



**ANALYSIS OF CLIMATE CHANGE ADAPTATION STRATEGIES ON RURAL GOAT FARMING IN ENUGU STATE, NIGERIA**

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**ABSTRACT**

The study analysed climate change adaptation strategies on rural goat farming in Enugu State, Nigeria. According to the findings, the majority of the respondents (50%) were between the ages of 31 and 40 years, and were mostly married and had a household size of 6 to 10 people, (50%) had completed secondary school as their highest level of education, and (47.6%) had 7 to 9 years of experience mitigating the effects of climate change on goat production in the study area. The results also showed that the main sources of information on climate change in the study area were family and friends, radio, social media, television, and extension agents. As a coping mechanism, majority of the respondents reared highly resistant goat breeds on their goat farms. The findings also indicated that goat production and ownership, access to extension agents, and awareness of climate change were all positive and significant at 5% level. This suggests that if these factors are maintained or increased, there will be an increase in the mitigation strategies used to combat climate change as well as an increase in goat production in the study area. Extension agents' information on climate change was positive and significant at 1% level, and household's size was positive at the 10% level as well. This suggests that as these variables are maintained, new ideas and innovations for climate change adaptation are adopted, making goat production in the study area sustainable.

**Keywords:** Change, Climate, Coping, Information Strategies.

**INTRODUCTION**

Global warming, droughts, flooding, and the depletion of natural resources are all consequence of climate change (FAO, 2019). The FAO (2021) stated that unless corrective action is taken, climate change is predicted to result in substantial yield losses of 3% to 30% and the extinction of 15% to 37% of terrestrial plant and animal species by 2050 and because their economies mostly rely on rain-fed agriculture, which is entirely dependent on environmental forces in developing nations which are particularly vulnerable to climate change. Due to their limited technological capabilities, traditional farming methods are unable to adapt to and lessen the effects of severe climate change (Abraham, 2015). Despite the fact that goats have many potential benefits, their current contribution to rural livelihoods is low due to climate change-related factors. These include low reproductive and productive performance, increased disease and parasite infection, restlessness, nutritional and thermal stressors, and decreased feed and fodder resources (FMARD, 2017).

Goat husbandry is one of the most important livestock species for the livelihoods and general well-being of many people in rural communities in developing nations like Nigeria. In Sub-Saharan Africa, smallholder farmers raise goats for their meat, skins, and wool, and infrequently for milk. For many people, goat farming is a source of job and money. Goats can survive and even perform better in environments with insufficient food supplies (Abraham, 2015). There are over 76 million goats in Nigeria, making it the country with the largest small ruminant



herd in Africa, followed by Sudan, Chad, Ethiopia, and Kenya (FMARD, 2017). West African dwarf goats, Red Sokoto goats, and Sahelian goats are the three most common goat breeds in Nigeria. Compared to metropolitan centers, goats are more common in rural and village settings. It is anticipated that smallholder farmers would continue to be important to agriculture despite the challenges posed by climate change, especially in developing nations like Nigeria (Wiggins & Keats, 2015). However, because of the adverse consequences of climate change, not all smallholder farmers will continue to raise goats. In lieu of this, the purpose of this study was to ascertain how goat farmers in Enugu State, South-Eastern Nigeria, are adapting to climate change.

## **MATERIALS AND METHODS**

### **The study Area**

The study was conducted in Enugu State, Nigeria. According to a 2016 census, Enugu State had seventeen (17) local government areas and 5.6 million residents. It is situated between latitudes 5°00' and 6°30' North of the Equator and longitudes 5°00' and 6°00' East of the Greenwich Meridian. Kogi and Benue States border it on the North, Ebonyi State borders it on the East, Abia State borders it on the South, and Anambra State borders it on the West. The State grows cassava, yam, and oil palm as crops. The primary language of the State is Igbo, and its citizens are of Igbo descent.

### **Sampling Technique and Sampling Size**

Due to the large number of goat farmers in the State, three local government areas (Enugu East, Awgu, and Oji River LGAs) were chosen at random from among the seventeen local governments in Enugu State in the first stage of the study, which employed a multi-stage random sampling technique. In the second stage, four communities were chosen at random from each local government area using the simple random technique. Ten (10) goat farmers were chosen from each community using a simple random sampling technique in the third stage, bringing the total number of respondents in the study area to one hundred and twenty (120) respondents.

### **Method of Data Collection**

Data were collected using personal interviews and the administration of a well-structured questionnaire on goat farmers in the study area. The questionnaire was used to obtain primary data based on the objectives of the study.

### **Methods of Data Analysis**

Descriptive statistics, such as tables, frequency distributions, and percentages, were used to analyze the data collected for the study. Frequency distribution and percentages were used to analyze objectives 1, 2, and 4, which were to describe the socioeconomic characteristics of the respondents in the study area, identify sources of information on climate change, and identify the coping strategies of goat farmers in the study area. Regression analysis was used to analyze objective 3, which was to determine the factors influencing climate change adaptation strategies.

To determine the variables influencing climate change adaptation strategies in goat farming, the tobit regression model was employed. A dependent dichotomous variable, which assumes just two values (zero or one), was used to estimate the likelihood of events using the tobit model. The model was estimated as follows;

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + e_i \quad \dots(1)$$

Where:

Y is a binary response variable defined as;



$Y = 1$  if the goat farmer participates in adaptation strategies to climate change and  $Y = 0$  if otherwise.

$X_1$ = Access to extension agents (1 = Yes, 0 = No)

$X_2$ = Climate change awareness (1 = Yes, 0 = No)

$X_3$ = Climate change information by extension agent (1=Yes 0=No)

$X_4$ = Weather conditions (1 = favorable, 0 = No)

$X_5$ = Goat production/ownership (1=Owned, 2=No)

$X_6$ = Marital Status (1 = Yes, 0 = No)

$X_7$ = Age (years)

$X_8$  = Household size

$X_9$ = Land Ownership (1=Owned, 2=Leased)

$b_1 \dots b_9$ = parameter estimates

$b_0$ = Intercept

$e_i$  = error term

## RESULTS AND DISCUSSION

### Socio-Economic Characteristics of Respondents

According to results from Table 1, (50%) of the respondents were between the ages of 31 and 40 years, followed by those between the ages of 41 and 50 years (18.3%), those over 50 years were just (11.7%), and those under 30 years were (20%). These findings suggest that those in the 31–50 age range were likely to be more resilient to fatigue from the arduous work and effort required to raise goats and adapt to climate change in the study area. According to the study by Anugwo *et al.* (2024) titled High Feed Costs in Poultry Farming; An Analysis of Effective Coping Strategies in Enugu State, Nigeria, the majority of the poultry farmers were middle-aged and these findings are consistent with that study. Additionally, Table 1 revealed that (25.0%) of the respondents were divorced, (16.7%) were single, and (58.3%) were married. This suggests that the majority of respondents were married and would have enough family labor to complete some of the labor-intensive jobs associated with raising goats and adjusting to the changing climate in the study area and this finding is in line with the study by Alemayehu, (2022). Results from Table 1, also revealed that (35%) of respondents had households with 6–10 people, (31.6%) had households with fewer than five people, (12.5%) had households with 11–15 people, (14.2%) had households with 16–20 people, and only (6.7%) had households with more than 20 people in the study area. Implying that the goat farmers have a sufficient amount of labor to address the causes of climate change.

Additionally, Table 1 revealed that (16.7%) of respondents lacked formal education, (20.8%) had completed primary school, while the majority (50.0%) had completed secondary school, and only (12.5%) had completed tertiary education. Implying that, majority of the respondents were educated, and have a high level of literacy which is anticipated to help improve comprehension of concepts and innovations utilized to lessen the consequences of climate change on goat husbandry in the study area. The results also indicated that (30.8%) of farmers in the study area raised their goats on 1–2 hectares of land, (58.3%) raised their goats on 3–5 hectares, and (10.9%) raised their goats on 6–8 hectares. These findings demonstrated that the majority of farmers in the study area had reasonably available land for goat rearing.



Table 1 indicates that the average number of years of farming experience was four years, while (15.8%) of the respondents had between one and three years of experience with climate change mitigating strategies for goat rearing, (23.3%) had between four and six years, and the majority of the respondents, (47.6%), had between seven and nine years of experience with climate change mitigating strategies for goat rearing, while (13.3%) had more than ten years of experience with climate change coping strategies for goat rearing in the study area. This suggests that many of the study respondents had a significant amount of expertise with coping mechanisms, which assisted in mitigating the impact of climate change on goat husbandry on their farms.

**Table 1: Socio-Economic Characteristics of the Respondent**

Age	Frequency	Percentages
<30	24	20
31-40	60	50
41-50	22	18.3
>50	14	11.7
Marital status		
Single	20	16.7
Married	70	58.3
Divorced	30	25
Household Size		
<5	38	31.6
6-10	42	35
11-15	15	12.5
16-20	17	14.2
>20	8	6.7
Educational level		
No formal education	20	16.7
Primary school	25	20.8
Secondary school	60	50
Tertiary level	15	12.5
Farm size		
0-2	37	30.8
3-5	70	58.3
6-8	13	10.9
Farming experience		
1-3	19	15.8
4-6	28	23.3
7-9	57	47.6
>10	16	13.3
Total	120	100

**Source:** Field Survey (2024)

### **Sources of Information on Climate Change**

According to results from Table 2, (22.5%) of the respondents had family or friends as their source of information about climate change, (20%) learned about climate change from their radio, and (18.3%) from the social media. The results also showed that just (5.8%) of respondents got their own information from newspapers or magazines in the study area, while (14.2%) of



respondents obtained their information about climate change from the television, (11.7%) from extension agents, and (7.5%) from cooperative societies. Given that few of the goat farmers in the study area have constant access to electricity to power their radios, televisions, and phones, and that even the current high price of fuel is not helping, it is evident that the primary source of information about climate change for these farmers came from their friends and family. This outcome is consistent with the research findings by Dhakal *et al.* (2021), which found that farmers viewed the interpersonal and group methods as the most common ways to obtain climate change information.

**Table 2: Sources of Information on climate change**

Sources of Information	Frequency	Percentages
Television	27	22.5
Radio	24	20
Newspaper/magazines	7	5.8
Social media	22	18.3
Cooperative societies	9	7.5
Family/friends	17	14.2
Extension visits	14	11.7
<b>Total</b>	<b>120</b>	<b>100</b>

**Source:** Field Survey (2024)

### **Factors affecting adaptation strategies to climate change**

The results of Table 3 shows that the regression model was able to explain about 72.1% of the link between climate change adaptation strategies and the predictive factors, with the error term accounting for the remaining 27.9%. The  $R^2$  value was 0.721 implied that the independent variables explained about 72.1% of the variability in climate change adaptation strategies and the remaining 27.9% were included in the error term. Table 3 results showed that goat production/ownership, access to extension agents, and awareness of climate change were all positive and significant at the 5% level, however goat production/ownership status of the farmers increased goat production by 65.7% as the farmers were very conscious in predicting unfavorable interplay between weather conditions during drought and floods and thereby took care of their goats very well. Access to extension agents contributed to 81.2% increase in goat production because new ideas and innovations about mitigating the vagaries of climate change were taught these goat farmers like use of high resistant goat breeds to withstand high drought, excess heat waves and high intensity of sunshine were all taught these farmers by extension agents in the study area, also awareness of climate change by goat farmers helped increase goat production by 58.2% as goat farmers were aware of this climate change phenomenon and the vagaries it portends and how to mitigate it in the study area. Extension agents' information on climate change was positive and significant at the 10% level and increased goat production by 46.4% as these information from extension agents made the respondents prepared about climate change as many of the respondents dug boreholes in their goat pens for all year round water supply even during drought and floods so as to make clean water available to their goats all year round in their pens in study area, these information also made some goat farmers to build fences around their goat pens to stop floods from entering the goat pens and as such keeping their goats healthy and increasing output. Household size was positive at the 1% level, implying that many of the persons in the different households were already aware of climate change and they provided enough hands for labor in mitigating its vagaries which increased goat production as well in the study area. This suggests





that as these variables increase, new ideas and innovations for climate change adaptation are adopted, making goat production in the study area profitable. This finding is consistent with the works of Lantokpode *et al.* (2022); Anugwo *et al.* (2025) who worked on Assessment of the Coping Strategies of Women Farmers in Delta State, Nigeria.

**Table 3: Factors affecting adaptation strategies on climate change.**

Variables	Coefficients	Std errors	T-values
Constant	3.8028*	1.7782	2.1385
Access to extension agent	0.8121**	0.3613	2.2477
Climate change awareness	0.5824**	0.2635	2.2102
Climate change information by extension agent	0.4642*	0.2251	2.0621
Weather conditions	0.9111	0.5383	1.6925
Goat production/ownership	0.6571**	0.2837	2.3161
Marital Status	1.0179	0.8979	1.1336
Age	0.5213	0.4234	1.2312
Household size	1.6254***	0.5297	3.0685
Land ownership	0.7352	0.3868	1.9007
Model	R <sup>2</sup> =0.721	Adjusted R <sup>2</sup> = 0.529	

**Source:** Field Survey (2024)      \*10%, \*\*5%, \*\*\*1%

### **Coping Strategies to Climate Change employed by goat farmers.**

According to the results in Table 4, the majority of goat farmers in the study area (70.8%) used high-resistant goat breeds to raise their livestock. This suggests that the majority of these farmers used goat breeds that are resistant to the whims of climate change as a major coping strategy in the study area, meaning they won't lose many livestock there. Additionally, Table 4 revealed that (53.3%) of respondents provided portable water for the goats on their farms. This suggests that goat farmers were conscious of the effects of water scarcity on their farms, and as a result, the majority of them provided water for their goats rather than depending on natural resources that may dry up as a result of climate change. Table 4 also revealed that (58.3%) of respondents re-grassed their paddock. This suggests that many farmers can continue to feed their livestock comfortably during harsh dry seasons brought on by climate change, without having to move around looking for grasses to graze. Additionally, (51.7%) of goat farmers established rangelands for goat rearing in order to avoid the whims of climate change in the study area. From Table 4 results, (60%) of respondents in the study area gave their goats medication on a regular basis. This suggests that most respondents made sure to vaccinate their goats to prevent diseases and pest outbreaks on their farms. Additionally, (75%) of respondents in the study area sold some of their livestock to cover daily farm expenses. This suggests that the majority of goat farmers used the money they raised from the sale of their goats to pay for some coping mechanisms they employed on the farm to lessen the effects of climate change. This outcome demonstrates that the goat farmers in the study area possess extensive knowledge of the coping mechanisms employed to lessen the impact of climate change on goat rearing. This finding conforms to the study by Quedrago *et al.* (2021) who posited that goat farmers are well aware of the vagaries of climate change.



**Table 4: Coping Strategies to Climate Change Employed by Goat Farmers**

Strategies	Percentage	Rank
Use of high resistant breeds	70.8	2 <sup>nd</sup>
Provision of portable water	53.3	6 <sup>th</sup>
Re-grassing of paddock	58.3	5 <sup>th</sup>
Rangeland establishment	51.7	7 <sup>th</sup>
Fencing of camp	51.7	7 <sup>th</sup>
Drug administration periodically	60	4 <sup>th</sup>
Sale of livestock to meet needs	75	1 <sup>st</sup>
Use of high-quality grass	66.7	3 <sup>rd</sup>

**Source:** Field Survey (2024)

## CONCLUSION AND RECOMMENDATIONS

The study examined climate change and its mitigation strategies on goat production in the study area. The findings showed that majority of the respondents were within the economic active age of 31-40 years, 58.3% of them were married, 35% of the respondents have household size of 6-10 persons, with 50% having secondary school level of education and 47.6% of them also having between 7 and 9 years climate change mitigating experience on goat production in the study area. The findings further revealed that family and friends were the major sources of climate change in the study area and most of them used high resistant goat breeds in their goat farms. Findings from the study further showed that access to extension agents, climate change awareness, goat production and ownership were all positive and significant at 5% level. Climate change information by extension agents was positive and significant at 10% level while household size was also positive at 1% level.

The study therefore recommends that policy makers, governments at all levels should take into consideration the problems faced by goat farmers on climate change when enacting policies in the agricultural sector as this will enhance their adaptation strategies to climate change. The government should increase the level of availability of electricity in the rural areas so that these goat farmers can always make use of their televisions, radios and charge their phones so as to get up to date information and ideas and innovations on how to mitigate the issues of climate change in the study area, also well trained agricultural extension agents should be hired to disseminate new ideas and innovations on climate change mitigation strategies on goat production in the study area.

## REFERENCES

- Alemayehu, Z. Y., Minale, A. S. and Legesse, S. A. (2022). Determinants of smallholder farmers' adaptation strategies to climate variability in Suha watershed, Upper Blue Nile basin, Northwest Ethiopia. *Arab Journal of Geoscience* **5**(1):17-25. <https://doi.org/10.1007/s12517-022-11004-6>.
- Abraham, F. (2015). Characteristics of Traditional Small Ruminant Production and Management in Awbare District of Ethiopian Somali Regional State. *Journal of Animal Production Advances*, **5**(9):697–704, <https://doi.org/10.5455/japa.20150626043822>
- Anugwo, S. C., Egwue, O. L., Olutumise, A. I. and Okonkwo, G. C. (2025). Climate Change in Rural Agriculture: An Assessment of the Coping Strategies of Women Farmers in Delta State, Nigeria. *Kronika Journal*, **25**(8):337-345.
- Anugwo, S. C. and Egwue O. L., (2024), High Feed Costs in Poultry Farming: An Analysis of Effective Coping Strategy in Enugu State, Nigeria. *Dutse Journal of Agriculture and Food Security*. **10**(1):9-18.
- Dhakal, A., Regmi, S., Pandey, M., Chapagain, T. and Kaphle, K. (2021). Features of Small Holder Goat Farming from Chitwan District of Bagmati Province in Nepal. *Archives of Agriculture and Environmental Science*, **6**(2):186-193. <https://dx.doi.org/10.26832/24566632.2021.0602010>
- FAO (2019). The Future of Livestock in Nigeria. Opportunities and Challenges in the Face of Uncertainty. Rome.



- FAO (2021). Climate-Smart Livestock Production. A Practical Guide for Asia and the Pacific Region. Bangkok. <https://doi.org/10.4060/cb3170en>
- Federal Ministry of Agriculture and Natural Resources [FMARD], (2017). Animal Population Data. Federal Ministry of Agriculture and Rural Development.
- Lantokpode, A., Ayokpon, N. H., Rodrigue, R. C. and Yabi, I. (2022). Manifestations of climate variability in the department of Alibori in Benin. *World Journal of Advanced Research and Reviews*, **13**(1):679–688.
- Ouedraogo, K., Zare, A. Korbeogo G., Ouedraogo O. and Linstadter, A. (2021). Resilience strategies of West African pastoralists in response to scarce forage resources. *Pastoralism: Research, Policy, and Practice*, **11** (16):1-4, <https://doi.org/10.1186/s13570-021-00210-8>.
- Wiggins, S. and Keats, S. (2015). Stepping Out of Agriculture. Evidence on Demand. London, UK: DFID. Retrieved from [doi:http://dx.doi.org/10.12774/eod\\_tg.february2015.wigginssetal](http://dx.doi.org/10.12774/eod_tg.february2015.wigginssetal)