IMPACT OF CLIMATE CHANGE AND ADAPTATION STRATEGIES AMONG PASTORALISTS AT THE LADDUGA (KACHIA) GRAZING RESERVE IN KADUNA STATE, NIGERIA

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Abstract
This paper assessed the impact of climate change and adaptation strategies among pastoralists in Kachia grazing reserve in Kaduna State. A Focal Group Discussion and structured questionnaire were used to interview 120 randomly selected pastoralists to obtain the data, which were analysed using descriptive statistics and logit model to ascertain the level of awareness of pastoralists to climate change, the sources of Information about climate change, the determinants of pastoralists adaptation to climate change, and the impact of climate variability and adaptation strategies by the pastoralists. The results indicate that over 80% of the respondents are aware of climate change. This high level of awareness was due to the influence of radio on the lives of the pastoralists, extension activities of the National Livestock Project Division (NLPD) and through personal observation by the respondents. Age of the pastoralists, animal rearing experience, membership of cooperative society and education level have significant impact on pastoralists adaptation to climate change. Disease condition of the heard due to increased rainfall which favours the growth of disease causing microorganisms is one of the adverse impact of climate variability. The major adaptation techniques employed by the pastoralists to deal with the problem is through adequate treatment and medication as reported by about 65% of the respondents. Other measures include: harvesting of forage material for use during the dry season and movement to the *fadama* areas where fodder and water are available and the purchase of fodder materials supplied from within and outside the reserve. Therefore, Government policies and investment strategies must support education, extension services and information about adaptation to climate change.

Keywords: Climate change, Impact, Adaptation, Pastoralists, Kachia

INTRODUCTION
Agriculture is the basic activity by which humans live and survive on the earth. It plays a key role in the Nigerian economy, employing two thirds of the labour force and accounting for over 40% of the G.D.P (CBN, 1999). The livestock sub sector has a population which comprises about 14 million cattle, 34 million goats, 22 million sheep and about 100million poultry (Yahuza, 2001). Other livestock and species of economic importance are donkeys, pigs and camels. Cattle represent one of the most economically significant groups within the livestock sub-sector, supplying meat, milk, butter, hide bones for domestic consumption and for industries.

Assessing the impacts of climate change on this important subsector of Nigerian agriculture is a vital task. This is because the influence of climate on crops and livestock persists despite irrigation, improved plant and animal hybrids and the growing use improved feeding materials, vaccines and dugs. This is as a result of the continued dependence of agricultural production on light, heat, water and other climatic factors and the significant magnitude and rapid rates of possible climate changes. All these factors combine to create the need for a consideration of the potential impacts of climate on agriculture.
The risks of climate change for least developed countries (LDCs) are hard to exaggerate, and communities, governments and other institutions in these countries must prepare in order to reduce its adverse effects. In an effort to reduce the negative effect of climate change, farmers/cattle herders' conflict, increase

productivity of livestock through adoption of improved animal production techniques, the federal government of Nigeria established grazing reserves in different parts of the country. The reserves are meant to settle the nomadic Fulani who are always on the move from the northern to the southern part of the country searching for feed, water and security of their animals. One of such grazing reserves is the Ladduga cattle grazing reserve in Kachia Local Government area of Kaduna State. This paper examined the Impact of Climate Change and Adaptation Strategies among Pastoralists at the Ladduga (Kachia) Grazing Reserve in Kaduna State, Nigeria. Specifically the study ascertained:

i. the level of awareness of pastoralists to climate change
ii. the sources of Information about climate change
iv the determinants of pastoralists adaptation to climate change
v. the impact of climate variability and adaptation strategies by the pastoralists.

METHODOLOGY
Study Area
The study was conducted in Kaduna State, located in the Northern part of Nigeria between latitudes 09^0 11^0 N and longitude of 06^0 and $09^030'$ N (google map, 2017). The State has a land mass of about 2.2 million hectares, with a population of 6,066,562 and annual population growth of 3.2% (NPC, 2006). The projected population figure for 2017 of the State is 8,773,209 (NPC, 2018). The specific study area is the Ladduga grazing reserve located between Latitude 10° 03' 38.2'' N, Longitude 7° 59' 42.47'' E and Latitude10^o 19' 47.59'' N, Longitude 8° 02' 04.98'' E (google map, 2018). The Grazing Reserve covers an area of over 73,000 hectares of land of which 33,411 hectares were demarcated, and divided into six blocks, a service centre and a transhuman corridor.

It has accessible feeder roads of about 150km, 13 earth dams for watering livestock and 19 boreholes for provision of potable water to Pastoralists and other inhabitants of the reserve. The grazing reserve has 14 nomadic primary schools, a secondary school, and a livestock training centre managed by National Livestock Project Division (NLPD).

The reserve presently has an estimated total of 866 pastoralists' households, with a population of about 25,000 people. The livestock population within the reserve was estimated to be 38,000 cattle, 13,000 sheep, 8,000 goats, 450 donkeys, 42 horses and 15,000 local poultry (NLPD 2016).

Sampling Procedure and Data collection
The data used for the study were primary data collected from120 randomly selected pastoralists Households residing in the Ladduga Grazing Reserve in Kachia LGA using a structured questionnaire and a Focal Group Discussion (FGD). Data were collected from the respondents in 2017 on socioeconomic characteristics, cattle rearing experience, membership of cooperative society, years of schooling, herd size, household size, awareness of climate change, adaptation techniques and problems of climate change using structured questionnaire.

Methods of Data Analysis
Descriptive statistics and Logit regression analysis were used to analyse the data.
Descriptive statistics: descriptive statistic such as percentages, frequency count and mean were used to analyse the measures of central tendency.
The logistic model. Logit regression method was used because the response variable in the analysis is dichotomous in nature. An adaptation to climate change as a response variable is considered as a binary outcome, where 1= adaptation and 0 = non - adaptation to climate change. Accordingly, the logistic regression model describing adaptation to climate change by the sampled pastoralists farmers is specified as follows:

$$P = \frac{e^h}{e^h + 1} \dots \dots \dots \dots \dots \dots \dots . (1)$$

Where p is the probability of adapting to climate change, $h = \beta_0 + \beta_1 x_1 + \ldots + \beta_7 x_7$ and $x_1 \ldots x_7$ are the explanatory variables. The inverse relation of equation (1) is

$$h = ln\left\{\frac{p}{1-p}\right\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots. (2)$$

Equation (2) is the natural logarithm of the odds ratio, known as the logit and it ranges between negative infinity and positive infinity. The explanatory variables included in the regression for each respondent were: x_1=Herd size, x_2=age of the pastoralist, x_3=Household size, x_4=years of cattle rearing experience, x_5=years of schooling, x_6= extension contact (dummy, having contact=1, 0 otherwise), x_7=membership of farmers' cooperative (dummy, member=1, 0 otherwise), β_0=constant and $\beta_1 - \beta_8$=coefficients to be estimated.

RESULTS AND DISCUSSION
This section discussed the result of the study on the impact of climate change and adaptation techniques on the pastoralists in Kachia grazing reserve of Kaduna State.
Awareness of climate change and its impacts
Table1: Awareness of climate change and its impacts

Item	Frequency	Percentage
Aware	96	80
Not aware	24	20
Total	120	100

Source: Field survey, 2017
The results as presented in table1 shows that, 96 of the 120 interviewed pastoralists which represents 80% of the sample are aware of the existence of climate change and its impact while 24 (20%) report non awareness. This shows that the pastoralists have a high level of awareness of climate change and its associated impact on their ways of living.
Sources of information
Table2: sources of information used by the pastoralists

Sources	Frequency	Percentage
Radio	44	45
Extension contact	36	37
Personal observation	16	18
Total	96	100

Source: Field survey, 2017
The result in Table2, showed the three most important sources of information on climate change by the respondents. Radio was ranked first by 45% of the respondents followed 37% for extension agent contact through the NLPD and personal observation accounts for 18%. This high level of the use of radio as a source of information was as a result of the close association rural people especially the Fulani have with radio. The presence of NLPD's livestock health extension activities in the reserve has also helped in increasing their level of awareness.

Determinants pastoralists adaptation to climate

Table 3: maximum likelihood estimates of logistic model for factors affecting pastoralists adaptation to climate change.

variable	β	S.E.	Wald	P value	Exp (β)
herd Size (x_1)	0.210	0.131	2.573	0.109	1.234
Age of pastoralist (x_2)	0.058	0.045	1.645	0.200	0.944
Household size (x_3)	0.004	0.151	0.001	0.980	1.004
Cattle rearing Experience (x_4)	0.812	0.228	12.684	0.000	0.444
Years of schooling (x_5)	0.527	0.131	16.179	0.000	1.694
Extension contact (x_6)	0.794	0.392	4.103	0.043	2.212
Membership of cooperative (x_7)	1.430	0.369	14.98	0.000	4.179
Constant	2.851	1.559	3.345	0.067	17.303
-2 Likelihood	125.52				

Source: Field survey, 2017

The maximum likelihood estimates of the logistic model for factors associated with pastoralists adaptation to climate change were obtained using the SPSS statistical package as reported in Table3. The probability of adapting to climate change significantly increased (p<0.01) as the years of schooling, years of cattle rearing experience and membership of cooperative increase. Ideally, educated and more experienced pastoralists coupled with cooperative membership are likely to understand climate change and its impact which lead to adaptation. Extension agent contact with P<0.05 is also significant factor in explaining climate change adaptation. Other variables such as Age of pastoralists, herd size and household size are statistically not significant in explaining adaptation to climate change. The odd ratio shows that, an increase in years of schooling, extension agent contact and membership of cooperative society has the tendency of increasing adaptation by 69%, 21% and 18% respectively.

Impact of climate variability

Drying of fodder and other feed materials, decrease in the amount of water for the Animals, increase in temperature which affect the performance of the Animals are some of the negative impacts of climate change in Ladduga. Increase in disease condition of the heard due to increase rainfall in some years which favours the growth of disease causing micro organisms is another adverse impact of climate

Adaptation techniques to climate change

The major problem of adaptation in the developing countries, is the relative lack of resources, institutions, and infrastructure to promote such adaptations. Despite these problems, pastoralists at Ladduga have their adaptive techniques that have existed for long. The major adaptation techniques employed by the pastoralists to deal with the problem of disease outbreak in the grazing reserve is through adequate vaccination, treatment and medication as reported by about 65% of the respondents. Other measures include: harvesting of forage material for use during the dry season and movement to the fadama areas where fodder and water are available during the dry season. Purchase of the fodder material from within and outside the grazing reserve is also another adaptive technique.

Summary, conclusion and recommendation

Summary

Adaptations to climate change exist at the various levels of agricultural organization. The pastoralists in Ladduga have demonstrated a high level of climate change awareness influenced by the use of various information sources and their level of adaptation depends educational level, extension agent contact, membership of cooperative and experience. Techniques such as regular vaccinations and proper medication,

fodder harvest and movement to the lowland fadama areas during the dry seasons are used to reduce impact of climate change.

Conclusion

Both the seriousness of the climate threat to pastoralists, and their capacity to adapt, need to be recognised. What is needed now is to increase the availability of local climate projections for specific pastoral areas (taking proper account of their levels of uncertainty), as well as the wide range of climate impacts on pastoralists, and work on ways to use this knowledge in building adaptive capacity. Climate impacts will be of various sorts and at various scales, through effects on graze and browse availability, patterns of animal diseases, higher prices of purchased cereals, or reduced availability of crop residues. Efforts should be directed toward reducing these impacts through several intervention projects by all tiers of government, non governmental organizations and the pastoralists themselves.

Recommendation

The result showed that climate change has its impact on pastoralists and the following are recommended based on the findings.

i. There is a need for research and extension programme on the dissemination of climate impacts information to pastoralists.

ii. Action to increase pastoralists' resilience to climate change should be taken, by helping pastoralists manage drought and other extreme events, fostering livelihood diversification and education, and giving pastoralists a voice through empowerment and good governance.

iii. More grazing reserves need to be carved out and existing ones rehabilitated to reduce migration possible farmers/pastoralists conflict.

iv. Cattle routes and other reserves encroached by farmers and other land users need to be demarcated for cattle use

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