



ASSESSING THE INFLUENCE OF CLIMATE VARIABILITY ON POULTRY PRODUCTION IN MAIDUGURI, BORNO STATE, NIGERIA

¹Aliyu, Y. M., ²Mudi, Z. A. and ²Thamus, Z. Y.

¹Department of Agricultural Extension Services, Faculty of Agricultural University of Maiduguri,

²Mohamet Lawan College of Agriculture, Borno State.

Correspondent Author's Email: aliyumudi2@gmail.com, **GSM:** 08067941311 and 09022588260

ABSTRACT

The study examines the socio-economic characteristics of poultry farmers and the influence of climate variability on poultry production in Maiduguri, Borno State, Nigeria. A structured questionnaire was used to collect data from 240 respondents. The findings reveal that poultry farming is predominantly male-dominated (63.8%), with most farmers aged between 31–40 years (40.0%). Educational attainment is relatively high, with 37.5% of respondents having tertiary education. Farm ownership is mainly through hiring (45.0%), and 50.0% of farmers have between 6–10 years of experience in poultry rearing. Climate variability significantly affects poultry production. High temperatures increase respiration and fluid loss in birds (60.0%), while excessive air circulation spreads diseases (40.0%) and damages poultry housing (42.7%). Rainfall leads to pest and disease proliferation (60.0%), while cloud cover reduces egg production (73.3%). High atmospheric pressure negatively impacts poultry growth and oxygen availability. Regression analysis indicates that socio-economic factors such as age ($p = 0.005$), household size ($p = 0.003$), education level ($p = 0.002$), farm ownership ($p = 0.005$), and poultry rearing experience ($p = 0.002$) significantly influence production ($R^2 = 0.85$). Major constraints include high feed prices (13.3%), high mortality rates (14.7%), sudden weather changes (10.7%), and middlemen interference (10.7%). To enhance poultry productivity and resilience to climate variability, farmers should adopt improved poultry housing with proper ventilation and insulation. Government and private sectors should support climate adaptation strategies and provide affordable veterinary and extension services.

Keywords: Temperature, Cloud, Cover, Climate, Variability, Poultry

INTRODUCTION

Poultry farming plays a crucial economic, nutritional, and socio-cultural role in the livelihoods of rural households across many developing nations, including Nigeria. Poultry encompasses a variety of domesticated birds such as chickens, turkeys, ducks, geese, ostriches, and guinea fowls, which contribute significantly to human food supply through meat and egg production. Beyond serving as a vital source of nutrition, poultry farming also provides raw materials for industries (feathers and waste by-products), generates employment, and serves as an income source, making it a key sector compared to other livestock enterprises (Habila, 2018). Poultry production is highly sensitive to environmental conditions, particularly temperature fluctuations and when exposed to high ambient temperatures, chickens require more energy for survival, leading to inefficient feed conversion, reduced productivity, and poor overall health (Olanrewaju *et al.*, 2020). Climate change further exacerbates these challenges, as poultry can only tolerate a narrow range of temperatures to maintain optimal productivity. Any drastic or unpredictable climatic variations force birds to adjust their behavior and physiology, potentially disrupting production and threatening the sustainability of poultry farming.

In Nigeria, poultry farming is a major agricultural activity, especially in rural areas where it complements crop farming as an additional income source. The success of poultry farming is influenced by several factors, with weather conditions being particularly significant. Extreme temperatures, heavy rainfall, and prolonged droughts negatively affect poultry health, growth, and farm productivity (Alade, 2019). Poultry farming exists in different scales across Nigeria, ranging from small backyard flocks to large commercial enterprises. Over time, the demand for poultry products has risen steadily due to population growth and shifting dietary preferences, as poultry meat



remains more affordable than other protein sources (Ande, 2022). Despite this growing demand, climate variability continues to pose a major challenge to poultry production. Statistics indicate that poultry meat consumption in Nigeria reached 5 kilograms per capita in 2000 (Garba and Adamu, 2020).

However, global climate change is expected to increase the frequency of extreme weather events, further complicating poultry farming operations. These climatic disturbances can lead to premature mortality, injuries, and reduced productivity within poultry systems. The complex relationship between climate change and poultry production requires further research to understand its long-term implications and develop adaptive strategies, particularly in developing regions where harsh climatic conditions already pose a barrier to intensive livestock production (Ahmed and Musa, 2019). Environmental stressors can disrupt the delicate balance between poultry and their surroundings, leading to physiological stress responses that affect growth and reproduction. The specific impact of adverse weather conditions depends on factors such as bird species, stocking density, and housing conditions. For instance, high stocking densities can increase heat stress in broilers, leading to reduced feed intake, lower weight gain, and poor overall welfare. Similarly, cold weather conditions may necessitate artificial heating in poultry houses, but the effects of such interventions remain inconsistent, and there are no definitive guidelines on their effectiveness (Yusuf and Mustapha, 2017).

Nigeria has experienced significant climate changes in recent years due to deforestation and rapid industrialization, resulting in erratic weather patterns, shorter rainy seasons, and more extreme temperatures. Given that livestock farming supports over 90 million people in the country, understanding climate-related challenges is essential for sustaining the sector (Onuoha, 2019). Poultry farming, in particular, plays a vital role in Nigeria's rural economy, offering quick financial returns, providing manure for crop farming, and requiring relatively low land and capital investment. Over the years, poultry production in Nigeria has declined significantly, operating at only about 30% of its previous potential. This decline is alarming, especially given the country's rapidly growing population and rising demand for animal protein. Reports from poultry farmers across Nigeria indicate that adverse weather conditions are a major contributor to economic losses and high mortality rates, particularly during extreme climatic events (Okeke, 2017). If production levels continue to drop, future poultry supply could be severely compromised. Understanding weather-related risks and predicting their occurrence could help poultry farmers implement effective management strategies to minimize losses. Step forecasting techniques may also be useful in predicting high-risk periods for poultry farming and allowing for better preparedness.

Given the strong link between weather and poultry production, it is crucial for poultry farmers to understand how climatic variability affect their operations. Weather affects poultry both directly by inducing physiological stress that lowers growth rates and egg production and indirectly, by influencing feed and water availability. Heat, cold, wind, and rainfall all play a role in determining poultry farm success (Adegbola, 2021). Experts estimate that Nigeria needs over 2 million metric tonnes of poultry products annually to meet the protein requirements of its 140-million-strong population. However, current production levels fall far below this demand. To bridge this gap, poultry farming must be strengthened and sustained through improved management strategies that address climate-related challenges. This study aims to examine the influence of climate variability on poultry production in Maiduguri Metropolitan Council, Borno State. Specifically, the study will explore seasonal weather variations primarily the rainy and dry seasons and their impact on poultry farming. It will also assess socio-economics factors influencing poultry production and identify some constraint affecting poultry production. The findings will help identify strategies to mitigate climate-related challenges and enhance productivity in all weather conditions. This research seeks to provide valuable insights into how extreme weather events affect poultry farming and how farmers can better prepare for such conditions (Usman, 2018). The primary objective of this study is to analyze the climate variability on poultry production in Maiduguri Metropolitan Council, Borno State. The specific objectives were to:

- i. describe the socioeconomic characteristics of poultry farmers in Maiduguri.



- ii. assess the factors influencing climate variability on poultry production in the study area.
- iii. determine the socioeconomic factors influencing poultry production in Maiduguri.
- iv. identify the major constraints to poultry production in the study area.

METHODOLOGY

Present day Maiduguri is derived from the twin settlements of Yerwa and Maiduwuri. Maiduguri is roughly circular urban area of 208 km². The area has 11°46'18" N to 11°53'21" N as its latitudinal spread and 13°03'23" E to 13°14'19" E as its longitudinal extension (Mukhtar, 2021). It was found in 1907 when the British installed Shehu Bukar Garbai who later moved from Kukawa, the capital of Kanem Borno Empire to Maiduguri and it is traditionally known as Yerwa. The average temperature of Maiduguri is about 20°C to 30°C with maximum of 37°C to 47°C and minimum of 11°C during winter. The city is characterized by hot and dry weather conditions throughout most of the year. There is a prolonged dry season in the city, lasting from October to April. During this period, rainfall is scarce and humidity levels are relatively low. Harmattan winds is experienced between December and February, which blow dry and dusty air from the Sahara Desert. The rainy season in Maiduguri occurs from May to September (Waziri, 2012). The vegetation of Maiduguri is Sahel Savannah with mainly grasses, shrubs and trees. Major crops grown in the area include millet, guinea corn, maize, groundnut and cowpea with vegetables like amaranthus, sorrel, and onions. (Waziri, 2012). Maiduguri Metropolis which is also known as Maiduguri Urban comprised of Maiduguri Metropolitan Council (MMC), some parts of Jere Local Government Area, some parts of Konduga Local Government Area and to a lesser extent, some parts of Mafa Local Government Area (Kawka, 2012). Maiduguri's population consists mainly of Kanuri and Shuwa Arab people with an admixture of Nigerian ethnic groups from the South. Another indigenous ethnic groups resident in Maiduguri include Babur Bura, the Gwoza and Marghi (Waziri, 2012). Since the mid-1960s the city has become an important industrial and educational centre for Borno state. Besides food-processing facilities, its industries manufacture leather goods, wooden and metal furniture, nails, and aluminum and steel structural products. Urban agricultural activities that farmers engage in Maiduguri Metropolis among others include marketing of crop products like cowpea, maize, guinea corn, groundnut, rearing and/or fattening of animals and fish farming in around the Metropolis (Sulumbe, 2012). The Sahel vegetation mainly consists of neem trees and few shrubs. Maiduguri is located in the semi-arid region of Northeastern Nigeria. The city is situated on a plain with an average elevation of 320 meters above sea level (Mele, 2020). The topography of the city is relatively flat, with several small hills and ridges. The most prominent hill in the city is the Maiduguri Hill, which is located in the northwestern part of the city. The relief of the city is dominated by the Chad Basin, which is situated to the west of the city. The drainage system of Maiduguri is characterized by several rivers and streams that flow through the city. The most important river in the city is the Ngadda River, which flows from the Mandara Mountains and empties into Lake Chad. Other important rivers that flow through the city include the Ngarnam River and the Alau Dam. The city also has several small streams and tributaries that feed into these rivers (Mele, 2020).

Method of Data Collection

Primary data were obtained directly from the respondent through the use of structured questionnaire complemented with interview schedule. However, the questionnaire was pre-tested on few selected respondents. Both the researcher and trained enumerators were engaged in data collection. The questionnaire sought information on climate change information and farmers' adaptation to flood in the study area.

Sampling Procedure

Multi-stage sampling procedure was used in analyzing data. In first stage; The population for this study consists of all poultry farmers in Maiduguri Metropolis and divided into seven administrative district visa; Bolori, Gwange, Galtimari, Maisandari, Maiduwuri, Shehuri North, and Yerwa. In the second stage; for the purposes of this study, three administrative districts were purposively selected based on their prominence in poultry production which are Maisandari, Bolori, and Yerwa districts. In the third stage; three (3) Wards each were identified and total of 9 Wards. In



fourth stage; eighty (80) poultry farmers were randomly and proportionately selected from each identified Wards and total of 240 farmers were selected as sampling size.

Method of Data Analysis

Data for this study were analyzed using both descriptive and inferential statistics. Descriptive statistics in the form of frequencies, mean and percentages will be used to achieve objectives i, ii, iv, while objective iii will be analyzed using multiple regression.

The model is specified implicitly and explicitly as follows:

$$Y = a + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + e$$

Where:

Y = Advisers weather Condition

B₁ – B₆ = Parameters estimated

X₁ – X₉ = Independent variables

X₁ = Age (years)

X₂ = Educational level (years spent in formal education)

X₃ = Family size (number)

X₄ = Access to adequate space (yes = 1, if otherwise = 0)

X₅ = Association membership (yes = 1, no = 0)

X₆ = Primary occupation (housewife = 1, if otherwise = 0)

X₇ = Farming experience (years)

X₈ = Access to credit

X₉ = Marital status

E = error term

RESULTS AND DISCUSSION

The Socio-economic Characteristics of Poultry Farmers in Maiduguri Metropolis

The result in Table 1 below shows that majority (63.8%) of respondents were male which indicating a predominance of male involvement in poultry farming within the region. This aligns with findings by Nwafor *et al.* (2020) who noted that traditional gender roles often limit women's participation in agricultural activities, including poultry farming. The age distribution shows that 40.0% of the respondents fall within the 31 - 40 years age bracket, suggesting a relatively youthful and potentially more energetic workforce engaged in poultry production. This is crucial as younger farmers may be more open to adopting innovative farming practices (Adeola and Ipinmoroti, 2018).

Less than help (48.3%) of the respondents are married, which indicates the influence of their farming decisions and household dynamics. Married individuals may have more stable financial and labor support systems, which could benefit poultry production (Odebisi *et al.*, 2019). The household size indicates that 40.0% of farmers comes from households with 5 - 8 members which implies that larger households may provide more labor for poultry management, which can enhance productivity (Aliyu and Abubakar, 2018). The education levels among respondents reveal that 37.5% of the farmers have attained tertiary education, suggesting a relatively educated farming population. Educated people are consider amongs innovator (Okwu *et al.*, 2019).

The farm ownership indicates that 45.0% of respondents rely on hiring farms. This reliance on hired farms may reflect financial constraints or a lack of land ownership, which is a common challenge among poultry farmers in developing regions (Ibeawuchi *et al.*, 2018) and experience in poultry rearing is varied, with 50.0% of respondents having between 6 - 10 years of experience. This level of experience is likely to contribute positively to their farming practices, as experienced farmers tend to have better management skills and knowledge (Opara, 2018).



Table 1: Distribution of Respondents Based on Socio-economic Characteristics

Variables	Frequency	Percentage (%)
Sex		
Male	153	63.8
Female	87	36.2
Age		
Less than 20 years	35	14.6
21 – 30 years	48	20.0
31 – 40 years	96	40.0
41 – 50 years	32	13.3
51 – 60 years	24	10.0
60 years and above	5	2.1
Marital Status		
Married	116	48.3
Single	60	25.0
Divorced	20	8.3
Widowed	24	10.0
Household Size		
Less than 5 members	48	20.0
5 – 8 members	96	40.0
9 – 11 members	48	20.0
12 – 14 members	40	16.7
15 members and above	8	3.3
Educational Level		
Non-Formal Education	30	12.5
Primary Education	60	25.0
Secondary Education	60	25.0
Tertiary Education	90	37.5
Farm Ownership		
Purchase	72	30.0
Hiring	108	45.0
Inherited	60	25.0
Poultry Rearing Experience		
Less than 5 years	60	25.0
6 – 10 years	120	50.0
Above 10 years	60	25.0

Source: Field survey; 2024

Factors Influencing Climate Variability on Poultry Production in Maiduguri

Table 2 result highlight the impact of various adverse weather conditions on poultry production in Maiduguri. The responses from poultry farmers reveal several key elements of weather and their associated consequences. **The result shows that** 40.0% of the respondents indicated excessive air circulation could facilitate the spread of diseases among poultry farmers and 42.7% of farmers noted that strong winds could damage poultry housing, leading to increased vulnerability for the birds. These findings are consistent with Odebiyi *et al.* (2020), which emphasizes the importance of maintaining optimal air quality in poultry environments to reduce disease transmission and protect housing structures. High temperatures were reported to significantly affect poultry health, with 60.0%



of farmers acknowledging that increased respiration leads to fluid loss in birds. Additionally, 40.0% of the respondents mentioned that higher temperatures result in increased water consumption may reduce feed intake of birds. This aligns with findings of Alade *et al.* (2019), who state that thermal stress can cause metabolic disturbances in poultry, affecting their overall growth and productivity.

The finding indicates that rainfall can exacerbate pest and disease proliferation, affecting 60.0% of respondents in the study area. Also, low temperatures during rainy seasons can negatively impact day-old chicks, as noted by 40.0% of the farmers. This observation correlates with earlier research by Eze *et al.* (2018), which found that wet conditions can lead to increased mortality rates and lower productivity due to heightened disease risks. Majority (73.3%) of respondents reported that cloud cover adversely affects egg production and reduced sunlight can hinder hens' laying patterns and overall productivity. Cloud cover was also noted to influence the internal temperature of poultry houses, impacting 26.7% of farmers. This finding supports the work of Babarinde *et al.* (2021), who discussed the correlation between sunlight exposure and reproductive performance in poultry. The results indicate that high atmospheric pressure can lead to respiratory distress in poultry, as reported by 22.7% of respondents. Additionally, 44.0% of them highlighted that high-pressure conditions hinder nutrient absorption, slowing growth rates. The impact of atmospheric pressure on poultry welfare has been documented by Alabi *et al.* (2020), who noted that fluctuations in pressure can induce stress responses in birds, affecting their overall health and productivity.

Table 2: Distribution of factors Influencing Climate Variability on Poultry Production in Maiduguri

S/N	Element of Weather	Consequences	Responses	Percentage (%)
1	Air	Reduced air could affect breath of the bird	13	17.3
		Excessive air can easily circulate diseases	30	40.0
		Excessive air can destroy poultry housing	32	42.7
2	Temperature	High temperature increase respiration that make birds to loosen fluid	45	60.0
		High temperature makes bird to drink more water and reduced feed intake	30	40.0
3	Rainfall	During rainfall there are proliferation of pest and diseases	45	60.0
		Low temperature during rainfall affects day old chicks	30	40.0
4	Cloud	Cloud cover and reduce sunshine affect egg production	55	73.3
		Cloud cover can affect the temperature inside poultry houses.	20	26.7
5	Atmospheric pressure	High atmospheric pressure can lead to reduced oxygen availability, which may cause respiratory distress in poultry	17	22.7
		High-pressure conditions may hinder nutrient absorption and utilization, resulting in slower growth rates and reduced weight gain in birds.	33	44.0
		Birds become restless/agitated under high-pressure conditions, leading to increased stress levels within the flock.	25	33.3

Source: Field Survey, 2024.

Socio-economics Factors Influencing Poultry Production in the Study Area

The regression analysis demonstrates that age, gender, marital status, household size, educational level, farm ownership, and poultry rearing experience significantly influence poultry production. The model's high R^2 (0.85) and adjusted R^2 (0.63) indicate that the explanatory variables account for 85% of the variation in poultry production and the rest were errors. This result underscores the importance of socio-economic and demographic factors in determining production outcomes.



The positive impact of education on poultry production had (coefficient =0.40: $p = 0.005$) and aligns with findings of Ochieng. (2020), who reported that higher educational attainment among poultry farmers improves the adoption of best practices, including disease prevention and feed management. Education equips farmers with the knowledge to employ modern techniques, thus enhancing productivity. Farm ownership's (coefficient =0.46: $p = 0.005$) had positive effect on poultry production in the study area. The result corroborates with Yusuf (2019), which emphasize that ownership provides farmers with autonomy in decision-making and resource allocation, thereby improving efficiency. The finding of experienced poultry farmers had significant impact with (coefficient =0.46: $p = 0.005$) on poultry production. This finding is supported by Ahmed (2018), who highlighted that experience enhances farmers' resilience to challenges like adverse weather conditions and disease outbreaks. The finding agree with Nwosu (2021) who found that extreme temperatures negatively affect poultry health and feed conversion rates, leading to reduced productivity.

Table 3: Socioeconomics Factors Influencing Poultry Production

Variable	Coefficient	t-value	p-value
Age (X1)	0.40	3.30	0.005**
Gender (X2)	0.28	2.20	0.033*
Marital Status (X3)	0.25	2.68	0.016*
Household Size (X4)	0.36	2.30	0.003**
Educational Level (X5)	0.37	3.26	0.002**
Farm ownership (X6)	0.46	2.70	0.005**
Poultry Rearing Experience (X7)	0.37	2.75	0.002**

Source: Field Survey, 2024.

Note: $R^2 = 0.85$; Adjusted $R^2 = 0.63$; F-statistic = 25.27 ($p < 0.05$)

Constraints to Poultry Production in Maiduguri

The findings in Table 4 below shows that 13.3% of respondents identified high feed prices as a primary constraint. Feed is a significant component of poultry production costs, and rising prices can drastically reduce profitability. This result is consistent with Oladejo *et al.* (2020), who noted that feed cost fluctuations directly affect poultry production viability. The high mortality rate among poultry was reported by 14.7% of respondents, underscoring concerns about disease management and environmental factors. High mortality can result from various issues, including inadequate health management and adverse weather conditions, as highlighted by Akinola (2021). Disease outbreaks, mentioned by 13.3% of respondents, pose a significant threat to poultry health and productivity. The prevalence of diseases can lead to substantial economic losses, reinforcing the need for effective biosecurity measures and veterinary services (Eze *et al.*, 2018). **Sudden Changes in weather** was acknowledged by 10.7% of respondents that it can disrupt poultry management practices and negatively affect bird welfare. This aligns with previous research indicating that climate variability poses challenges to livestock production systems (Nwafor *et al.*, 2019). The inadequacy of market outlets, noted by 6.7% of respondents, limits farmers' ability to sell their products effectively in the study area.

Poor purchasing as identified by 5.3% of respondents may result in limited consumer demand for poultry products, affecting farmers' sales and income while **Poor or inadequate extension contact as** reported by 8.0% of respondents. Insufficient extension services can hinder farmers' access to crucial information on best practices, disease management, and market trends, impacting productivity. About, 9.3% of respondents indicated that inadequate technical knowledge in poultry management constrains their ability to optimize production and ensure bird welfare. Interference by middlemen in poultry product pricing, highlighted by 10.7% of respondents, can reduce farmers' profits and disrupt fair pricing mechanisms.



Table 4: Constraints to Poultry Production in the Study Area

S/N	Constraints	Responses	Percentage (%)
1	High prices of feed	10	13.3
2	Poor purchasing mentality	4	5.3
3	Poor market outlet	5	6.7
4	High mortality rate	11	14.7
5	Sudden change in the element of weather	8	10.7
6	Disease outbreak	10	13.3
7	Poor/inadequate extension contact	6	8.0
8	Poor technical knowhow on poultry management	7	9.3
9	Middle men interference with poultry product prices	8	10.7
10	Inadequate required facilities to manage poultry	6	8.0

Source: Field Survey, 2024.

CONCLUSION AND RECOMMENDATIONS

The study examined the socio-economic characteristics of poultry farmers, the influence of climate variability on poultry production, socio-economic factors affecting production, and key constraints in Maiduguri Metropolis. The findings indicate that poultry farming in the area is male-dominated (63.8%), with a majority of farmers aged between 31–40 years (40.0%), signifying a youthful and active workforce. Education plays a significant role, as 37.5% of respondents attained tertiary education, which could enhance the adoption of modern farming techniques. Additionally, 50.0% of poultry farmers have between 6–10 years of experience, suggesting considerable expertise in poultry management.

Climate variability has significant adverse effects on poultry production. Excessive air circulation, high temperatures, and rainfall contribute to disease proliferation, reduced feed intake, and increased mortality rates. Strong winds and cloud cover also negatively affect poultry housing and egg production. The regression analysis highlights that age, gender, household size, education level, farm ownership, and experience significantly influence poultry production, with an R^2 value of 0.85. The study further identifies constraints affecting poultry farming, including high feed prices (13.3%), high mortality rates (14.7%), disease outbreaks (13.3%), sudden weather changes (10.7%), and middlemen interference (10.7%). These factors limit productivity and profitability in poultry farming. Based on the result of this study, the following recommendations were made:

1. **Climate Adaptation Strategies:** Poultry farmers should adopt improved housing structures with adequate ventilation and insulation to mitigate the effects of high temperatures, excessive air circulation, and rainfall. Government and agricultural extension services should provide training on climate-smart poultry farming.
2. **Affordable Feed and Inputs:** To address high feed costs, government intervention through subsidies or the establishment of local feed production industries should be considered. Farmers should also explore alternative feed sources such as agricultural by-products.
3. **Enhanced Veterinary Services:** To reduce poultry mortality and disease outbreaks, veterinary services should be made more accessible and affordable. Government agencies and private sectors should collaborate to provide regular vaccination and disease surveillance programs.
4. **Improved Market Access:** Strengthening the poultry value chain by creating better market linkages and cooperatives can reduce middlemen interference. Policies should also be implemented to regulate pricing mechanisms to ensure fair earnings for farmers.
5. **Extension Services and Technical Support:** Agricultural extension services should be enhanced to provide farmers with up-to-date knowledge on poultry management, disease control, and climate adaptation techniques. Training programs and demonstration farms should be established to improve farmers' technical know-how.
6. **Infrastructure Development:** Government and private stakeholders should invest in infrastructure, including storage facilities, processing plants, and reliable electricity, to improve poultry farming conditions and reduce losses.



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