Climate Change Perceptions and Smart Agricultural Practices among Goat Farmers in Bassa, Plateau State, Nigeria

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Abstract: **This study analyzed climate change perceptions and smart agricultural practices among goat farmers in Bassa Local Government Area of Plateau state, Nigeria. Multi-stage sampling technique was adopted for the study. Primary data were collected using structured questionnaires. Statistical and inferential techniques were used for data analysis. The results of the study revealed that the socioeconomic characteristics significantly affected goat farmer's adoption decisions. The most significant effect of climate change on flock performance was indicated through pest and disease infestation (3.44). Irregular rainfall pattern (3.3) had the most significant effect on grazing land. Semi-extensive systems (3.51) were the most prevalent farm management practice; however the level of adoption of smart agricultural practices was relatively low among the respondents. The estimated Nagelkerke R^2 was 0.678, suggesting that 68% of the variation in farmer's adoption decision was accounted for by the variables in the regression model. Also, all the constraints identified significantly affected their adoption decisions. Efforts to ameliorate these adoption constraints are strongly recommended.**

Keywords**: Adoption, Goat Farming, Management Practices, Perceived Effects, Socioeconomic Factors**

I. INTRODUCTION

There is an interrelationship between climate change and the livestock production [I]. Livestock play a critical role in the livelihoods of many of the rural population, acting as a source of both credit and savings in rural communities that are remote from financial services, providing food and cash income for the urban as well as the rural poor, and for many people offering a route out of poverty [I]. Major livestock systems like goat farming are credited with providing environmental services, including promoting rangeland health (and total biomass) and thereby helping to capture atmospheric carbon and mitigate climate change. Studies by [II] and [III] have indicated that Africa is generally acknowledged to be the continent most vulnerable to climate change. The weather is erratic and unreliable to livestock farmers. [IV] have concluded that the worst impact of climate change is felt by livestock farmers. [V] predicted future economic losses and the increased risk of hunger due to climate change. It seems clear that high climatic variability associated with goat production will constitute important production constraint [VI]. Climate smart agricultural practices refer to the adjustments in ecological, social, and economic systems as well as response to climatic conditions and their effects. The capacity of goat farmers to adapt to climate change can be significantly influenced by their level of awareness about the effects of climate change in their communities. There is great need for farmers to develop strategies to cope with the stress and damage climate change can impose on the agricultural production [VII]. The development and implementation of climate smart agricultural practices will go a long way to help offset the unpredictable nature of the climate for sustainable livestock production. Livestock farmers in developing countries are especially vulnerable to these impacts of climate change. It is against this backdrop that this study will seek to find answers to the following research questions:

i. What are the socioeconomic characteristics of the respondents?
ii. What are the perceived effects of climate change on flock performance?
iii. What are the perceived effects of climate change on grazing land?
iv. What are the smart agricultural practices adopted in the study area?
v. What are the determinants of the farmer's adoption decisions?
vi. What are the constraints of the farmer's adoption decisions?

II. METHODOLOGY

*Study Area***:** The study was conducted in Bassa Local Government Area (LGA) of Plateau state. It has a land mass of 1,776 kilometers. Bassa Local Government is made up of nine districts with major ethnic groups including Miango, Amo, Rukuba, Gashish and Buji [VIII]. The average monthly temperature in the study area ranges between 20^{o}C - 31^{o}C. It also has an average mean monthly rainfall about 122.6mm in April which increases rapidly to 302.8mm in August. The rainfall begins to decline in September and drops to 57.7mm in October. Rainfall in Bassa local government area is

generally conventional with occasional torrential storm that is accompanied by hailstones [IX].

Sampling Procedure: A multistage random sampling technique was employed in selecting the respondents used for the study. In the first stage, three (3) districts, i.e. Miango, Amo and Rukuba were purposively selected due to the prevalence of goat farmers in the area. In the second stage, two (2) villages were randomly selected from each of the three districts; the last stage involved the systematic random selection of goat farmers within the selected villages using a list of livestock farmers compiled by the [IX]. Using a constant sampling proportion of 0.08 (8%) a sample size of 102 respondents was selected from a sample frame of 1,275 goat farmers, while only 82 questionnaires were retrieved and used for the purpose of this study.

Data Collection: Primary data was collected using well-structured questionnaires.

Method of Data Analysis: Both descriptive and inferential statistics was used to analyze the data. The analytical techniques used for this study include descriptive statistics (frequencies, percentages and mean) to analyze objectives i and iv and vi, mean score ranking to analyze objective ii and iii, and the Logit regression model to analyze objective v.

Mean Score Ranking (MSR): was used to evaluate the perceived effects of climate change on flock performance and grazing land in the study area. To determine the mean, each item was calculated by multiplying the frequency of each response pattern with its appropriate nominal value and dividing the sum with the number of respondent to the items. The effects were therefore ranked using their mean scores. This can be calculated as follows;

$Xs = \Sigma (f_n x_n)/N$ …… (I)

Where: Xs=mean score; ∑=Summation; f_n= Frequency of 'n' occurrence; x_n = Score assigned to 'n' occurrence

Given that; 1= not intense (NI), 2 = low intensity (LI) and 3 = high intensity (HI)

N = Total number of respondents

Xs =1+2+3=6/3=2 …… (II)

Therefore any mean score ≥2 will be considered significant.

Logit Regression Analysis: was used to analyze the determinants of the farmer's adoption decision in the study area as applied in a study by [X]. The Logit regression model was used to establish relationship between the likelihood of adoption of smart agricultural practices and the various factors affecting it. The model is specified implicitly as;

$Y_i = \beta_0 + \beta_i X_{ij} + U$ …… (III)

Where;

Y_i=a dichotomous response variable such that; Y=1, if farmers adopt a smart agricultural practice(s) and Y = 0, if farmers do not;

B_0 = intercept;

Bi= coefficient of the estimated parameters;

Xij= Set of independent variables; and

U = error term which is normally indicated as zero mean and variance.

Therefore the regression model can be specified explicitly as follows:

$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + U_i$ …… (IV)

Where;

Y_i=a dichotomous response variable such that; Y=1, if farmers adopt a smart agricultural practice(s) and Y = 0, if farmers do not;

B_0 = intercept;

$\beta_1, \beta_2 \ldots \beta_7$ = the coefficients of the independent variables;

X_1= Gender (1=male, 0=female);

X_2 = Education (number years spent in school);

X_3 = Flock size (numbers);

X_4= Farming experience (years);

X_5= Credit access (1=yes, 0=no);

X_6 = Extension contact (frequency of contact); and

U_i = disturbance term or error term which is normally indicated as zero mean and variance

III. RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Goat Farmers

The result in Table I revealed that most (62.19%) of the goat farmers in the study area are male, suggesting that males are more involved in raising small ruminants (Goats) with the females involved in other activities like processing of farm produce and marketing of livestock products. The mean number of years spent in school by the respondents was 7 years, which implies that most of the respondents had attained some level of formal education. Furthermore, the respondents had a mean flock size of 14 goats, suggesting that the goat farmers in the study area were mostly small scale livestock farmers producing at subsistent level. Also, the mean farming experience of the respondents was 17 years, suggesting that most of the farmers had adequate years of livestock production experience. Most (83.75%) of the goat farmers have no access to agricultural credit, which further aggravates the problems of inadequate capital. This may be attributable to the inadequacy of financial institutions in the study area and the cumbersome procedures of applying for agricultural credit

from these institutions. The mean frequency of extension contact with farmers was once; suggesting that the farmers received limited or no extension contact. This result corroborates with findings of [III] and [II] who also reported that socioeconomic factors significantly affected farmer's adoption decisions.

Perceived Effects of Climate Change on Flock Performance

The result in Table II revealed that the perceived effects of climate change on flock performance are very significant and was indicated through pest and disease infestation (3.44), parasite incidence (2.37), irregular appetite (2.21), increased mortality (2.17), and decreased birth rate (2.02) as reflected by the mean scores. This also corroborates with findings of [III], [XI] and [VII] who reported similar results.

Perceived Effects of Climate Change on Grazing Land

The result in Table III revealed that the perceived effects of climate change on grazing land was very significant and were indicated through irregular rainfall pattern (3.37), prevailing temperature (2.98), drought (2.32), and flood occurrence (2.23) as reflected by the mean scores. This also corroborates with findings of [III], [XI] and [VII] who reported similar effects of climate change on grazing land.

Level of Adoption of Climate Smart Practices

The result in Table IV revealed that the level of adoption of climate smart practices among the goat farmers was relatively low. The most significant practices adopted include; semi-extensive systems (3.51), adoption of improved breeds (2.35), fodder trees (2.29), and use of feed supplements (2.04) as reflected by the mean scores. This result corroborates with findings of [VI] and [II] who reported similar levels of adoption of management practices.

Factors Influencing Farmer's Adoption Decision

The Logit regression analysis presented in Table V was used to determine the socioeconomic factors that influence the goat farmer's adoption decisions. The regression coefficients of flock size (0.694), farm experience (0.421) were positive and statistically significant at 1% (p<0.01) level. Also, education (0.091) and extension contact (0.419) were positive and statistically significant at 5% (p<0.05) level, this implies an increase in these positive variables, holding other factors constant will lead to an increase in the likelihood of adoption of smart agricultural practices among the goat farmers. The coefficient of access to credit (-0.716) was negative, but statistically significant at 5% (p<0.05) level, this negative coefficients suggests an inverse relationship with farmers adoption decisions. Log of likelihood function was estimated at 7.469 and was significant at (p<0.05), it explained the variance in the outcome variable; the result indicated that the model was very fit. The Nagelkerke R^2 was estimated at 0.678, indicating that the model was well fitted. Hence, suggesting that 69% of the variation in the goat farmer's adoption decisions was accounted for by the variable inputs in the model. This study confirms the influence of socioeconomic characteristics on the adoption decision of farmers. The results from the regression analysis indicate that most of the explanatory variables affect the probability or likelihood of adoption of climate smart agricultural practices in the study area. This result corroborates with findings of [VI] and [II] who also reported that socioeconomic factors influence farmer's adoption decisions.

Constraints of Farmer's Adoption Decision

The result of Table VI revealed that the constraints of farmer's adoption decision include; lack of capital (90.2%), inadequate land (97.6%), lack of technology (84.1%), and poor extension contact (79.3%). All the constraints identified significantly affected the goat farmers adoption decisions in the study area. This result corroborates with findings of [III] and [II] who also reported similar constraints of farmer's adoption decisions.

IV. `CONCLUSIONS

This study analyzed climate change perceptions and smart agricultural practices among goat farmers in Nigeria. The results of the study revealed that the socioeconomic factors of the respondents significantly affected their adoption decisions. The perceived effects of climate change on flock performance and grazing land were significant as reflected by the mean scores. Also, the level of adoption of climate smart practices among the goat farmers was relatively significant as reflected by the mean scores. The results from the regression analysis indicate that most of the explanatory variables affect the probability or likelihood of adoption of climate smart agricultural practices in the study area. All the constraints identified significantly affected the goat farmers adoption decisions. Efforts should be channeled towards ameliorating these constraints. Furthermore, the following recommendations are suggested based on the observations and inferences made from the study;

i. Modifying tenure policies and practices to mitigate incidence of land fragmentation.
ii. Improving farmer's access to agricultural credit, extension services and climate information.
iii. Increasing farmers access to improved production inputs and technology at subsidized costs.
iv. Increased sensitization of livestock farmers on the possible effects of climate change, management and adaptation practices.

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Tables

Table I: Summary Statistics of the Socioeconomic Characteristics of the Goat Farmers

VARIABLE	MEAN	FREQUENCY	PERCENTAGE (%)
Gender (male)			
Education	7.4	51	62.19
Flock size	14.8	67	83.75
Farming experience	17.2	40	48.78
Credit access (No)			
Extension contact			
Feed source(grazing)	1.1	51	62.20
Management(semi intensive)			

Source: Field Survey (2017)

Table II: Effects of Climate Change on Flock Performance

PERCEIVED EFFECTS	∑FN	MEAN	RANK
Pest and disease infestation	282	3.44	1st
Incidence of parasite	194	2.37	2nd
Irregular appetite	181	2.21	3rd
Increased mortality rate	178	2.17	4th
Decreased birthrate	166	2.02	5th
Pregnancy abortion	157	1.91	6th
Irregular growth rate	143	1.74	7th

Source: Field Survey (2017)

Table III: Effects of Climate Change on Grazing Land

PERCEIVED EFFECTS	∑FN	MEAN	RANK
Irregular pattern of rainfall affects pasture availability	276	3.37	1st
Prevailing temperature has effect on the pasture	244	2.98	2nd
Drought is a common occurrence	190	2.32	3rd
Flood occurrence hinder pasture growth	183	2.23	4th
Other degradation factors	142	1.73	5th

Source: Field Survey (2017)

Table IV: Climate Smart Practices Adopted

CLIMATE SMART PRACTICES	∑FN	MEAN	RANK
Semi-extensive systems	288	3.51	1st
Adoption of cold tolerant breed of goat	193	2.35	2nd
Planting fodder trees	188	2.29	3rd
Provision of supplement feed	167	2.04	4th
Pest & disease control	147	1.79	5th
Charcoal pots	133	1.62	6th
Irrigation of pasture during dry season	112	1.36	7th

Source: Field Survey (2017)

Table V: Determinants of Farmer's Adoption Decision

VARIABLE	COEFFICIENT	STANDARD ERROR	T-VALUE
Gender(X_1)	0.241$^{n.s}$	0.184	1.309
Education(X_2)	0.091**	0.044	2.068
Flock size(X_3)	0.694***	0.215	3.228
ExperienceX_4)	0.421***	0.137	3.07
Credit (X_5)	-0.716***	0.223	3.211
Extension(X_6)	0.419**		
-log likelihood function	7.469	0.182	2.302
Nagelkerke R^2	0.678		

Source: Field Survey (2017), **= Significant at (P<0.05), * = Significant at (P<0.1) and $^{n.s}$= Not Significant

Table VI: Constraints of Farmer's Adoption Decision

CONSTRAINTS	FREQUENCY*	PERCENTAGE (%)
Poor extension contact	65	79.3
Lack of capital	74	90.2
Poor input supply	45	54.9
Lack of technology	69	84.1
Inadequate land	80	97.6

Source: Field Survey (2017), * = Multiple Response