



Determinants of Livelihood Diversification among Agro-pastoralists due to Climate Change Effects in the Selected States of North-West Nigeria

¹Suleiman, R., ¹Akpoko, J. G., ¹Akinola, M. O., ²Yusuf, O. and ²Oladimeji, Y.U

¹Department of Agricultural Economics and Rural Sociology, Institute for Agricultural Research. Ahmadu Bello University, P.M.B 44, Zaria, Kaduna State, Nigeria

²Department of Agricultural Economics and Rural Sociology, Institute for Agricultural Research. Ahmadu Bello University, P.M.B 44, Zaria, Kaduna State, Nigeria

Corresponding Author: GSM No; 08033576713, E-mail; rabiuleiman@yahoo.com

Abstract

The study was conducted to determine the factors that influence livelihood diversification among agro-pastoralists in Kano, Kaduna and Jigawa States. A multi-stage sampling was employed to select 260 agro-pastoralists in the 18 communities. Data was collected with the use of well-structured questionnaire, focus group discussions (FGDs) and key informant interview conducted with stakeholders. The results reveals that the means age of respondent was 55 years with higher proportion (59.6%) had quranic education. Majority (85%) were married, with the mean household size of 7 persons. Also 75% of the respondent kept cattle on commercial enterprises. Majority (76.9%) and (78.4%) does not have access to credit and cooperative organisation respectively. Milk value addition, livestock sales, crop production, small handwork and commercial transportation were some of the livelihood activities engaged by the agro-pastoralists due to climate change effects. The results of tobit regression with log likelihood sign of 285.5 and ANOVA based fit measure of .122 indicated that age, purpose of livestock kept and access to market were positive and significance at 5%. Period of residence in the area and household size were positive and significant at 1% while access to credit facility was found to be also positive and significant at 10%. Combination of factors revolving on resource base, diversity and synergy of different activities, peaceful co-existence, grassroots institutions and level of mobility. The traditional coping strategies should be strengthen through co-operative society and Presence of government should be felt through provision of credit facilities, subsidizing production inputs and provision of social infrastructure to enhance linkage between the agro-pastoralists households and government, non- governmental agencies and urban centre to market their products to improving their livelihood activities.

Keywords: Determinants, livelihood, diversification, agro-pastoralists Climate-change

Introduction

Climate change is a global phenomenon that results in global warming, droughts, flooding and depletion of natural resources (Adger *et al.* 2003; Parry *et al.* 2004; Naqvi and Sejian 2011). A study by Nelson *et al.* (2009) indicated that climate change is expected to bring about significant yield losses between 3 and 30 % and extinction of land plants and animal species between 15 and 37 % by 2050 unless remedial measures are taken into consideration. Developing countries are highly vulnerable to climate change since their economy predominantly relies on rain-fed agriculture that totally depends on natural factors. Traditional farming systems practiced, which have low technological capacity, cannot help to adapt and mitigate drastic climate change (Tubiello, 2012)

Despite the occurrences of persistent droughts and agriculture failure emanated from climate change in the Tigray region, livestock provides multiple economic and social benefits. Particularly, sheep and goats are easily convertible to cash to meet households' financial problems such as school fees and agricultural inputs from the sales of live animals and their by-products (meat, egg, manure etc.). As a result, sheep and goats are considered as assets (as a form of insurance) that require minimum initial investment with quick returns due to fast multiplication (Ayele *et*

al., 2008; Legesse *et al.*, 2008; Amankwah *et al.*, 2012; Musara *et al.*, 2013; Hailu, 2014).

The livelihood improvement opportunity can improve the livelihood of the livestock keepers by reducing the poverty. The livelihood opportunity takes different advantages including income diversification, resources storage and reduction of poverty. They can lead the livestock sector as green economy through green livestock farming. In addition, the livestock farmers can introduce the sustainable agricultural land management with the method of minimize the environmental impact by conserving the biodiversity and ensuring sustainable use of natural resources. This can represent three potential relationships among livelihood enhancement, ecological services to climate change and biodiversity preservation (FAO, 2012).

A comprehensive understanding of the effects of and vulnerability to climate change on the livelihood activities of agro-pastoralists is critical in order to guide concerted and focused investment interventions needed to protect agriculture, which is centered on many African economies. The study aims to contribute to livelihood improvement among livestock keepers by supporting the developmental practitioners like non-governmental organizations NGOs and researchers working on climate change related aspects; can use it, as a benchmark or supplementary information for agro-pastoral development and livelihood intervention. Directly or indirectly this study targeted agro-pastoral community to promote their resilience to shock in integration with other stakeholders. (Babatunde *et al.*, 2007)

Materials and Methods

The study was conducted in Kano, Jigawa and Kaduna States as the representative of all other States in Northwestern Nigeria. The North-western zone has an annual mean rainfall of between 750 mm to 1200 mm and annual mean temperature of 28⁰ – 37⁰ C. The major occupation of people in the zone is predominantly farming. The major crop grown in 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 state in the zone (NAERLS, 2012).

Multi-stage stratified random sampling procedure involving a combination of purposive and random sampling was used to collect data for the target population out of sampled agro-pastoral households. Stratified random sampling procedure according to Lawal *et al.*, (2007) involves dividing the population into homogeneous groups containing subjects with similar characteristics. Reconnaissance survey conducted reveals that there were 144 agro-pastoralists households in the three selected LGAs in Jigawa State, 178 agro-pastoralists families household in the three LGAs in Kaduna State and 198 agro-pastoralists families household in the three LGAs of selected from Kano State. Therefore, a total of five hundred and twenty (520) settled families' household of agro-pastoralist household families were sampled in the nine (9) LGAs of the three (3) States under study.

Data were collected using quantitative and qualitative methods. The Participatory Rural Appraisal (PRA) methods involving Focus Group Discussions (FGDs) and Key Informant Interviews (KII) at village level and direct field observations through transect walks was used as a qualitative data collection method. An in-depth interview was conducted with agro-pastoralists' who are the relevant stakeholders to the questions of climate change and environmental factors in the study areas through the use of a well-structured questionnaire conducted to find out whether the agro-pastoralists properly understood what is climate change and its effects on their livelihood

activities. One FGDs was held at each LGA with the *Serki* (leader) and selected 15 members of the agro-pastoralists communities with each FGDs containing 15 agro-pastoralists. Discussants in the FGDs and participants of the questionnaires were purposively selected based on three criteria: (a) settled in the area for ≥20 years, (b) practice agro-pastoral farming for livelihoods for ≥20 years (c) knowledge on climatic and environmental conditions of the area.

Table 1: Distribution of respondents in the study area

Selected states	Selected LGA's	Selected villages	No of settling agropastoralists	50% selected
Jigawa	Birnin Kudu	Kafingana and Dokoki	56	28
	Ringim	Chai-Chai and Shafa	42	21
	Dutse	Warwade and Jidawa	46	23
Kaduna	Chikun	Sabon Gayan and Kurmi Biri	62	31
	Soba	Maigana and Turawa	56	28
		Kudan and Likoro	60	30
Kano	Madobi	Kanwa and Kwankwaso	64	32
	Kura	Karfi and Dan Hasssan	72	36
	Tudunwada	Yarkasa and Natalia	62	31
TOTAL			520	260

Source: Reconnaissance survey, (2015)

On the other hand, the secondary data were generated from the various three Agricultural Development Projects of Kano, Kaduna and the Jigawa States and the Institute for Agricultural Research (IAR) metrological department and National Animal Production Research Institute (NAPRI) both in Zaria. This organization are in constant contact with farmers in the States under study through their extension networks and were able to provide information about the general perspectives of the farming system in those areas. Qualitative data analysis was based mainly on descriptive statistics including frequencies, means, percentages, and cross-tabulations while Tobit regression model was used to determine the relationship between socio-economics and institutional variables influencing livelihoods activities of agro-pastoralists.

The empirical model is specified as follows:

a. Socio-economic characteristics and institutional variables.

$$Y_i = Y^*_i \text{ if } Y^*_i \geq 0 \dots\dots\dots(11)$$

$$Y^*_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 \text{ e} \dots\dots\dots (11)$$

Where:

Y_i = Livelihoods activities of pastoralists (Y_1 = sales of livestock, Y_2 = crop farming, Y_3 =milk and milk by-product production, Y_4 = waged employment, Y_5 = animal traction, and Y_6 = Change in livestock breeds)

Y_i^* = Unobserved livelihoods activities of pastoralists ($[(Z-I_i)/Z]$)

Z = Number of livelihoods activities involved/ practiced by pastoralists

e_i = Truncated error term

β_0 = Intercept term

$\beta_1 \dots \beta_{14}$ = Slope coefficients

x_{1i} = Age (Years)

x_{2i} = Education (Years spent in schooling)

x_{3i} = Extension contacts (Number of extension contacts in a year)

x_{4i} = Livestock rearing experience (Number of year)

x_{5i} = Household size (Number of dependence)

x_{6i} = Loss of animals due to climate change effects (Number)

x_{7i} = Period of residence (Number of years residence in the area)

x_{8i} = crops loss (Amount of crop loss in Naira)

x_{9i} = Access to market (Number of access)

x_{10i} =Membership of cooperative(s) (Number of cooperative belong to)

x_{11i} =Amount of credit (Amount received in Naira)

Results and Discussion

The results of socio-economic characteristics of agro-pastoralists reveals that the mean age was 55years. This result implies that the greater proportion of the agro-pastoralist in the study area was old. Age is a very important variable that determines the degree of active involvement of livelihood activities. This confirms the study by African Development Bank (2002) which reported that majority of the people located in the West African Sub-region are about 45-60 years. The result of this findings shows that high percentage of the agro-pastoralist had a Quranic education background. The mean value for education was found to be 4.19 this indicated a varied different in the educational background among the agro-pastoralists in the study area. 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. The result of the findings also illustrates that majority (85%) of the agro-pastoralist in the study area were married. This implies that marital status among agro-pastoralists will allow more hand in different livelihood activities. The mean household size was found to be 7 persons among the respondents in the study area. Which specifies that the household size is relatively large reflecting the polygamous and extended family nature of Moslem in northern Nigeria. The high dependency ratio, however, indicates the pressure placed on household resources and this, according to Echebiri (2002), reduces both per capita income and saving that could be used to acquire more food for the family. The result further indicates that the agro-pastoralists are well experienced and had engaged in farming and pastoral activities for a long period of time. This number of years of experience allow agro-pastoralists to have a good understanding of the perception of climate change as this enables the agro-pastoralists to strive for good adoption options and profitable diversification strategies. The result reveals that 75% of the

livestock kept are cattle, 12% sheep, 4%, 5% chicken and 2% each belong to turkey and duck. This implies that most of the agro-pastoralists in the study area reared cattle than any other livestock. 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. The result from the Table 2 substantiates that majority (94.61%) of the agro-pastoralists residence in the area while (5.38%) were not residents in the area.

Table 2: Socio- economic characteristics of respondents

Variable	percentage	means
Age (N=260)		
< 30 years	1.92	
31- 40	16.15	
41- 50	44.62	
51-60	28.46	54.73
60 and above	8.85	
Education (N=260)		
No formal education	26.2	
Quranic education	59.6	4.19
Primary education	10	
Secondary education	4.2	
Marital status (N=260)		
Married	85	
Single	10	
Divorced/separated	5	
Household size (N=260)		
1-4	11.15	
5-8	73.47	7
9-12	15.00	
13 and above	0.38	
Years of farming experience (N=260)		
31-40		
41-50		
51-60		
>60		
Purpose of livestock rearing (N=260)		
Commercial	80	
Subsistence	20	
Residence in the area (N=260)		
Residence	246	
Not residence	14	

Source: Reconnaissance survey, (2015)

Results from Table 2 shows that majority (77%) does not have access to the credit facility. Result also indicates that maximum amount of credit received by the agro-pastoralist was ₦750, 000 while the minimum was ₦300, 000 with the mean value of ₦469, 166.70k. The low access to credit could be attributed to the conditions that are attached which most of the agro-pastoralists could not meet. Result also shows that majority (78.46%) of the agro-pastoralists in the study area do not belong to any organization while 22% belong to the cooperative organization. The finding also indicates that the maximum year spent in the cooperative organization was 24 years while the minimum was found to be .9 years with the mean value of 16 years. The result indicates that 91.54% of the agro-pastoralists had access to extension contact while 8.46% had no access to extension contact. The result further indicates that the maximum number of visits in a year was

three times and the minimum of one time per year. The result from Table 3 illustrates that majority (97%) had access to the market for buying and selling of their product while 3.47% had no access to the market. The result further shows that maximum access to market per week was found to be three times and the minimum number of access was one time per week. The mean of the number of access per week was 1.

Table 3: Socio- economic characteristics of respondents

Variable	Percentage	means
Access to Credit facility		
Access (N)	23.08	N 469, 166.70k.
No access	76.92	
Membership of cooperative organization (N=260)		
Non-member of cooperative	78.46	
Religious	4.23	
Livestock	11.15	15years
Political	6.53	
Access to extension (N=260)		
Access	91.54	
No access	8.46	1
Access to market (N=260)		
Access	96.53	
No access	3.47	1.

Source: Reconnaissance survey, (2015)

Livelihood Diversification of Agro-pastoralists in the study areas

Accordingly, in this study, livelihood diversification refers to the attempts by individual agro-pastoralists and households to find new ways to raise incomes and reduce the climate change and environmental factors effects. The ability of agro-pastoralists to fulfill their role as food producers directly depend on the viability of their livelihoods and factors affecting their livelihood strategies. The livelihood of agro-pastoralists depends on three things: first, access to assets such as land, livestock, pasture, water, animal health services, market, and credits. Second; the environment in which these assets are combined with production and consumption, specifically the organizational and institutional infrastructure within which they operate, which affect their ability to use these assets to achieve positive livelihood outcomes, and thirdly, the dynamic content of risks (human and continuous trends that affect assets and their environmental and determine the vulnerability of livelihoods (Rass, 2006).

Livelihood diversification can take place through both agricultural diversifications such as rearing of different livestock, production of multiple crops and non-agricultural livelihood diversification such as: undertaking small enterprises or choosing non-agricultural sources of livelihood like casual labour and uses of drought animals in the farm to earn a living. (Ellis, 2000)

Result from Table 4 indicates that the most preferred livelihood activities by the agro-pastoralists in the study area include: livestock sale, milk and milk value chain addition were the most important source of cost income ranked as 1st, it was also revealed through the FGD that Gross annual livestock income was realized through the sale of live animals (cattle, sheep, goat, and chicken), and through pure and coagulated milk (Nunu) that were sold. Crop production is another area that agro-pastoralists involves and most preferred as 2nd. It was revealed that over the years, there has been an increase in cultivation witness across the region due to climate change that made

them diversify. Land under crops was relatively small, the average of land cultivated was 2.1 acres, ranging from 0.25 to 5 acres per household. Crops grown in the area include maize, guinea corn, millet, and potatoes. Other livelihood activities were waged employment activities mainly include small handwork, commercial transportation, and other local services as well as trade in agricultural and non-agricultural goods. Diversification in rural livelihoods is the subject of conceptual and policy-based research because income from farming has come under pressure due to climate change effects (Brown *et al.*, 2006) It is being realized for some time that rural people no longer remain confined to crop production or livestock-rearing but combine a range of occupations to construct a diverse portfolio of activities (Ellis, 2000)

Table 4: Livelihood activities involved in by agro-pastoralists in the study area

Livelihood activities involved in by agro-pastoralists in the study area	Frequency	Percentage	Most preferred
Milk value addition and Livestock sales	237	91.2	1 st
Crop production	184	70.8	2 nd
Small handwork	165	63.5	3 rd
Commercial Transportation	48	18.5	4 th
Trading in foodstuff	45	17.3	5 th
Farm labour	32	12.3	6 th
Sale of cow dung	30	11.5	7 th
Art and craft	18	6.9	8 th
Hunting and fishing	15	5.8	9 th
Petty trading	4	1.5	10 th
Beekeeping	3	1.2	11 th

* Multiple responses

Tobit regression analysis results on the relationship between socio-economic and institutional variables on livelihood activities of Agro-pastoralists.

The log livelihood function sign of 285.5 and anova based fit measure of .122 in Table 5 illustrates that most of the signs related to the factors influencing livelihood and activities of the agro-pastoralist were not as expected. In the socio-economic variables, the coefficient of age was positive and significant at 5%. This implies that age is an important factor in determining the livelihood activities of agro-pastoralists. The older the agro-pastoralist, the more the ability to secure more livelihood activities. The implication of this is that there is an opportunity in an increase of livelihood activities as the age increases. These findings are similar to the findings of Amaza *et al.* (2006). They reported that age as a significant influence on the livelihood activities of agro-pastoralists. This is because age gives an experience into different livelihood activities that are profitable and sustainable. In the same vein Bamake *et al.* (2012) reported that old age is positively correlated with livelihood activities of agro-pastoralists/farmers.

The coefficient of the period of residence was positive and significant at 1%. The positive influence of the period of residence is usually attributed to the longer period of time that agro-pastoralist have lived in such area. This gives them the prospect to know and has the knowledge of different livelihood activities that are more promising, also, it enables the farmers to study the socio-cultural, environmental and livelihood activities of the area. This will enable the agro-pastoralists to know what to engage in terms of livelihood activities that are more money-making in the area. This

conforms to the findings of Olawoye (2002) that the number of years of residency plays a crucial role in respondents' livelihood activities. More so, the coefficient of household size was significant at 1% this suggests that the number of household size play a crucial role in the determinant of livelihood activities of agro-pastoralists, with large household size farm labour is assured. This result is similar to that obtained by Babatunde *et al.* (2007) who noted that household size has a negative coefficient that is significant at 5% level, implying that as the household size gets larger the probability of family labour increase. The coefficient of the farming purpose was also found to be significant at 5% which implies that purpose of farming played an important role in the socio-economic factors influencing livelihood activities of agro-pastoralists.

In the institutional variable group, the coefficient of access to credit was positive and significant at 10%. This implies that credit enhanced the livelihood activities of agro-pastoralist. This could be attributed to the fact that for those agro-pastoralists who are able to apply for the credit facility, a reasonable amount of credit was granted to them. Thus, making it easy to engage in any other livelihood activities such as crop production with easy access to inputs such as seeds, fertilizer, and pesticides since resource-base is very poor for most of the agro-pastoralist. This supported the findings of Karen (2010) who reported that credit use increase livelihood activities of agro-pastoralist. Similarly, Liu (2006) reported that financial constraints may deprive farmers of various livelihood activities which may result in poverty.

The result further reveals that the coefficient of access to market was positive and significant at 5%. The implication of this is that with access to market will improve the livelihood activities of agro-pastoralists. The findings are similar to Babatunde *et al.* (2005). They reported that spatial variable such as access and distance to market significantly enhance livelihood activities of agro-pastoralist. It is worthwhile to say that the sale of dairy products such as pure and coagulated milk (nunu) and other by-products such as butter and cheese provide roughly household income in a nearby market due to their perishable nature. In addition, the scope for livelihood activities also gets boosted when there are good social infrastructure facility and proximity to urban market (Karim, 2010).

Table 5: Tobit regression analysis results on relationship between socio-economic and institutional variables on the livelihood activities of Agro-pastoralists.

Variables	Coefficient	Std. Err.	T-Value
Socio-economic variables			
Age (years)	.00220541	.00095499	2.309**
Edu (years)	-.342169	.780440D-04	-.438 ns
Livestock rearing experience (years)	.00042177	.00112291	.376 ns
Number of livestock(No)	.00078873	.00290054	.272 ns
Period of residence (year)	.00042923	.00013323	3.22 ***
Life lost (number)	.00082664	.00323169	.256 ns
Institutional variables			
Access to credit (₦)	.4425	.222090D-07	1.993*
Extension contact (number)	.00524767	.00626599	.837 ns
Access to market (number)	.02880136	.01395078	2.064**
Cooperative membership (years)	.00043599	.00073098	.596 ns
Sigma	.07317623	.00330453	22.144
Log likelihood function =	285.5186		
Info. Criterion: AIC =	-2.02707		
Anova based fit measure=	.122178		
Decomp based fit measure=	.113538		

*** = significant at 1% ** = significant at 5% * = significant at 10% & ns = not significant

Conclusion and Recommendations

The effects of climate change on the livelihood activities of agro-pastoralists has become a serious threat to their livelihood activities, making them diversify into other livelihood activities. The result of Tobit regression on the socioeconomics / institutional variable influencing livelihood activities of agro-pastoralists reveals that the coefficient of age, a period of residence and household size was positive and significant at 1%, while the coefficient of access to credit and market were found to be significant at 10% and 5% respectively. Under the agro-pastoralism resilience of livelihood is determined by a combination of different indicators at different levels. Hence the indicators and linkages at the community, household, and plot levels are worth considering. In other words, there is needs to consider environmental and social, individual, group, local and external factors. Generally, the core areas of resilience are combination of factors revolving on resource base, diversity and synergy of different activities, peaceful co-existence, grassroots institutions and level of mobility. Therefore, it is recommended that, Traditional coping strategies should be strengthen through cooperative society and presence of government should be felt through provision of credit facilities, subsidizing production input and provision of social infrastructure to enhance linkage between the agro-pastoralist households and urban centre to market their products to better their livelihood activities.

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