



SMALL RUMINANT FARMERS' PERCEPTION OF CLIMATE CHANGE IN MORO LOCAL GOVERNMENT AREA, KWARA STATE, NIGERIA

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Abstract

This study examined the small ruminant farmers' perception of climate change in Moro Local Government Area (LGA) of Kwara State, Nigeria. About 120 small ruminant farmers were selected for the study. Analytical tools such as descriptive (frequency count, percentage, mean score) and inferential [Pearson product moment correlation (PPMC)] statistics were used to analyse the data. The result revealed that about 57.5% of the respondents were male, average age of 38.3 years, income of ₦56633.33, and household size of about 5 persons. The average number of goat and sheep was 10 and 5 respectively. About 52% of the respondents utilized extensive system of rearing and 60.8% had access to extension services. About 77.5% of the respondents indicated Ministry of Agriculture as their main source of information on small ruminant production. The result revealed that planting of trees/erecting cover to serve as shades to reduce heat stress (90.8%) was the most frequently used adaptation strategies to climate change. About 59.2% of the respondents have high level/status of use of adaptation strategies. The highest ranked perception statement was increase in temperature (4.48), while disease outbreak and high mortality (2.78) ranked highest as factor affecting small ruminant production. It is therefore recommended that there should be provision of information on the adaptation strategies as climate change is now a reality that is not going away and provision of veterinary services to reduce disease outbreak.

Keyword: Small Ruminant Farmers, Perception, Climate Change, Adaptation Strategies

Introduction

Climate change is a global problem and its impact is made visible especially in the agricultural sector where it has significantly affected production in most developing countries (Elum *et al.*, 2017). Climate change and agriculture are interrelated processes, both of which occur all over the world. Global warming is projected to have significant impacts on conditions affecting agriculture, including temperature, precipitation and glacial run-off (Funk *et al.*, 2012). Climate change has led to overall decrease in agricultural productivity and yields, including rangeland livestock production, threatened food security and increased the risk of famine (FAO, 2008). According to the Intergovernmental Panel on Climate Change, Africa is one of the most vulnerable continents to climate change (IPCC, 2007). Climate change refers to changes in the occurrence of extremes of climate over a long period of time (IPCC, 2001). It includes long-term events such as changes in temperature and rainfall patterns (Boko *et al.*, 2007). According to the IPCC (2021), sixth assessment report, the last five years have

been the hottest on record since 1850, the global surface temperature was 1.09 centigrade higher (between 2011-2020) and human activities had resulted in widespread and rapid changes to the earth (atmosphere, cryosphere and biosphere). There are many ways climate change affects the small ruminant production, the effects include; increased temperature, change in the amount of rainfall, shift in precipitation patterns and increased frequency of extreme weather events. Increased heat stress and reduced water availability can also have a direct negative impact on livestock production (FAO, 2021). Climate change is characterized by slow, gradual, long-term changes in the environment; slow-onset events (gradual shifts of growing seasons, gradual changes in ecosystems); long-term temperature changes slow gradual shifts in consumer behaviour and government policy to respond to it (Dan, 2021).

Sheep and goats are classified as small ruminants. They are cloven-footed animals which are called small ruminants, and belong to the genus, *Ovis* and *Capra*, respectively (Otaru and Iyiola-Tunji, 2014). The breeds

of sheep and goats in Nigeria are thought to have originated from Western Asia passing through the Middle East to North Africa and finally to Nigeria. They are ruminants like cattle because they chew the cud and have four stomachs. Nigeria has the largest small ruminant herd in Africa followed by Sudan, Chad, Ethiopia and Kenya and there are about 76 million goats, and 42.1 million sheep in Nigeria, which are mainly indigenous breeds (FMARD, 2017). Small ruminants are kept by smallholder farmers for meat, hides, wool, and to a less extent, milk. Small ruminant population is concentrated more in Northern than Southern Nigeria. The Gross production value of goat and sheep meat in 2016 was US \$373.1 million and \$73.4 million (NASS, 2011). Small ruminants have a significant cultural role in rural and urban centres in Nigeria, especially during the festive periods. Goat production constitutes a very important part of the rural economy with more than 95% of the rural households keeping goats and ranks next to cattle in income generation and economic sustenance (Duku *et al.*, 2011).

Climate change is already affecting every inhabited region across the globe with human influence contributing to many observed changes in weather and climate extremes (IPCC, 2021). As climate change is an emerging challenge limiting agricultural production all over the world, the perception of the farmers on climate change will determine their responses (adaptation strategies) to the changes in climatic variables. The information on perception to climate change will help determine the kind of interventions to be given to them. Over the years, several livestock were lost due to heat stress, flooding, drought and frequent outbreak of diseases which occurred as a result of climate change. Losing small ruminant animals to the negative effects of climate change will pose challenges and threats to farmers' livelihoods and food security as agriculture plays an important role in the rural areas of Nigeria. According to Funk *et al.* (2012), not much is known about smallholder farmers' perceptions of climate change on their agricultural practices. There is dearth of information on the Perception of Small ruminant farmers to climate change in the study area. Based on these, the study assessed small ruminant farmers' perception of climate change in Moro LGA, Kwara State, Nigeria.

The specific Objectives were to;

- 1) ascertain the socio-economic characteristics of the respondents
- 2) determine the adaptation strategies to climate change among the respondents
- 3) assess the small ruminant farmers' perception of climate change in the study area
- 4) determine the factors affecting small ruminant production in the study area.

Hypotheses of the study

Hypothesis 1: There is no significant relationship between socio-economic characteristics of small

ruminant farmers and their perception of climate change.

Hypothesis 2: There is no significant relationship between respondents' adaptation strategies to climate change and their perception of climate change.

Methodology

The study was carried out in Moro LGA, Kwara State. Majority of the people in the LGA were farmers. The total respondents for the study consist of 120 small ruminant farmers which were randomly selected from five rural communities in the LGA. The communities are Shao =20, Ogbagba =20, Abilude =20, Asomu =20 and Malete =20. To determine the adaptation strategies on climate change, the Yes and No scale were used where Yes = 1 and No = 0. In order to determine the respondents' level of use of adaptation Strategies on climate change, any respondent that used at least 6 of the adaptation Strategies on climate change (representing more than 50%) of the practices was categorized as High Level/Status, while respondents that utilized less than 6 of the adaptation Strategies on climate change (representing less than 50%) of the Adaption Strategies was categorized as Low Level/Status. In order to determine the perception on climate change, a five-point likert scale was assigned and scored as follows: Strongly Agree (SA) =5, Agree (A) =4, Undecided (U) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1. To measure the factors affecting goat farming, a 3-point rating scale was used and score assigned, where not a factor =1, less severe=2 and highly severe=3. Descriptive statistics such as frequency counts, percentage and means were used to analyse the finding of the study. Inferential statistics used to test the hypotheses was Pearson product moment correlation (PPMC).

Results and Discussion

Socio-economic Characteristics of the Respondents

The socio-economic characteristics of the small ruminant farmers are presented in Table 1. The result revealed that more than half (57.5%) of the respondents were male, while 42.5% were female. This result is in agreement with the findings of Dhakal *et al.* (2021) in their study on features of small holder goat farming from Chitwan district of Bagmati province in Nepal which reported that more than half (53.1%) of respondents were male. The table further reveals that the average age of the respondents was 38.3 years, implying that the small ruminant farmers are still young and are expected to be agile in contributing to the production of small ruminant animals. The table shows that majority of the respondents were married (60%) as many further attained tertiary level of education (46.7%). Islam as indicated by 60% was the dominant religion of respondents. The average household size of respondents was 5 persons. Further results show that the average years of experience in small ruminant production was 4years, with an average annual income of ₦56,633.33. About 43.3% of the respondents were members of social group/cooperatives, while majority (56.7%) did not

belong to any social group/cooperatives. Regarding other supportive occupation, about 40% indicated trading. Table 1 further show that the average number of small ruminants reared was 10 goats and 5 sheep, implying that small ruminant farmers are small holders. The main rearing system was extensive system (52.5%), in line with the findings of Ajala and Gefu (2003), who reported that small ruminants are mostly managed under extensive systems in Northern Nigeria. The main motive for small ruminant production was for financial

purposes (60.8%), in line with the findings of Yusuf *et al.* (2018) who reported that majority of respondents' kept small ruminant animals for commercial purposes. About 33.3% of the respondents indicated that personal savings was the main source of credit/finance. Majority (60.8%) of the respondents indicated that they had access to extension services on small ruminant production, while others (39.2%) indicated access to extension services.

Table 1: Socio-economic Characteristics of the Respondents

Variables	Frequency	Percentage	Mean (SD)
Gender			
Male	69	57.5	
Female	51	42.5	
Age (years)			38.3(11.718)
30 and below	41	34.2	
31 – 40	42	35.0	
41 – 50	17	14.2	
51 – 60	17	14.2	
61 and above	3	2.5	
Marital Status			
Single	38	31.7	
Married	72	60.0	
Separated	2	1.7	
Widowed	5	4.2	
Divorced	3	2.5	
Educational Level			
No formal	13	10.8	
Primary	5	4.2	
Secondary	46	38.3	
Tertiary	56	46.7	
Religion affiliation			
Christianity	40	33.3	
Islam	72	60.0	
Traditional	8	6.7	
Annual Income from rearing of ruminant			56633.33(66029.779)
10,000 and below	4	3.3	
10,001 - 50,000	77	64.2	
50,001 – 100,000	28	23.3	
1000,001 and above	11	9.2	
Years of Experience in rearing of ruminant			4 (2.356)
1 – 3	67	55.8	
4 – 6	44	36.7	
7 – 9	4	3.3	
10 and above	5	4.2	
Household Family Size			5(2.834)
1 – 3	42	35.0	
4 – 6	42	35.0	
7 – 9	21	17.5	
10 and above	15	12.5	
Membership of social group/cooperatives			
Yes	52	43.3	
No	68	56.7	
Other supportive occupation			
Crop farming	16	13.3	
Trading	48	40.0	
Civil servant	46	38.3	
Artisan	8	6.7	
Students	2	1.7	
Herd size			
Number of goat			10(5.838)
1 – 10	71	59.2	
11 – 20	47	39.1	
21 and above	2	1.7	
Number of sheep			5(5.717)
0	30	25.0	
1 – 10	70	58.3	
11 – 20	18	15.0	
21 and above	2	1.7	
Rearing system			
Intensive system	14	11.7	
Semi-intensive system	43	35.8	
Extensive system	63	52.5	
Main motive for small ruminant production			
Financial	73	60.8	
Family consumption	25	20.8	
Financial and family consumption	22	18.3	
Sources of credits			
Personal Savings	40	33.3	

Family/neighbor	42	35.0
Friends	14	11.7
Cooperative society	8	6.7
Bank	16	13.3
Access to extension services on small ruminant production		
Yes	73	60.8
No	47	39.2

Source: Field survey, 2021

Adaptation Strategies to Climate Change among Small Ruminant Farmers

The results of adaptation strategies to climate change among the small ruminant farmers are presented in Table 2. The result showed that majority of the respondents applied planting of trees/erecting cover to serve as shades to reduce heat stress (90.8%), feeding animals with grains and concentrates (78.3%), silage production (74.2%), use of weather forecasting information and stocking species that are tolerant to harsh weather conditions (68.3%), storing grass for dry

season (66.7%) and rears more than one species (68.3%). This implies that these were the main adaptation strategies to climate change by the respondents.

Other notable adaptation practices to climate change were de-stocking during dry season (30.0%), diversify livelihoods/supportive occupations (27.5%), cultivation of crop along with rearing of goat (31.7%), farm insurance (32.5%), and membership of association/social group/cooperative societies and diversify livelihoods/supportive occupations (27.5%).

Table 2: Adaptation strategies to climate change among respondents

Adaptation Strategies to Climate Change	Yes, used/applied Frequency	Percentage
Planting of trees/erecting cover to serve as shades to reduce heat stress	109	90.8
Use of weather forecasting information	82	68.3
De-stocking during dry season	36	30.0
Storing grass for dry season	80	66.7
Silage production	89	74.2
Feeding animals with grains and concentrates	94	78.3
Rears more than one species	78	65.0
Diversify livelihoods/supportive occupations	33	27.5
Stocking species that are tolerant to harsh weather conditions	82	68.3
Farm insurance	39	32.5
Cultivation of crop along with rearing of goat	38	31.7
Membership of association/social group/cooperative societies	33	27.5

Source: Field survey, 2021

Level/Status of Use of adaptation strategies to climate change among small ruminant farmers

The level of application of adaptation strategies to climate change among small ruminant farmers is illustrated in Table 3. The table shows that majority (59.2%) of the respondents highly utilized the

adaptation strategies to climate change for small ruminant production in the study area. The level of application of adaptation strategies to climate change among the remaining 40.8% of the small ruminant farmers was low.

Table 3: Level/Status of Use of Adaptation Strategies to climate change among the small ruminant farmers

Level/Status of Use	Percentage score range of total usage	Frequency	Percentage
Low	0 – 50.0	49	40.8
High	51.0 – 100.0	71	59.2

Source: Field survey, 2021

Small Ruminant Farmers' Perception to Climate Change

The perception of small ruminant farmers on climate change is presented in Table 4. The perception statements were ranked in the order of highest to lowest, indicated from first to eight. The perception were: increase in temperature (4.48) ranked first, increased incidence of drought (4.06) ranked second, climate change has led to increase in disease outbreaks (3.98) ranked third, climate change is responsible for scarcity of pasture and grass (3.73) ranked fourth, climate

change is responsible for the high mortality among goats (3.70) ranked fifth, climate change is responsible for the increase flooding (3.63) ranked sixth, there is increase in cost of food due to climate change (3.62) ranked seventh and there is decrease in rainfall (3.32) which ranked eighth. This finding implies that the foremost perception of small ruminant farmers in the study area were perception for increase in temperature, increased incidence of drought and increase in disease outbreaks as a result of climate change.

Table 4: Perception of respondents on Climate Change

Perception statement	SD	D	U	A	SA	Mean	Rank
There is increase in cost of food due to climate change	1(0.8)	25(20.8)	6(5.0)	75(62.5)	13(10.8)	3.62(0.963)	7th
Climate change has led to increase in disease outbreaks	1(0.8)	1(0.8)	7(5.8)	101(84.2)	10(8.3)	3.98(0.502)	3rd
There is increased incidence of drought	0	5(4.2)	11(9.2)	76(63.3)	28(23.3)	4.06(.702)	2nd
There is increase in temperature	1(0.8)	5(4.2)	8(6.7)	28(23.3)	78(65.0)	4.48(.860)	1st
Climate change is responsible for the increase flooding	0	21(17.5)	12(10.0)	77(64.2)	10(8.3)	3.63(.869)	6th
There is decrease in rainfall	1(0.8)	16(13.3)	52(43.3)	46(38.3)	5(4.2)	3.32(.788)	8th
Climate change is responsible for scarcity of pasture and grass	0	12(10.0)	16(13.3)	84(70.0)	8(6.7)	3.73(.730)	4th
Climate change is responsible for the high mortality among goats	0	9(7.5)	52(43.3)	25(20.8)	34(28.3)	3.70(.967)	5th

*Source: Field survey, 2021**Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), Strongly Disagree (SD)***Factors affecting Small Ruminant Production**

The results of factors affecting small ruminant production among respondents are presented in Table 5. The result of perception of respondents on climate change reveals that disease outbreak and high mortality (2.78) ranked first, high cost of production (2.68) ranked second, lack of start-up capital (2.63) ranked third, lack of adequate information/extension services (2.58) ranked fourth, scarcity of grass during the dry season (2.57) ranked fifth, marketing problems (2.55) ranked

sixth, non-availability of high quality breeds (2.41) ranked seventh, incessant occurrence of drought during dry season (2.38) ranked eighth, unavailability of modern equipment (2.17) ranked tenth, theft (2.14) ranked eleventh, and low demand for the meat (2.03) ranked twelfth. This finding implies that disease outbreak and high mortality, high cost of production and lack of start-up capital were the leading factors affecting small ruminant farmers in the study area.

Table 5: Factors affecting Small Ruminant Production among the Respondents

Factors	Not a factor Freq.(%)	Less severe Freq.(%)	High severe Freq.(%)	Mean(SD)	Rank
Lack of start-up capital	10(8.3)	25(20.8)	85(70.8)	2.63(.636)	3 rd
Non-availability of high-quality breeds	10(8.3)	51(42.5)	59(49.2)	2.41(.642)	7 th
Unavailability of modern equipment	2(1.7)	96(80.0)	22(18.3)	2.17(.417)	10 th
Theft	2(1.7)	99(82.5)	19(15.8)	2.14(.385)	11 th
Inadequate technical know how	15(12.5)	47(39.2)	58(48.3)	2.36(.696)	9 th
Low demand for the meat	32(26.7)	52(43.3)	36(30.0)	2.03(.755)	12 th
Scarcity of grass during the dry season	8(6.7)	46(38.3)	65(54.2)	2.57(1.143)	5 th
Lack of adequate information/extension services	1(0.8)	48(40.0)	71(59.2)	2.58(.512)	4 th
Incessant occurrence of drought during dry season	3(2.5)	68(56.7)	49(40.8)	2.38(.537)	8 th
High cost of production	5(4.2)	28(23.3)	87(72.5)	2.68(.550)	2 nd
Marketing problems	9(7.5)	36(30.0)	75(62.5)	2.55(.633)	6 th
Disease outbreak and high mortality	2(1.7)	23(19.2)	95(79.2)	2.78(.458)	1 st

*Source: Field survey, 2021***Test of Hypotheses****Hypothesis 1: There is no significant relationship between socio-economic characteristics of respondents and their perception to climate change**

The result of PPMC analysis showing the relationship between socio-economic characteristics of respondents and perception of respondents to climate change as presented in Table 6. The result reveals that the rearing system (0.444) was positively related at $p \leq 0.05$ level of significance to perception of climate change of the

respondents on small ruminant production, while age (-0.270) and number of goats reared (-0.330) were inversely related to perception of climate change of the respondents on small ruminant production in the study area. This implies that the rearing system, age and number of goats reared have a negative influence on their perception of climate change. This result is in agreement with the findings of Slegers (2008) who reported that socioeconomic characteristic has influence on the perception of farmers on climate change.

Table 6: The result of PPMC analysis between the socioeconomic characteristics and perception of respondents to climate change

Socioeconomic Characteristics	r Value	P Value	Remarks
Age	-0.270**	0.003	Significant
Years of experience	0.037	0.690	Not Significant
Income	0.043	0.640	Not Significant
Number of Sheep	-0.132	0.151	Not Significant
Number of Goats	-0.330**	0.000	Significant
Motive for Small Ruminant Farming	0.048	0.606	Not Significant
Rearing system	0.444**	0.000	Significant
Supportive Occupation	-0.150	0.101	Not Significant
Access to extension services	-0.164	0.074	Not Significant

**= Correlation is significant at the 0.01 level (2-tailed). *=Correlation is significant at the 0.05 level (2-tailed)

Hypothesis 2: There is no significant relationship between respondents' adaptation strategies to climate change and their perception of climate change

The result of PPMC analysis (Table 7) between the respondents' adaptation strategies to climate change and perception of respondents to climate change shows that use of weather forecasting information (0.090), storing grass for dry season (0.268), feeding animals with grains and concentrates (0.311) and rears more than one specie (0.322) were positive and significantly related to the

respondents' perception of climate change, while farm insurance (-0.343) was negative and significant at $p \leq 0.05$ level. This result implies that the more the use of weather forecasting information, storing grass for dry season, feeding animals with grains and concentrates and more than one specie, the higher the perception of the respondents on climate change. The higher the use of farm insurance, the less the perception of the respondents on climate change.

Table 7: The result of PPMC analysis between the respondents' adaptation strategies to climate change and perception of respondents to climate change

Adaptation Strategies	R Value	P Value	Remark
Planting of trees/erecting cover to serve as shades to reduce heat stress	0.090	0.324	Not Significant
Use of weather forecasting information	0.350**	0.000	Significant
De-stocking during dry season	0.117**	0.200	Not Significant
Storing grass for dry season	0.268**	0.003	Significant
Silage production	0.049	0.595	Not Significant
Feeding animals with grains and concentrates	0.311*	0.010	Significant
Rears more than one species	0.322*	0.010	Significant
Diversify livelihoods/supportive occupations	-0.105	0.254	Not Significant
Stocking species that are tolerant to harsh weather conditions	0.146	0.111	Not Significant
Farm insurance	-0.343**	0.003	Significant
Cultivation of crop along with rearing of goat	0.058	0.528	Not Significant
Membership of association/social group/cooperative societies	-0.037	0.685	Not Significant

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

Conclusion

Farmers rearing small ruminant animals in Moro LGA are dominated by married young farmers. Extensive system of management and use of personal saving are prevalent for small ruminant production in the study area. Planting of trees/erecting cover to serve as shades to reduce heat stress, feeding animals with grains and concentrates, silage production, use of weather forecasting information and stocking species that are tolerant to harsh weather conditions, storing grass for dry season and rears more than one species were the highly used adaptation strategies for small ruminant production in the study area. The highest ranked perceptions of small ruminant farmers in the study area were perception for increase in temperature, increased incidence of drought and increase in disease outbreaks as a result of climate change. Disease outbreak and high mortality, high cost of production and lack of start-up capital were the leading factors affecting small ruminant farmers in the study area. Extension service providers should therefore, create more awareness on climate

change to the small ruminant farmers. Provision of information on the adaptation strategies, and veterinary services to reduce disease outbreak.

References

- Ajala, M.K. and Gefu, J.O. (2003). Socio-economic Factors influencing small ruminant management practices in Kaduna State. Moor J. Agric. Res. 4:274-280.
- Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R. and Yanda, P. (2007). Africa. Climate change 2007: Impacts, adaptation and vulnerability”, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, in Parry, M L, Canziani, O F, Palutikof, J P., van der Linden, P J and Hanson, C E (Eds), Cambridge University Press.Cambridge. Pp. 433 - 467.
- Dan, M., (2021). Double Impact: Covid-19 and Climate Change in Food and Agriculture. Observations and

- recommendations for policy-makers in Southeast Asia.
- Dhakal, A., Regmi, S., Pandey, M., Chapagain, T. and Kaphle, K. (2021). Features of small holder goat farming from Chitwan district of Bagmati province in Nepal. *Archives of Agriculture and Environmental Science*, 6(2): 186-193. <https://dx.doi.org/10.26832/24566632.2021.0602010>
- Duku, S., Price, L., Vander, Z. A. and Tobi ,H. (2011). Influence of male or female headship on the keeping and care of small ruminants: the case of the transitional zone of Ghana. *Livestock Res. Rural Dev.*, 23 (1): 1-10.
- Elum, Z.A., Modise, D.M and Marr, A., (2017). Farmer's perception of climate change and responsive strategies in three selected provinces of South Africa. *Clim. Risk Manage.* 16: 246–257.
- FAO (2008). Food and Agriculture Organization. Climate Change and Food Security: A Framework Document, FAO-UN, Rome.
- FAO (2021). Food and Agriculture Organization. *Climate-smart livestock production. A practical guide for Asia and the Pacific region*. Bangkok. <https://doi.org/10.4060/cb3170en>
- FMARD (2017). Animal population data. Federal Ministry of Agriculture and Rural Development.
- Funk, C., Michaelsen, J. and Marshall, M. (2012). Mapping recent decadal climate variations in precipitation and temperature across Eastern Africa and the Sahel. in Remote Sensing of Drought: Innovative Monitoring Approaches, Wardlow, B.D., Anderson, M.C. and Verdin, J.P. (Eds), CRC Press, Boca Raton, FL, Pp. 331-358.
- IPCC (2001). Climate change 2001: impacts, adaptation vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change, University Press, Cambridge.
- IPCC (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC, Cambridge University Press, Cambridge, Pp. A869-883.
- IPCC (2021). Climate Change 2021, the Physical Science Basics - Sixth Assessment Report- Summary for Policy-Makers. Working Group, 9th August, 2021.
- NASS (2011). National Bureau of Statistics/Federal Ministry of Agriculture and Rural Development Collaborative Survey on National Agriculture Sample Survey (NASS), 2010/2011.
- Otaru, S.M. and Iyiola-Tunji, A.O. (2014). Paper presented at National Workshop on "Strategies for improving livestock and fisheries extension service delivery for sustainable productivity" which was held at National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria from 26th – 28th August, 2014.
- Slegers, M.F.W. (2008). If only it could rain: farmers' perceptions of rainfall and drought in semi-arid Central Tanzania. *Journal of Arid Environments*, 72 (11): 2106-2123.
- Yusuf, A. Aruwayo, A. and Muhammad, I. R. (2018). Characterization of Small Ruminant Production Systems in Semi-Arid Urban Areas of Northern Nigeria. *J. Appl. Sci. Environ. Manage.*, 22 (5): 725 – 729.