Climate Change Adaptation Strategies of Agro-Pastoralists Households in Some Selected States in Northwest Nigeria

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Abstract

This study was conducted to identify the most commonly used major adaptation strategies that agro-pastoral households pursue among sets of options to mitigate the effects of climate change in some selected states in northwest Nigeria. The data were collected from randomly selected 260 households, interviewed through a structured questionnaire, key informant interview and focus group discussion (FGD). Descriptive statistics and multinomial logit (MNL) regression model was employed to analyse the data and determine the factors influencing household choices of adaptation strategies related to climate change. The results showed that 44.62% of the respondents were between the ages of 41 and 50 years, and that 59.6% had Qur'anic education. The most commonly used adaptation strategies were: water harvesting (70.0%) and diversification of livelihood activities (72.3%). The MNL regression model revealed that type of livestock kept was significant at various levels of all adaptation-based categories. Access to market and household size were positive and significant at 5% and 10% respectively in rotational grazing-based category. Also, access to credit was significant at 1% in the mixed farming category; and lack of modern techniques of farming, meagre access to improved varieties crop and livestock and inadequate access to credit facilities were constraints to adaption. Therefore, modern techniques of farming and expansion of microfinance institutions for microcredit facilities to strengthen agro-pastoralists' capacity to adapt to climate change were recommended.

Keywords: Climate change, agro-pastoralists, adaptation strategies

Introduction

Agro-pastoralism is an agricultural production system constituting nearly half of the land area of sub-Saharan Africa (Solomon et al., 2013). Agro-pastoralists are of particular importance for the continent and in some countries they represent the majority of the population. Worldwide, agro-pastoralists constitute one of the poorest population subgroups and are mostly in Africa. The incidence of extreme poverty ranges from 25% to 55% due to recent modification in weather and climate elements, which have posed a great deal of challenge to humanity, especially the marginalized, vulnerable and those whose livelihood revolves round elements of climate. According to FAO (2008), agro-pastoralists in Nigeria not only own a major proportion of the national herd, but also contribute a significant share to national meat production.

Many countries in sub-Saharan Africa, including Nigeria, are vulnerable to climate variability and change because large segments of its population are poor, dependent on income opportunities that are highly sensitive to the weather, and have low access to education, information, technology, and health services. They have low adaptive capacity to deal with the consequences of climate variability and change (World Bank, 2010). Pastoralists and agro-pastoralists use mobility to respond quickly to fluctuations in resource availability, dictated by the dry land's scarce and unpredictable rainfall. They also employ a

number of highly specialized risk spreading strategies to safeguard their herds against drought. They have successfully evolved complex indigenous pastoral resource management systems (Niamir, 1999).

Adaptation according to Adger, (2003), is the adjustment of a system to moderate the impacts of climate change, to take advantage of new opportunities or to cope with the consequences. The Stern Review (Stern, 2006) relates adaptation to building resilience, and recognizes that it will be a key response to reduce vulnerability to climate change. Adaptation is not limited to discrete projects (Leary, 2000), such as dams and sea walls. It includes a wide range of adjustments by entities such as households, firms and other institutions in response to the effects of climate change and variability. These include such activities as managing natural resources, input mixes in production, and changes in laws, programmes, policies and investments (Pandey, 2006; IPCC, 2007).

Agro-pastoralists are vulnerable to climate variability and change because large segments of its population are poor, dependent on income opportunities that are highly sensitive to the weather, and have low access to education, information, technology, and health services. They have low adaptive capacity to deal with the consequences of climate variability and change. The country is one of the developing countries in the world, where 77.5% of the people live on less than two dollars a day and 46% of the total population is undernourished (World Bank, 2010). The 85% of population in Nigeria depends on agriculture to make a living (Funk *et al.*, 2005). It was also noted that, there is a slow but growing recognition of local adaptations to the changing situation in terms of efficiency, effectiveness and sustainability. As a matter of fact, the change of climate in the past periods and the trend of its continuity in the future indicate the need to understand agro-pastoralists awareness level and their livelihood strategies with this effect. Therefore, recognition of local adaptation is seen as an entry point to strengthen the resilience of local people to climate change (Macchi et al., 2008). Therefore, this study was conducted to identify the most commonly used major adaptation strategies that agro pastoral households pursue among set of options to mitigate the effects of climate change in some selected states in north-western Nigeria.

Methodology

The study was carried out in North western part of Nigeria. This region is made up of seven States namely: Jigawa, Kaduna, Katsina, Kano, Kebbi, Sokoto and Zamfara State. The study was conducted in three (3) selected States: Kano, Jigawa and Kaduna States has the representative of all other States in north-western Nigeria. The activities of the agro-pastoralists signify for human and food security in Nigeria's northern region. There are similarities in the historical backgrounds of the Agro-pastoralists in the vast arable lands of northern region of Nigeria (Agbegbedia et al., 2014). The choice of these States was based on the high concentration of agro-pastoralists in the region. The north-western zone has an annual mean rainfall of between 750 mm to 11624 mm and annual mean temperature of 28^0 – 52^0C. The major occupation of people in the zone is predominantly farming. The major crop grown is the region includes maize, sorghum, ground-nut, rice, cowpea, cotton, pepper, onion and tomato, while the major livestock includes sheep, goat, cattle, camel poultry and donkey. The weather is usually dry during the dry period of September to April, before the rains become fully established in early May across all the States in the zone (NAERLS, 2012).

Multistage sampling technique involving a combination of purposeful and random sampling was used to collect data for the target population out of sampled agro-pastoral households. The first stage is the purposive selection of 3 States with settled Fulani agro

pastoralists in the zone. The three States were selected purposively with due consideration of distinct agro-ecological conditions, agro- pastoralists presence, future development project programming, logistics, and resource availability. In the second stage three (3) Local Government Areas (LGA) from each of the State were purposively selected. The selection of these LGAs was based on the high population of agro- pastoralists in those areas, thus include Birnin Kudu, Ringim and Miga LGAs in Jigawa State; Madobi, Kura and Tudun Wada LGAs in Kano State and Kujama, Soba and Kudan LGAs in Kaduna State. The third stage involves the random selection of two villages in each of the LGA selected for the study. These villages were; Kafingana and Kantoga (Birnin Kudu LGA); Chai-Chai and Shafa (Ringim LGA); Warwade and Jidawa (Dutse LGA) of Jigawa State. Kanwa and Kwankwanso-Ruga (Madobi LGA); Yarkasa and Natala (Tudun Wada LGA); Karfi and Dan Hassan (Kura LGA) of Kano State, while Sabon Gayau and Kurmi Biri (Chikun LGA); Turawa and Maigana (Soba LGA); Kudan and Likoro (Kudan LGA) of Kaduna State. In the final stages 50% of settled agro- pastoralists' household head were randomly selected in each of the two villages selected for the study. The choice of 50% was based required sample size at 95% confidence level and 9% level of precision.

Reconnaissance survey conducted unveils that there are 144 settle Fulani families household in the two selected LGA in Jigawa State, 178 settled Fulani families household in the two LGA in Kaduna State and 198 settle Fulani families household in the two LGA of selected from Kano States. Therefore, the total of five hundred and twenty (520) settled families' household of agro pastoralists were sampled in the nine (9) LGAs of the three (3) States under study. Only 50% of the entire population of the agro-pastoralists family household was sampled. Therefore, the entire population of Two hundred and sixty (260) agro pastoralists were used as sample size for the study.

Primary and secondary data was used to solicit for information for this study. The primary data was obtained through field survey. An in-depth interview were conducted with agro-pastoralists who are the relevant stakeholders to the questions of adaptation strategies to climate change in the study areas through the uses of a well-`structured questionnaire and focused group discussions (FGDs) conducted to find out whether the agro-pastoralists properly understood adaptation strategies to climate change. One FGDs was held at each LGA with the *Seriki* (leader), all household heads and selected members of the communities with each FGDs containing 15 agro-pastoralists. The data collected were analysed using appropriate analytical techniques using descriptive and inferential statistic to achieve the stated objectives of the study and also to test the hypotheses. But quantitative data analysis was based mainly on descriptive statistics including frequencies, means, percentages and cross-tabulations. Also, multinomial logit (MNL) regression model was employed to determine the factors influencing a households' choice of the most commonly used major adaptation strategies related to climate change. According to Greene (2003), the MNL model for adaptation choice specifies the relationship between the probability of choosing option *Ai* and a set of explanatory variables *X,* as follows:

$$U\beta'jXi+\varepsilon j \text{ and } Uk=\beta'kXi+\varepsilon k$$

Where *Uj* and *Uk* are perceived utilities of adaptation options *j* and *k*, respectively, *Xi* is the vector of explanatory variables which influences the perceived desirability of each option; $\beta\ j$ and βk are the parameters to be estimated, and εj and εk are error terms assumed to be independently and identically distributed. For climate change adaptation options, if a household decides to use option *j.*

The dependent variable is therefore the log of one alternative relative to the base alternative. According to Green (2003), MNL coefficients are difficult to interpret, and associating b_j with the *jth* outcome is tempting and misleading. To

interpret the effects of explanatory variables on the probabilities, marginal effects are usually employed. The marginal effects measure the expected change in probability of a particular choice being made with respect to a unit change in an explanatory variable (Green, 2003). In this analysis, diversification of agro-pastoralists livelihood, rotational grazing and mixed farming practice option was used as the base category. The signs of the marginal effects and respective coefficients may be different, as the former depend on the sign and magnitude of all other coefficients.

Results and Discussion

The result of socio-economic characteristics of agro-pastoralists from Table 3, reveals that 44. 62% of respondents were found to be in the age range of 41-50 years. This implies that majority of agro-pastoralists were old. The result of findings in line with Maddison (2014), who asserted that age of the agro-pastoralists has both positive and negative impacts on adaptation measures to climate change effects. Also higher proportion (59.6%) of agro-pastoralists was illiterate. Torimiro et al. (2003) in his findings stipulated that high level of illiteracy was found to be very common among the agro-pastoralist households because they could not see any link between herding (which constitute their major livelihood) and high level of education. 85% were married. The implication is that there is stable household which is better positioned to practice other livelihood activities (Adesiji *et al.*, 2012). Result also indicated that 73.47% had household size ranges from 5-8 persons. The result of these findings collaborates with the findings of Ajala (2000) that large household size is reflecting the polygamous and extended family nature of agro-pastoralists in the northern Nigeria. Results further shows that 49.23% had between 41-50 years farming experience. Also, 23% of respondents had access to credit and the mean amount of credit received was found to be N469.166.70 and only 21.9% belong to various organization with mean year of 15 years as memberships. About 91.54% of respondents had access to extension advisory services with maximum of 3 visit in a year. 96.53% of the respondent had access to market with maximum of 3 times in a week.

Most used adaptation strategies by respondents

Most agro-pastoralists household claimed to have observed changes in climate over 20 years were subsequently asked if they have responded through adaptation to counteract the impact of the climate change. They revealed that they are using different adaptation strategies to adapt with the negative effects of climate change. The most commonly used major adaptation strategies as reveals among the set of options used by the agro-pastoralists in the study area include among others; Rotational grazing (56.2%), water harvesting (70.0%), land fallowing (53.0%), spitting of herds (64.2%), mixed farming practice(61.5%) and diversification of livelihood activities (72.3%). Others includes: soil conservation (57.3%), vaccination and treatment of livestock (56.9%), uses of forecasting technology (41.5%) and others (23.3%) such as collective action employed in digging of well, financial contribution towards livelihood improvement, securing more land for integration of more food crop farming and pasture. However, The FGD conducted reveals that lack of improve tolerant seed and livestock, inadequate access to extension service delivery, lack of social amenities and credit facilities as some of the problems that are associated with adaptation strategies employed against climate change.

Determinants of respondents' choice of adaptation strategies

The likelihood ratio statistic (194.69) as indicated by the MNL regression model was found to be highly significant (Table 5) indicating the overall fit of the model. The MNL model results presented on Table 4 indicated that diversification of

agro-pastoralists livelihood activities as an adaptation strategy was positively and kept in all categories of adaptation strategies to climate change at all level of significant. This suggested that type of livestock kept played an important role in diversification of livelihood activities of agro-pastoralists, because livestock sale remain the most common livelihood activities of agro-pastoral in most Africa continent. It could be observed also that most agro-pastoralists economies were mostly relied on livestock of economic benefit to sustain earning for their livelihood activities. Based on rearing camels, cattle, sheep, chickens and goats. Mobility and the ability to access pasture and water are fundamental to the continuation of this livelihood (FAO, 2008). Access to market and household size were significant at 10% and 5% level of probability in the rotational grazing category. Also access to credit was positive and significant at 5% in the mixed farming category. This implies that access to credit facility will influence diversification of livelihood activities, which will enable agro-pastoralists to practice mixed farming (crop and livestock production).

Conclusion and Recommendations

Agro-pastoralists are one of the most vulnerable groups affected by climate change and variability. Various adaptation strategies were employed by the agro-pastoralists in the study area to cushion the effect of climate change on the agro-pastoralists livelihood activities. As evidences obtained from this study indicate, the increasing frequency of climate change effect made agro-pastoralists community in the study area vulnerable to recurrent drought and other climate change/variability effects; attacking their capability to adapt various adaptation strategies. Results of MNL regression model reveals that variables such as: type of livestock kept , farm income, distance to market, access to credit, farm income and extension contact were influenced by the adaptation based category for the study at 1%, 5% and 10% respectively. Although it is difficult to come up with solutions of immediate gratification to address the evolving adaptation strategies such as: lack of modern techniques and access to finance immediately. It was therefore recommended that: (i) Agro-pastoralists should be expose to modern techniques of farming in crop and livestock production to improve agro-pastoralist income generating activity. (ii) Expansion of micro-finance system for saving and microcredit service which is easily accessible, available, affordable and acceptable according to the social norm, culture and religious aspects play significant role in strengthening of the agro-pastoralist adaptation strategies of climate change.

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Table 2: Summary of definition and measurement of explanatory variables

Variables	Definition	Measurement	Expecting sign
Age	Household head age	Years	+
Education	Education status of household head	(1=Read/write,2= Quranic, 0 =Illiterate.	+ /-
Household size	Dependents in the household total family members	Number	+ /-
Herd/Farm size	Size of herds/farm	Number of herd/ farm	+/ -
Farming experience	Years of spent in farming activities	Years	+
Access to Extension	Access to agricultural extension services	Number	+ /-
Market distance	Distance to Market	Number in kilometer	+ /-
Access to credit	Accessibility to market	Amount of credit received	+

Table 3: Socioeconomic distribution of respondents

Age (N= 260)	**Frequency**	**Percentage**
< 30 years	5	1.92
31- 40	42	16.15
41- 50	116	44.62
51-60	74	28.46
60 and above	23	8.85
Education (N= 260)	**Frequency**	**Percentage**
No formal education	68	26.2
Quranic education	155	59.6
Primary education	26	10
Secondary education	11	4.2
Marital status (N= 260)		
Married	221	85
Single	26	10
Divorced/Separated	13	5
Household size (N= 260)	**Frequency**	**Percentage**
1-4	29	11.15

5-8	191	85
9-12	39	15.00
13 and above	1	0.38
Total	260	100
Farming Experience (N= 260)		
30-40 years	10	3.85
41-50 years	128	49.23
51-60 years	117	45.00
>60 years	5	1.92
Amount of credit received (n=60)		
300000-400000	33	55.00
400001-500000	14	23.33
500001-600000	4	6.67
600001-700000	1	1.67
700001-800000	8	13.33
Access to extension contact in a year (n= 238)		
Once	116	48.74
Twice	97	40.76
Thrice	25	10.50

Table 4: Adaptation strategies used by respondents against climate change effects

Adaptive strategy	Frequency	Percentage	
Diversification of livelihood	188	72.3	
Soil conservation	149		57.3
Mixed farming practice	160	61.5	
Rotational grazing	146	56.2	
Land fallowing	138	53.0	
Splitting of herds	167		64.2
Water harvesting	182	70.0	
Vaccination and treatment	148	56.9	
Weather forecasting technology	108	41.5	
Others	66	25.3	

*Multiple response

Table 5: Parameter estimates of multinomial logit model on adaptation strategies

Variable	**Coefficients**		
	Diversification of livelihood activities	*Rotational grazing*	*Mixed farming*
Age	0.043	- 0.109*	0.036
Education	0.810	0.014	-0.702
Marital status	16.076	-18.176	0.635
Household size	-0.475	-7.623**	-1.902
Farm size	-0.719	-0.483	-0.222
Farming experience	0.165	18.179	-0.176
Type of livestock kept	0.167**	0.347***	-0.218*
Access to extension contact	-0.411	-0.349	-1.964**
Access to credit	0.000	0.000	0.001***
Access to market	15.833	-2.311*	1.480

Base outcome= Various livelihood activities, forage availably and improved seeds varieties.
Number of observation = 260
Log likelihood = -106.921
Pseudo R2 = 0.4771

Significant ***=1%, ** =5% and *= 1%