis used rainfall and temperatures data recorded over the past 40 years from 1975 to 2015. The trend of annual rainfall in Katsina state for 40 years is depicted graphically in figure 2A, whereas the trend of annual temperature in Katsina state for 19 years is represented graphically in figure 2B. The trend analysis of the temporal changes in rainfall and temperature over 18 years show a consistent rising trend in annual mean surface temperature and inter-annual variability in precipitation in the study area.

Figure 2A shows a steady increase with much fluctuations-rising and falling trend in annual mean rainfall in the study area with the average maximum rainfall (314.9 mm) between 2006 - 2007. The speed of increase is higher for 1990 to 2000 and 2003 to 2012. Figure 2B reveals the trend analysis of record of the level of temperature between 1996 - 2015 in the study area, which shows an increasing trend with the average minimum (20.2°C), and average maximum (34.5°C) temperature recorded in 2005 and 2008 respectively.

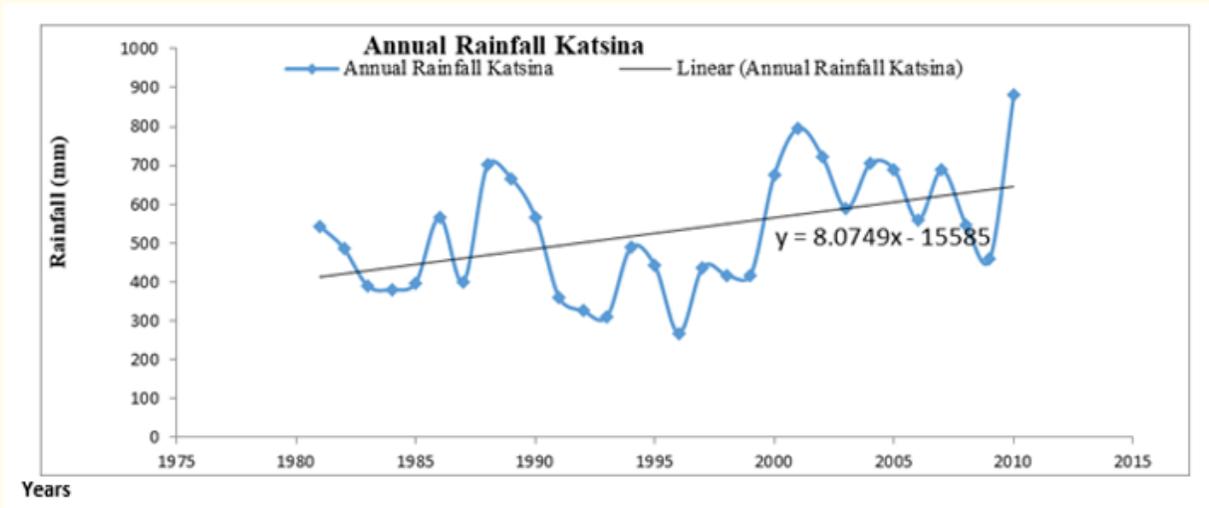


Figure 2A: Annual mean Rainfall for Katsina(1975-2015).

Source: NMet SGusau.

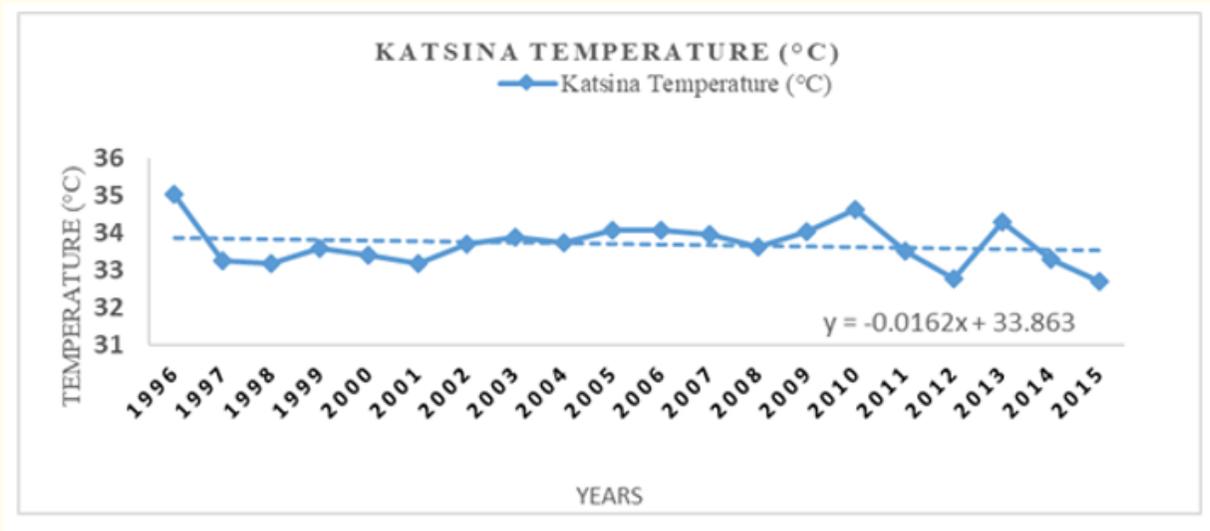


Figure 2B: Annual mean Temperature for Katsina (1996-2015).

Source: MetS, Gusau.

The preceding analysis is validated by Odjugo (2010) indicating that the temperature trend in Nigerian since 1901 shows increasing pattern. The increase was gradual until the late 1960s and this gave way to a sharp rise in air temperatures from the early 1970s, which

continued until date. Odjugo (2010) further stressed that the mean air temperature between 1938 and 2007 in the semi-arid region of Nigeria was 28.96°C while the rainfall amount was 847 mm. Between 1938 and 1972 climatic period, the temperature was 28.24°C and the rainfall amounted to 937 mm while it was 29.67°C and 758 mm respectively for the period of 1973 - 2007. This indicates an increase of 1.43°C for temperature and reduction of 178 mm of rainfall for the two climatic periods. This greatly hampered both crop and animal production.

Comparing pastoralists perceptions with the meteorological data

Pastoralists' perceptions were compared with the results of historical trend from Meteorological data. It was found that pastoralists' perception of climate variability is in tandem with the trend analysis of climate data obtained for the study area. Thus, pastoralists' knowledge indicated a good match with the scientific knowledge. This specifies that the pastoralists have requisite experience and high-level indigenous knowledge in climate variability.

Pastoralists' perceived causes of climate variability and change

Respondents rating of the severity of the identified causes of climate change indicated that majority (65%) of the respondents perceived that human activities such as farming, overgrazing, wood fuel collection and urbanization are among the principal causes of climate variability and change. This result is validated by the findings of Enete and Onyekuru (2011) that most agricultural practices by small-holders exacerbate climate change. Moreover, 20% (60 respondents) perceived it as caused by natural factors such as changes in volcanic activity and solar output, 9 representing 3% suggested both anthropogenic and natural factors, while 12% (36) viewed it as an act of God.

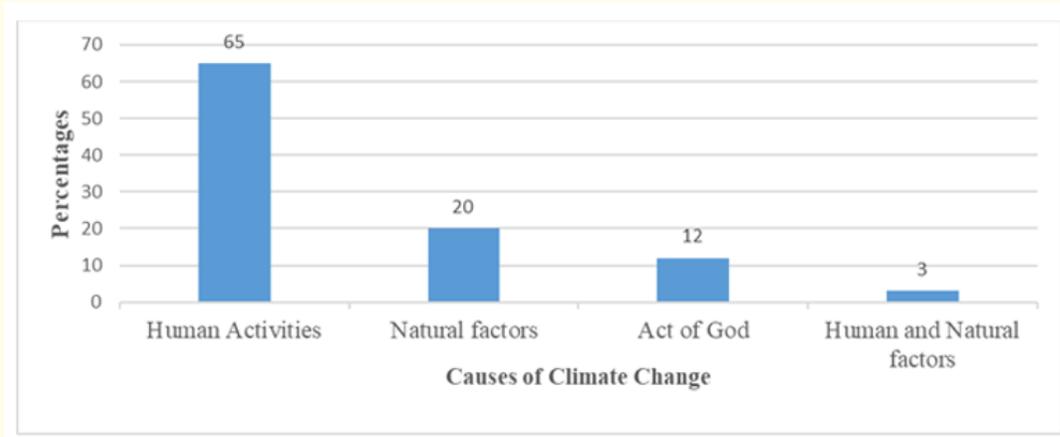


Figure 3: Causes of Climate Change.

Source: Fieldwork, 2018.

Impacts of climate variability and change as perceived by pastoralists

The perceived impacts of climate variability by the respondents in the study area are decreased forage availability and quality (40.00%), decreased animal productivity (24.00%), scarcity of drinking water (7.00%), increased animal mortality (8.00%) and increased conflict between communities (21.00%). Undoubtedly, the high impacts of climate variability and change, which has led to decline in forage availability and quality, are ascribed to erratic and uncertain rainfall and drought occurrences in the study area; consequently decreas-

ing animal performance in terms of fertility, meat and milk yield. Additionally, it was reported during the FGD that the decrease in forage availability ensuing poor performance of animal has had negative effects on income of pastoralists. As a result, some have turned agro-pastoralists, others live on off-farm livestock activities and the rest particularly youngsters migrate to urban areas to seek for wage employment, while maintaining ties with their homes. Mbonile and Mwamfupe (1997) corroborates this investigation.

Adaptation strategies in combating impacts of climate variability and change

Two major categories of adaptation choices; adjustment in pastoral practices and shifts to non-pastoral livelihoods are identified in the study area. Based on adjustment in pastoral practices, table 4 reveals that increased nomadism (ranked 1) was the most commonly used method of combating climate variability by the pastoralists. Herd splitting (ranked 2) and increased fodder storage (ranked 3) followed this. Regarding shifts to non-pastoral livelihood, table 4 indicates that arable farming (ranked 1) was the most commonly used climate change adaptation strategy. Next in rank were artisanal activities (ranked 2) and trading activities (ranked 3). Increased nomadism, fodder storage and herd splitting as adaptation methods could be associated with the lower expense and ease of access by farmers. For instance, increased fodder storage could be achieved by ensuring harvest of excess production during boom periods for use during lean periods and fodder production on farms, instead of depending entirely on wild fodder sources. NEST (2011) supports the forgoing assertion. Similarly, shifts to non-pastoral activities as adaptation strategies indicate that pastoralists engage in other livelihood diversification means to meet family and other social responsibilities as well as purchasing necessary inputs.

Adaptation Strategies	Use of Adaptation Strategies			Adaptation Indices	Rank Order
	Commonly	Occasionally	Not all		
Adjustment in Pastoral Practices					
Increased fodder storage	189 (95)	7 (3)	4 (2)	385	3
Digging and boring of more wells	187 (94)	9 (4)	4 (2)	383	4
Herd Destocking	10 (5)	183 (92)	7 (3)	203	6
Herd Splitting	191 (96)	6 (3)	3 (1)	388	2
Acquirement of more adjustable breeds	175 (88)	17 (8)	8 (4)	367	5
Increased nomadism	200 (100)	0 (0)	0 (0)	400	1
Shifts to Non-Pastoral Livelihoods					
Trading activities	109 (54.5)	65 (32.5)	26 (13)	238	3
Artisanal activities	87 (43.5)	103 (51.5)	10 (5)	277	2
Arable farming	123 (61.5)	69 (34.5)	8 (4)	315	1
Veterinary services	51 (25.5)	104 (52)	45 (22.5)	206	4

Table 4: Climate change adaptation strategies of pastoralists (n = 200).
Source: Fieldwork, 2018. Note: Figures in Parenthesis are in Percentages.
Adaptation Index: commonly x 2 + occasionally x 1 + not all x 0.

Conclusion

The conclusion of the findings indicated that majority of the pastoralists were aware of the phenomenon of climate change, however, their level of knowledge about the causes of climate change was low. The pastoralists relied mostly on personal experience because they were aged with great experience in livestock production. It was also evident that the farmers have applied some coping strategies such as increased fodder storage, boring of more wells and sourcing for other sources of income. These have gone a long way in alleviating the impact of climate variability on lives stock production in the study area.

Recommendations

In view of the findings of the study, policy makers should ensure adequate dissemination of climate change information about causes and consequences of climate change and adaptation strategies via the mass media. In addition, government should identify and compile indigenous adaptive strategies to climate change that pastoralists may have used over the years as an approach to tackle adaptation issues in the sudano-sahelian region of Nigeria. Moreover, government should guarantee improved frequencies of agricultural extension services and provision of improved breeds of animals that are resistant to the climate conditions of the region. Enlightenment on preservation of more fodder for use by the animals will help to supplement fodder scarcity.

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