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INVESTIGATING CLIMATE SMART AGRICULTURAL PRACTICES IN LIVESTOCK PRODUCTION IN SOKOTO STATE, NIGERIA: AN APPLICATION OF PRINCIPAL COMPONENT ANALYSIS

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Abstract

This study sought to investigate the factors influencing the use of climate smart agricultural practices in livestock production in Sokoto State, Nigeria. Multi-stage sampling procedure was used to select 60 respondents for the study. Data analysis was carried out using descriptive statistics, Principal Component Analysis (PCA) and Ordinary Least Square (OLS) regression. The descriptive statistical analysis reveals that the average age of the livestock farmers in Sokoto State was 54 years. Regression results shows that the significant determinants of using climate smart agricultural practices in livestock production were education and communication equipment which were both significant at ($p<0.01$). This implies that those who had informal education had their indices of climate smart agricultural practices for livestock enterprise being significantly lower by 33.59% when compared with their counterparts with formal education. Farm size was positively significant ($p<0.05$). This connotes that a unit increase in farm size will lead to corresponding increase in the indices of climate smart agricultural practices by 0.0664 for livestock farmers. The study concludes that livestock farmers were adversely influenced by education.This might be as a result of the predominance of Arabic education in the study area. It is recommended that: Government, Non-Governmental Organizations and farmers' associations should create a conducive learning environment to encourage the livestock climate smart Practioners to improve on their performance. Policy on informal education should be enriched and developed in the curriculum to meet the livestock climate smart agricultural challenges. Extension delivery system approach should be upgraded to meet the present information age.

Keywords: *Climate-Smart-Agriculture, Livestock, Principal-Componet-Analysis, Sokoto State.*

Introduction

Nigeria is endowed with estimated 19.5million cattle,72.5 million goats 41.3 million sheep, 7.1million pigs, 278,840 camels, 145million chickens, 11.6million ducks, 2.1 million turkey and 974499 donkeys (National Agricultural Sample Survey,2011) making the nation the topmost livestock production in West Africa. Despite this huge and robust population of livestock in Nigeria enterprise, majority of livestock in Nigeria is kept by subsistence farmers. The gap between the actual and expected protein intake among Nigerians continues to widen (Oyedeji et al, 2003). The Livestock sub-sector contributes only 5.1% to our National Gross Domestic Product, thereby making Nigeria a net importer of protein food of animal origin (Rahji *et al.,* 2015). Climate variation ocassioned by the green gas carbon emmission had imposed a great threat to the suvival of the livestock industry in Nigeria**.** This, coupled with myriads of factors have hinderered the livestock industry from attaining greater economic heights. Fluctuations in weather and other climatic factors directly affect the quality and availability of fodder and feed and also accelerate degradation of grazing land owing to increased drought of food risk as well as the threat of disease Terdoo et al.(2014) In 2016, about ₦2,000 billion loss was recorded in the livestock sector due to climate fluctuations. Climate-smart agriculture is agricultural approach that sustainably increases productivity, enhances resilence (adaptation) reduces green house gas (mitigation) and enhances achievement of national food security. Application of this concept to livestock farming will eliminate potential threat in livestock. Climate Smart has the potential to enable the livestock industry attain its enviable position. It is on this premise that this reseach attempted to find solution to the factors influencing the climate smart agricultural practices such as building resilence, grassland restoration and feed management, manure management and crop-livestock intergration in livestock enterprises. The specific objective of the study is to examine the socio-economic characteristics of climate Smart livestock farmers and determine the factors that influence climate smart agricultural practices in livestock enterprises in the study area.

Material and Methods

The Study area which is Sokoto State is divided for administrative purpose into four agricultural zones namely: Tambuwa, Sokoto, Isa and Gwadabawa zones. This region is described by a relatively hot climate, with seasonal rainfall and a marked dry season (Draper and Maureen 2009). The soils is characterized as reddish brown or brown soils of the semi-arid and arid areas and are known as tropical ferruginous soils which are made up of about 85% sand with PH values that varies between 6.0 and 7.0 (Harris, 1999). It is therefore evident that changing climates (increasing droughts or floods) will influence agricultural productivity.

The climate makes the farmers to cultivate a very widespread of crops such as cereal, legumes and vegetables. Livestock such as cattle, goats, sheep, and poultry birds such as chickens, turkeys, pigeons and ostriches among others are reared extensively. The population of this study includes all livestock farmers in sokoto state of nigeria.

Primary data for the study was collected using well-structured pretested questionnaire. Multi-stage sampling procedure was employed for the collection of data from the rural farming households. The first stage involved a purposive selection of Tambuwa, and Gwadabawa agricultural development zones from the four agricultural development zones in the state.This is because livestock are predominantly reared in these two zones, the second stage involved a random selection of two (2) Local Government Areas from each of the two agricultural development zones to make four (4) local governments in all. The third stages involved a random selection of five (5) communities from each Local Government Areas to give a total of twenty (20) Communities. Lastly, three (3) farming households were randomly selected from each of the communities to give a total of sixty (60) respondents.

Method of Data Analysis

In this study, descriptive statistics such as means, frequency distribution, and standard deviation were used to describe the socio-economic characteristics of the climate Smart agricultural farmers. To determine the factors influencing the practice of climate smart agricultural in livestock enterprises, the socioeconomic variables were regressed against composite dependent variables relating to the use of climate smart agricultural techniques in livestock enterprises. The Principal Component Analysis (PCA) was used to compute the composite dependent variable that was being estimated with a multiple regression model. The principal component analysis was used to generate the composite variable obtained from the use of climate smart agriculture for livestock such as building resilence, grassland restoration and feed management, manure management and crop-livestock intergration.

The principal component analysis as specified by Ifelunini *et al*., (2013) is presented thus: Given variables (Xs represent the various factors used to develop the composite indices for livestock) $X_1,\ldots, X_p$ measured in 'n' farmers, while $Z_1,\ldots, Z_p$ are the principal components which are uncorrelated linear combinations of the original variable, $X_1,\ldots, X_p$, given as:

$Z_1 = \alpha_{11}X_1 + \alpha_{12}X_2 +\ldots+ \alpha_{1p}X_p$

$Z_2 = \alpha_{21}X_1 + \alpha_{22}X_2 +\ldots+ \alpha_{2p}X_p$

. . . .

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$Zp = \alpha_{p1}X_1 + \alpha_{p2}X_2 +\ldots+ \alpha_{pp}X_{pz}$

This matrix of equations can be expressed as z = Ax, where z = $(Z_1\ldots Z_p)$, x = $(X_1\ldots X_p)$ and A is the matrix of coefficients. The coefficients of the first principal component, $\alpha_{11}\ldots \alpha 1p$, are chosen in such a way that the variance of Z_1 is maximized subject to the constraint $\alpha_{211}\ldots \alpha_{21}p = 1$This matrix of equations can be expressed as z = Ax, where z = $(Z_1\ldots Z_p)$, x = $(X_1\ldots X_p)$ and A is the matrix of coefficients. The coefficients of the first principal component, $\alpha_{11}\ldots \alpha 1p$, are chosen in such a way that the variance of Z_1 is maximized subject to the constraint $\alpha_{211}\ldots \alpha_{21}p = 1$

Y = Composite variable (it values ranges from 0 to 2)
X_1 = Educational status; 1 educated in Arabic, 0 otherwise
X_2 = Religion; 1 if Muslim , 0 otherwise
X_3 = Household size; number of person(s)
X_4 = Flock size; number
X_5= Land acquisition; 1 if inherited, 0 otherwise
X_6 = Type of labour; 1 if skilled and unskilled , 0 otherwise
X_7 = Membership of association; 1 if yes, 0 otherwise
X_8 = Communication kits used ; 1 if TV or GSM, 0 otherwise
X_9 = Number of Extension contacts; numbers of times
X_{10} = Access to credit; 1 acess to credit, 0 otherwise
X_{11} = Lack of high quality breed; 1 quality breed, 0 otherwise
X_{12} = Lack of time to practice Climate smart agriculture time availability, 0 otherwise
X_{13} = Lack of process technology 1 availability, 0 otherwise.

The multiple regression model is specified thus :

$Y = \beta_0 + \sum_{n=1}^{13} \beta_i X_i + \varepsilon_i$..1

Where Y represents the dependent variables (the composite variables generated from the use of csa livestock techniques by the farmers such as building resilence, grassland restoration, feed management, manure management and crop-livestock intergration for livestock and it values ranges from 1 to 2), β_0 represents the intercept, β_i the coefficients of the independent variables, X_i the vector of independent variables listed above and ε_t the stochastic or error term.

Table 1: Socio-economic Characteristics of the Livestock Climate Smart Farmers

Variable	Range	Frequency	Percentage
Age	< 20	2	0.68
	20-30	16	5.44
	31-40	94	31.97
	41-50	52	17.69
	51-60	84	28.57
	>60	46	15.65
	Total	294	100.00
Households Size	1-5	30	10.20
	6-10	147	50.00
	11-15	64	21.77
	16-20	32	10.88
	>21	21	07.15
	Total	294	100.00
Expenditure	<5,000	112	38.10
	5,000 -10,000	15	05.10
	11,000-15,000	42	14.29
	16,000-20,000	45	15.30
	>20,000	80	27.21
	Total	294	100.00
Experience	1-5	34	11.56
	6-10	63	21.43
	11-15	42	14.29
	16-20	20	06.80
	21-25	48	16.33
	>26	87	29.59
	Total	294	100.00
Flock Size	1-10	155	52.72
	11-20	45	15.31
	21-30	68	23.13
	>30	26	08.84
	Total	294	100.00
Extension Contact	1-5	227	77.21
	6-10	31	10.54
	11-15	26	08.84
	>16	10	03.40
	Total	294	100.00

Source: Field Survey Data (2016).

Factors Influencing Climate Smart Agricultural Practice in Livestock Enterprises

Table 2 shows that mean Variance Inflation Factor (VIF) of 1.10 which shows that there was no multi-collinearity among the independent variables. Also, heteroscedasticity was automatically corrected for, hence robust estimates were used. Table 3 present F-statistics value of 3.18. This was significant ($p<0.01$) and indicates that the model is well fitted. The multiple coefficient of determination (R-Square) value of 0.5286 revealed that 52.86% of the variability in the indices of climate smart agricultural practices was accounted for by the independent variables.

Regression results in table 3 show that education and communication equipment were significant ($p<0.01$). This implies that those who had informal education (Arabic education) had the indices for climate smart agricultural practices for livestock enterprise to be significantly lower by 0.3359 when compared with their counterparts with formal education. The result is in line with the work of (Terdon and Adekola 2014) who found setbacks in livestock production as a result of dominance of informal education among the farmers in the northern part of Nigeria. The study further suggests that the use of climate smart agriculture for livestock production by respondents who communicated by handsets was significantly lower by 0.483 than those who were informed by radios, televisions and videos.(Oyekale and Oyekale 2010) observed that lack of communication caused a great loss in animal output.

Flock size was significant at ($p <0.05$). This connotes that a unit increase in flock size will lead to corresponding increase in the indices of climate smart agricultural practices by 0.0664 for livestock farmers. This result is in support of Philips (2010) who concluded that livestock production is directly linked with competition of animal for space, natural resources and food and feeding supplement which was a function of farm size.

Extension contact and lack of access to high quality hybrid both were significant at ($p <0.05$). It means that respondents who had no extension contact and those with lack of access to high quality hybrid had significantly lower use of climate smart agricultural practices for livestock by 0.1887 and 0.4626 respectively. Philip *et al*., (2009) obtained a similar result and attributed the poor performance to lack of funding in the extension delivery system to the farmers and paucity in coordination of the extension program in Nigeria.

Table 2: Multi-Collinearity Test of Variables

Variable	VIF	Tolerance	Eigenvalue
Education	1.08	0.9260	8.5056
Religion	1.12	0.8950	1.0884
Households	1.17	0.8513	0.9528
Farmsize	1.20	0.8339	0.8854
Landacquisition	1.06	0.9430	0.6006
Labour	1.03	0.9693	0.4165
Membership	1.16	0.8632	0.3597
Communication	1.19	0.8377	0.3422
Extension contact	1.02	0.9768	0.2737
	1.04	0.9652	0.2335
Lack of access to credit.	1.08	0.9228	0.1604
Lack of hiqua.hybrid.	1.05	0.9556	0.0971
Lackoftime to pracsa.	1.12	0.8902	0.0669
Lack of proctechno.			0.0170
Mean VIF	1.10		

Source: Authors computation from Multicollinearity Test

Table 3: Factors Influencing Climate Smart Agricultural techniques on Livestock Enterprise

Livestockcsa	Coefficient	Robust Standard Error	t-value	p-value
Education	-0.3359	0.1258	-2.67	0.008*
Religion	0.2012	0.3283	0.61	0.541
Households	0.0295	0.0303	0.97	0.332
Flock Size	-0.0664	0.0290	2.29	0.023**
Landacquisition	-0.3768	0.3582	-1.05	0.294
Labour	-0.2779	0.2886	-0.96	0.336
Membership	-0.1244	0.1798	-0.69	0.490
Communication	-0.4830	0.1840	-2.63	0.009*
Extension contact	-0.1887	0.0742	-2.55	0.011**
Inadequate credit.	-0.1013	0.2106	-0.48	0.631
Inadequate .hybrid.	-0.4626	0.2116	-2.19	0.030**
Inadequate pracsa.	-0.2074	0.1784	-1.16	0.246
Inadequate proctechno.	0.0800	0.3432	0.23	0.816
Constant	0.6366	0.5840	1.09	0.277
Number of Obs:	294			
F (13, 280)	3.18			
Prob> F	0.0002			
R-Squared	0.5286			
Adj R-Squared	0.4881			
Root MSE	1.4301			

Source: Authors Computation from Regression Analysis
*Note: *, ** and *** means 1%, 5% and 10% level of significant respectively*

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