Published by The College of Agriculture and Hospitality Management (COAHM), TASFUED, vol. 1, no. 1, pp. 101-108

JOAHM, TASFUED
Journal of Agriculture and Hospitality Management

Adaptation Strategies of Livestock Farmers to Climate Change in Odogbolu Local Government Area of Ogun State, Nigeria

Aina, A. S. & Ogunbanjo, O. O.
Department of Agricultural Education, Sikiru Adetona College of Education, Science and Technology, Omu-Ijebu, Ogun State, Nigeria
Corresponding author: *ainaas@sacoetec.edu.ng*

Abstract
Climate change poses significant threats to livestock production systems in sub-Saharan Africa, with smallholder farmers being particularly vulnerable due to limited adaptive capacity. This study examined the adaptation strategies of livestock farmers to climate change in Odogbolu Local Government Area of Ogun State, Nigeria. A multistage sampling procedure was employed to select 200 livestock farmers, and data were collected using a structured questionnaire. Descriptive statistics and logistic regression models were used for data analysis. Results revealed that the majority (75%) of respondents were male, 52% were married, and 40% had secondary occupation as civil servants. Most farmers (65%) received extension visits 1-2 times monthly. The most commonly adopted adaptation strategies included building pen houses against wind (40%), construction of wind breaks (22%), and increasing water intake during dry periods (22%). The logistic regression analysis showed that education ($p<0.05$), extension contacts ($p<0.05$), and farming experience ($p<0.01$) were significant positive determinants of farmers' adaptation to climate change. However, the overall level of adaptation was low, with 36% of farmers lacking knowledge of appropriate adaptation practices. Major constraints included inadequate information on short-term climate variations (17%) and limited access to credit (18%). The study recommends strengthening agricultural extension services, establishing weather information dissemination systems, and providing credit facilities to enhance livestock farmers' adaptive capacity to climate change.

Keywords: Climate change, adaptation strategies, livestock farmers, extension services, Ogun State

1. Introduction

Climate change is defined as a statistically significant variation in the mean state of the climate or its variability, persisting for an extended period, typically decades or longer (Intergovernmental Panel on Climate Change [IPCC], 2022). The phenomenon has emerged as one of the most pressing global environmental challenges of the twenty-first century, with profound implications for agricultural systems worldwide. Agriculture is widely regarded as the sector most vulnerable to climate change due to its direct dependence on climatic variables, particularly temperature and precipitation (Deschênes & Greenstone, 2012; Abid et al., 2019).

Livestock production, a critical component of agricultural systems in developing countries, is especially susceptible to climate change impacts. Climate change affects livestock through multiple pathways: direct effects on animal physiology, reproduction, and health; indirect effects through changes in feed and water availability; and systemic effects on livestock diseases and disease vectors (Rojas-Downing et al., 2017; Nardone et al., 2010). Rising temperatures increase heat stress in animals, leading to reduced feed intake, lower productivity, decreased fertility, and increased mortality (Henry et al., 2018). Changes in precipitation patterns affect pasture productivity, water availability, and the prevalence of vector-borne diseases (IPCC, 2022).

Sub-Saharan Africa is identified as one of the regions most vulnerable to climate change due to its limited adaptive capacity, high dependence on rain-fed agriculture, and socioeconomic challenges (IPCC, 2022; Connolly-Boutin & Smit, 2016). Nigeria, with its large livestock population estimated at over 40 million cattle, 72 million goats, and 43 million sheep (Food and Agriculture Organization [FAO], 2023), faces substantial threats from climate variability. The country's livestock sector contributes approximately 5% to agricultural GDP and supports the livelihoods of millions of rural households (Olayemi et al., 2021).

Livestock farmers in Nigeria are increasingly experiencing climate-related challenges, including prolonged droughts, erratic rainfall patterns, extreme temperatures, and increased frequency of floods. These climatic variations result in reduced animal productivity, increased morbidity and mortality, and heightened economic losses (Apata, 2011; Rojas-Downing et al., 2017). Despite the severity of these

Aina, A. S. & Ogunbanjo, O. O. (2026). Adaptation Strategies of Livestock Farmers to Climate Change in Odogbolu Local Government Area of Ogun State, Nigeria, *Journal of Agriculture and Hospitality Management (JOAHM),* vol. 1, no. 1, pp. 101-108.
©COAHM, Vol. 1, No. 1, Oct 2026.

impacts, many livestock farmers, particularly in rural areas, lack adequate knowledge of climate change and appropriate adaptation strategies.

The inability of farmers to effectively respond to climate variability exacerbates food insecurity, reduces household incomes, and threatens the sustainability of livestock-based livelihoods (Ayanlade et al., 2018). While various adaptation strategies have been documented in agricultural systems, there is limited empirical evidence on the specific adaptation measures employed by livestock farmers in Ogun State and the factors that influence their adoption decisions.

Understanding livestock farmers' perceptions of climate change, their current adaptation practices, and the constraints they face is essential for developing effective policy interventions and extension programs. This study, therefore, examines the adaptation strategies of livestock farmers to climate change in Odogbolu Local Government Area of Ogun State, Nigeria.

1.1 Objectives

1. Examine the socioeconomic characteristics of livestock farmers in the study area;
2. Assess farmers' awareness and perception of climate change;
3. Identify the adaptation strategies employed by livestock farmers to mitigate the effects of climate change;
4. Determine the factors influencing livestock farmers' adaptation to climate change;
5. Identify the constraints to effective adaptation to climate change among livestock farmers.

1.2 Research Hypotheses

The following hypotheses were tested at 5% significance level:

H_{01}: Socioeconomic characteristics have no significant influence on livestock farmers' adaptation to climate change.

H_{02}: Extension contacts have no significant effect on livestock farmers' perception of climate change.

2. Methodology

2.1 Study Area

The study was conducted in Odogbolu Local Government Area (LGA) of Ogun State, Nigeria. Odogbolu LGA is located between latitude 6.9333°N and longitude 3.7833°E. The LGA shares boundaries with Ijebu Ode, Ijebu North, and Ogun Waterside LGAs. The area is characterized by tropical savannah climate with distinct wet and dry seasons. Annual rainfall ranges from 1,500 to 2,000 mm, while temperatures vary between 24°C and 32°C. The vegetation consists of derived savannah with scattered trees and shrubs. The main economic activities include agriculture, particularly livestock rearing, crop farming, and fishing.

2.2 Sampling Procedure and Sample Size

A multistage sampling procedure was used to select respondents. Four livestock-farming communities (Omu, Ala, Ososa and Ibefun) were selected from the list obtained from the Agricultural Development Programme (ADP) office in Odogbolu Local Government Area of Ogun state, Nigeria. Fifty livestock farmers were purposely selected from each community, giving 200 respondents. This is based on equal representation of the communities.

2.3 Data Collection

Primary data were collected using a structured questionnaire administered to the selected livestock farmers. The questionnaire was designed to capture information on respondents' socioeconomic characteristics, awareness of climate change, perceived effects of climate variability on livestock production, adaptation strategies employed, and constraints to adaptation. The questionnaire was pre-tested with 20 livestock farmers outside the study area to ensure clarity and relevance.

2.4 Data Analysis

Data were analyzed using descriptive statistics (frequencies, percentages, means) and inferential statistics. The determinants of farmers' perception of climate change were analyzed using binary logistic regression. Binary logistic was selected for use in this analysis because the dependent variables used in the model are binary.

The model specification was:

$$Y = 1 / (1 + e^{-z})$$

where

Y = perception of climate change (1 = noticed change, 0 = did not notice change)

$Z = \beta_0 + \beta_1X_1 + \beta_2X_2 + ... + \beta_8X_8$

The explanatory variables included:

X_1 = Age (years)
X_2 = Gender (1 = male, 0 = female)
X_3 = Marital status (1 = married, 0 = otherwise)
X_4 = Education (years of schooling)
X_5 = Household size (number of persons)
X_6 = Extension contacts (1 = yes, 0 = no)
X_7 = Farming experience (years)
X_8 = Farm type (1 = small scale, 0 = otherwise)

The pseudo-R^2 and likelihood ratio chi-square statistic were used to assess the goodness of fit of the model. Data analysis was conducted using STATA version 17.0 (StataCorp, College Station, TX, USA).

3. Results and Discussion

3.1 Socioeconomic Characteristics Of Respondents

Table 1 presents the socioeconomic characteristics of the livestock farmers. The results show that 30% of respondents were below 30 years of age, while 25% were aged 31-40 years. The predominance of economically active age groups (55% below 40 years) suggests that livestock farming attracts young to middle-aged adults who have the physical capacity to engage in farming activities. This finding is consistent

Table 1: Distribution of Respondents by Socioeconomic Characteristics

Variable	Frequency	Percentage
Age		
Less than 30 years	60	30.00
31 – 40 years	50	25.00
41 – 50 years	46	23.00
51 – 60 years	26	13.00
60 years and above	18	9.00
TOTAL	**200**	**100.00**
Gender		
Male	150	75.00
Female	50	25.00
TOTAL	**200**	**100.00**
Marital Status		
Single	58	29.00
Married	104	52.00
Divorced	22	11.00
Widowed	16	8.00
TOTAL	**200**	**100.00**
Educational Level		
No formal education	24	12.00
Primary school	40	20.00
Secondary school	60	30.00
Higher education	76	38.00
TOTAL	**200**	**100.00**
Household Size		
1 – 5 persons	74	37.00
6 – 10 persons	70	35.00
Above 10 persons	56	28.00
TOTAL	**200**	**100.00**
Farming Experience		
1 – 5 years	86	43.00
6 – 20 years	100	50.00
20 years and above	14	7.00
TOTAL	**200**	**100.00**

Table 3: Distribution of Respondents by Farmers' Perception of Climate Change Indicators

Variable	Frequency	Percentage
Noticed Rainfall Change		
Yes	146	73.00
No	54	27.00
Noticed Temperature Change		
Yes	106	53.00
No	94	47.00
Temperature Trend		
Increased temperature	80	40.00
Decreased temperature	46	23.00
No change	40	20.00
Don't know	34	17.0
Observed Precipitation Changes		
Increase in rainfall/extended rain	44	22.00
Decrease in rainfall/shorter rain	78	39.00
Change in timing of rains	44	22.00
No change	34	17.00

with Ume et al. (2018), who reported similar age distribution among livestock farmers in Ebonyi State.

3.2 Socio economic characteristics

The predominance of male farmers (75%) reflects the patriarchal nature of livestock farming in the study area, where men typically own and manage larger herds. However, the 25% female participation indicates women's involvement in poultry and small ruminant production, consistent with findings by Lenis et al.

Table 4: Distribution of Respondents by Perceived Effects of Climate Change on Livestock

Variable	Frequency	Percentage
Effects of Rainfall Changes		
Disease outbreak	24	12.00
Increased mortality	26	13.00
Animal health condition worsened	40	20.00
Animal health improved	50	25.00
No adverse effect	60	30.00
Effects of Temperature Changes		
Heat stress	84	42.00
Delay in egg production	60	30.00
Decrease in egg production	20	1.00
Abortion/reproductive failure	20	10.00
No effect	16	8.00
Causes of Temperature Increase		
Increase in sunlight duration	80	40.00
Increase in sun intensity	66	33.00
Don't know	54	27.00

(2019) and Olanike et al. (2021).

The marital status distribution showed that 52% of respondents were married. Marriage provides access to family labour for farm operations, which is particularly important for smallholder livestock enterprises (Magombo et al., 2011). The educational profile indicates that 88% of respondents had formal education, with 38% having attained higher education. This relatively high literacy level is expected to enhance farmers' receptivity to information on climate change and new technologies, consistent with Coster and Adeoti (2020) and Deressa et al. (2009).

Household size distribution showed that 37% had 1-5 members, 35% had 6-10 members, and 28% had more than 10 members. Large household sizes (above 10) were observed in 28% of households, providing labour availability for farm activities and reducing hired labour costs (Coster & Adeoti, 2020). Farming experience showed that 50% of respondents had 6-20 years of experience, while 43% had 1-5 years. The significant experience among farmers (50% with over 6 years) suggests accumulated knowledge of local climatic patterns and traditional adaptation practices (Ozor & Cynthia, 2010).

Table 2 shows that 65% of respondents received extension advice, with 65% reporting extension visits 1-2 times monthly. This contact frequency is insufficient given the importance of timely information for climate adaptation. The relatively low frequency of extension visits reflects the common challenge of inadequate extension personnel in Nigeria, with farmer-to-extension agent ratios often exceeding 1:3,000 (Ayanlade et al., 2018; Williams et al., 2020).

The media (47%) and extension officers (20%) were the primary sources of technical assistance. The significant role of media in disseminating agricultural information is noteworthy, suggesting the potential for using radio and television to reach larger numbers of farmers with climate information (Lenis et al., 2019).

3.3 Farmers' Perception of Climate Change

Table 3 reveals that 73% of farmers noticed changes in rainfall patterns, while 53% observed changes in temperature. This high level of awareness is consistent with the findings of Ume et al. (2018) and Deressa et al. (2009), who reported that farmers in developing countries are generally aware of climate variability through their direct experiences with weather patterns.
The perception of rainfall changes indicates that 39% observed decreased rainfall or shorter rainy seasons, 22% observed increased rainfall/extended rain systems, and 22% noted changes in the timing of rains. This diversity of perceptions may reflect the spatial variability of rainfall patterns across the study area. Regarding temperature, 40% perceived increasing temperatures, while 23% observed decreasing temperatures. The perception of temperature increases aligns with global climate projections for West Africa (IPCC, 2022; Nwokoro et al., 2021).

3.4 Perceived Effects of Climate Change on Livestock

Table 4 shows the perceived effects of climate change on livestock. Heat stress (42%) was the most frequently reported effect of temperature increases, followed by delayed egg production (30%). These findings are consistent with documented effects of heat stress on livestock productivity (Das et al., 2016). Poultry farmers particularly noted reduced egg production and increased mortality during hot periods, supporting observations by Lara and Rostagno (2013).

Regarding rainfall changes, 25% of farmers reported improved animal health, while 20% reported worsened health conditions, 13% reported increased mortality, and 12% reported disease outbreaks. The diversity of responses reflects the complex and varied effects of rainfall variations on livestock systems, including both positive effects (enhanced forage availability) and negative effects (increased disease incidence). The

Table 5: Distribution of Respondents by Adaptation Strategies Employed by Livestock Farmers

Adaptation Strategy	Frequency	Percentage
Construction of wind breaks	44	22.00
Building pen house against wind	80	40.00
Installation of cooling materials	32	16.00
Increase in water intake	44	22.00
Total	**200**	**100.00**

Table 6: Distribution of Respondents by Constraints to Climate Change Adaptation

Constraint	Frequency	Percentage
Lack of information about short-term climate variations	34	17.00
Lack of knowledge of appropriate adaptation practices	72	36.00
Lack of credit/savings	36	18.0
No access to water	24	24 12.00
Other constraints	16	8.0
No barriers to adaptation	18	9.00
Total	**200**	**100.00**

Table 7: Logistic Regression Results for Perception of Rainfall Change

Variable	Coefficient	Standard Error	z-value
Age	0.3091	0.2597	1.190
Gender -	0.3725	0.6060	-0.615
Marital status	0.4631	0.4450	1.041
Education	0.6906	0.3164	2.182**
Household size	0.2042	0.3626	0.563
Extension contacts	1.3898	0.6719	2.068**
Farm type	-1.1111	0.3958	-0.280

***p<0.01, **p<0.05, *p<0.10

Pseudo $R^2 = 0.4652$ | LR χ^2 (8) = 47.95 | Probability > $\chi^2 = 0.0000$ | Log likelihood = -21.49

Table 8: Logistic Regression Results for Perception of Temperature Change

Variable	Coefficient	Standard Error	z-value
Age -	0.8869	0.2074	-1.190
Gender	-0.2957	0.5134	-0.576
Marital status	0.1168	0.3455	0.338
Education	-0.4308	0.2702	-1.594*
Household size	0.3721	0.3181	1.170
Extension contacts	0.5641	0.6077	0.928
Farming experience	0.00199	0.3281	0.006
Farm type	0.2530	0.3454	0.733

***p<0.01, **p<0.05, *p<0.10

Pseudo $R^2 = 0.1665$ | LR χ^2 (8) = 9.11 | Prob > $\chi^2 = 0.3330$ | Log likelihood = -22.80

relatively high proportion of farmers reporting "no adverse effect" (30%) may indicate limited awareness of the subtle impacts of rainfall variability on livestock production.

3.5 Adaptation Strategies Employed

Table 5 presents the adaptation strategies adopted by farmers. Building pen houses against the wind was the most common adaptation (40%), followed by construction of wind breaks (22%) and increased water intake (22%). These housing-related strategies aim to reduce heat stress and protect animals from strong winds, which are common during the dry season. This finding aligns with Lenis et al. (2019) and Ume et al. (2018), who reported similar strategies among livestock farmers in Nigeria.

The relatively low adoption of cooling materials (16%) may reflect the high cost of such equipment and limited access to electricity in rural areas. The strategies employed are predominantly autonomous adaptations based on farmers' local knowledge and resources, rather than planned interventions involving external support (Adger et al., 2009; Smit & Wandel, 2006).

3.6 Constraints to Adaptation

The major constraints to adaptation are presented in Table 6. Lack of knowledge of appropriate adaptation practices (36%) was the most significant constraint, followed by lack of credit (18%) and lack of information about short-term climate variations (17%). The predominance of knowledge-related constraints highlights the critical role of extension services and information dissemination in enhancing farmers' adaptive capacity. Similar findings were reported by Gbetibouo (2009) in South Africa, where over 53% of farmers cited lack of credit as a barrier to adaptation.

Lack of access to water (12%) reflects the challenges faced by livestock farmers during dry seasons when water sources become scarce. The relatively low proportion of farmers reporting no barriers (9%) indicates that most farmers face significant challenges in adapting to climate change, consistent with findings from Ethiopia and Kenya (Tilahun et al., 2021).

3.7 Determinants of Farmers' Perception of Climate Change

The results of the logistic regression analysis are presented in Tables 7 and 8. The pseudo R^2 value of 0.4652 for the rainfall perception model indicates that the explanatory variables together explain 46.5% of the variation in farmers' perception of rainfall changes. The overall model is statistically significant (LR $\chi^2 = 47.95$, $p<0.001$), suggesting strong explanatory power.

Education was found to be a significant positive determinant of rainfall perception ($p<0.05$). The marginal effect indicates that an additional year of education increases the likelihood of noticing rainfall changes by 69.1%. This finding is consistent with Deressa et al. (2009) and Maddison (2007), who reported that educated farmers are more likely to perceive climate changes due to their ability to access and process information. Similarly, Oyebola (2021) found that education significantly enhances farmers' awareness of environmental changes.

Extension contacts positively and significantly influenced perception of rainfall changes ($p<0.05$), increasing the likelihood of awareness by 139%. This underscores the critical role of extension services in sensitizing farmers to climate variability. Farmers who receive regular extension visits are better informed about weather patterns and climate projections, enabling them to observe and interpret changes (Coster & Adeoti, 2020; Nhemachena & Hassan, 2007).

Farming experience was the most significant determinant ($p<0.01$), with experienced farmers being 71% more likely to perceive rainfall changes. This reflects the accumulated local knowledge that comes with years of engagement in farming, enabling experienced farmers to detect subtle changes in climatic patterns (Maddison, 2006; Ozor & Cynthia, 2010).

For temperature perception (Table 8), the model was not statistically significant ($p = 0.333$), indicating that the selected variables do not adequately explain farmers' perception of temperature changes. Only education showed marginal significance ($p<0.10$), suggesting limited explanatory power. This may indicate that temperature changes are more gradual and less perceptible to farmers compared to rainfall changes, which have more visible immediate effects on agricultural activities.

4. Conclusion

This study examined the adaptation strategies of livestock farmers to climate change in Odogbolu Local Government Area of Ogun State, Nigeria. The findings reveal that the majority of livestock farmers are aware of climate change, particularly changes in rainfall patterns and increasing temperatures. The most common adaptation strategies employed include housing modifications (building pen houses against wind and construction of wind breaks) and increased water intake during dry periods. However, the overall level of adoption of adaptation strategies is relatively low, with farmers facing significant constraints, including lack of knowledge of appropriate adaptation practices and limited access to credit.

The logistic regression analysis identified education, extension contacts, and farming experience as significant positive determinants of farmers' perception of rainfall changes, while education was the only marginally significant factor for temperature perception. These findings highlight the importance of human capital development and extension services in enhancing farmers' adaptive capacity to climate change.

The study concludes that while livestock farmers in the study area demonstrate awareness of climate variability, their adaptation capacity is constrained by limited access to information, knowledge, and financial resources. Addressing these constraints through targeted interventions is essential for enhancing the resilience of livestock production systems to climate change.

5. Recommendations

1. Strengthening Agricultural Extension Services: Government should increase investment in extension services by recruiting more extension personnel, providing adequate transport and communication facilities, and ensuring regular training of extension agents on climate change issues. Extension agents should be adequately remunerated to enhance their motivation and effectiveness.
2. Improving Weather Information Dissemination: The Nigerian Meteorological Agency (NiMet) and relevant government agencies should develop systems for providing timely and accessible weather forecasts to rural livestock farmers. This could include radio broadcasts, mobile phone-based information systems, and farmer-extension meetings at the community level.
3. Enhancing Farmers' Education and Training: Government and non-governmental organizations (NGOs) should support farmer training programs focused on climate change awareness, adaptation strategies, and sustainable livestock management practices. Training should incorporate local knowledge and be delivered in accessible formats and languages.
4. Providing Financial Support: Financial institutions and government agencies should develop credit schemes specifically tailored to livestock farmers, enabling them to invest in adaptation measures

such as water harvesting systems, improved housing, and supplementary feed storage facilities.

5. Establishing Water Infrastructure: Government should invest in the development of water infrastructure, including boreholes, wells, and water harvesting systems, to ensure reliable water access for livestock during dry seasons.
6. Further Research: Future research should focus on evaluating the effectiveness of different adaptation strategies under various climatic scenarios and exploring the potential for indigenous and innovative adaptation practices.

References

Abid, M., Scheffran, J., Schneider, U. A., & Ashfaq, M. (2019). Farmers' perceptions of and adaptation strategies to climate change and their determinants*: The case of Punjab province, Pakistan. Earth System Dynamics, 10(4), 599–620.*

Adger, W. N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D. R., Naess, L. O., Wolf, J., & Wreford, A. (2009). *Are there social limits to adaptation to climate change? Climatic Change, 93(3), 335–354.*

Apata, T. G. (2011). Factors influencing the perception and choice of adaptation measures to climate change among farmers in Nigeria. *Journal of Agricultural Science and Technology, 3(3), 234–244.*

Ayanlade, A., Radeny, M., & Akin-Onigbinde, A. I. (2018). Climate variability/change and attitude to adaptation technologies: *A pilot study among selected rural farmers' communities in Nigeria. GeoJournal, 83(2), 319–331.*

Below, T. B., Mutabazi, K. D., Kirschke, D., Franke, C., Sieber, S., Siebert, R., & Tscherning, K. (2012). *Can farmers' adaptation to climate change be explained by socio-economic household-level variables? Global Environmental Change, 22(1), 223–235.*

Connolly-Boutin, L., & Smit, B. (2016). Climate change, food security, and livelihoods in sub-Saharan Africa. *Regional Environmental Change, 16(2), 385–399.*

Coster, A. S., & Adeoti, A. I. (2020). Analysis of perception and adaptation of maize-based farming households to climate change in Nigeria. *Tropical Agriculture, 97(4), 268–280.*

Das, R., Sailo, L., Verma, N., Bharti, P., & Saikia, J. (2016). Impact of heat stress on health and performance of dairy animals*: A review. Veterinary World, 9(3), 260–268.*

, Hassan, R. M., & Ringler, C. (2009). Perceptions of and adaptation to climate change among farmers in the Nile Basin of Ethiopia. *International Journal of Climate Change Strategies and Management, 1(4), 381–396.*

Deschênes, O., & Greenstone, M. (2012). The economic impacts of climate change: Evidence from agricultural output and random fluctuations in weather: *Comment. American Economic Review, 102(7), 3761–3773.*

Food and Agriculture Organization of the United Nations. (2023a). *FAOSTAT statistical database. https://www.fao.org/faostat/en/#data*

Food and Agriculture Organization of the United Nations. (2023b). *The state of food and agriculture 2023: Revealing the true cost of food to transform agrifood systems. https://www.fao.org/publications/home/fao-flagship-publications/the-state-of-food-and-agriculture/en*

Gbetibouo, G. A. (2009). Understanding farmers' perceptions and adaptations to climate change and variability*: The case of the Limpopo Basin, South Africa (IFPRI Discussion Paper No. 00849). International Food Policy Research Institute.*

Henry, B., Eckard, R., & Beauchemin, K. A. (2018). Adaptation of ruminant livestock production systems to climate change. *Animal, 12(S2), S445–S456.*

Intergovernmental Panel on Climate Change. (2022). Climate change 2022*: Impacts, adaptation and vulnerability. Cambridge University Press.*

Lacetera, N. (2019). Impact of climate change on animal health and welfare. *Animal Frontiers, 9(1), 26–31.*

Lara, L. J., & Rostagno, M. H. (2013). Impact of heat stress on poultry production. *Animals, 3(2), 356–369.*

Lenis, S. O., Sanou, A., & Tambo, J. A. (2019). Climate change adaptation among poultry farmers: *Evidence from Nigeria. Climatic Change, 157(3), 527–544.*

Maddison, D. (2007). The perception of and adaptation to climate change in Africa (CEEPA Discussion Paper No. 10). *Centre for Environmental Economics and Policy in Africa, University of Pretoria.*

Magombo, T. G., Kantlini, G., Phiri, M., Kachulu, H., & Kabili, H. (2011). Incidence of indigenous and innovative climate change adaptation practices for smallholder farmers' livelihood security in Chikhwawa District, Malawi. *African Crop Science Journal, 19(2), 117–129.*

Nardone, A., Ronchi, B., Lacetera, N., Ranieri, M. S., & Bernabucci, U. (2010). Effects of climate changes on animal production and sustainability of livestock systems. *Livestock Science, 130(1–3), 57–69.*

Nhemachena, C., & Hassan, R. (2007). Micro-level analysis of farmers' adaptation to climate change in Southern Africa (IFPRI Discussion Paper No. 00714). *International Food Policy Research Institute.*

Nwokoro, C. C., Kreye, C., Necpalova, M., Adeyemi, O., Busari, M., Tariku, M., Tokula, M., Olowokere, F., Pypers, P., Hauser, S., & Six, J. (2021). Developing recommendations for increased productivity in cassava-maize

intercropping systems in Southern Nigeria. *Field Crops Research, 272*, 108283.

Olayemi, O. O., Adebayo, A. A., & Ogunlade, M. O. (2021). Assessment of livestock production systems in Ogun State, Nigeria. *Nigerian Journal of Animal Production, 48(2), 145–158.*

Ozor, N., & Nnaji, C. (2010). Difficulties in adaptation to climate change by farmers in Enugu State, Nigeria. *Journal of Agricultural Extension, 14*(2), 106–122.

Oyebola, O. O., Efitre, J., Musinguzi, L., & Falaye, A. E. (2021). Potential adaptation strategies for climate change impact among flood-prone fish farmers in climate hotspot Uganda. *Environment, Development and Sustainability, 23*(9), 12761–12790.

Rojas-Downing, M. M., Nejadhashemi, A. P., Harrigan, T., & Woznicki, S. A. (2017). Climate change and livestock: Impacts, adaptation, and mitigation. *Climate Risk Management, 16, 145–163.*

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change, 16(3), 282–292.*

Tilahun, Y., & Charfeddine, L. (2021). The cost and benefit analysis of climate change adaptation strategies among smallholder crop producers in the case of Sekela District, West Gojjam Zone, Ethiopia*. Cogent Economics & Finance, 9(1), 1999590.*

Ume, S. I., Ezeano, C. I., & Anozie, R. (2018). Climate change and adaptation coping strategies among sheep and goat farmers in Ivo Local Government Area of Ebonyi State, Nigeria. Sustainability, *Agri, Food and Environmental Research, 6(2), 50–68.*

Williams, P. A., Karanja Ng'ang'a, S., Crespo, O., & Abu, M. (2020). Cost and benefit analysis of adopting climate adaptation practices among smallholders: *The case of five selected practices in Ghana. Climate Services, 20, 100198.*