Climate Change and Small Scale Poultry Production in Selected Local Governmentareas of Kwara State, Nigeria

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ABSTRACT

The study examined climate change and small scale poultry production in selected local government area of Kwara State, Nigeria. A sample size of 100 poultry farmers were selected using multi stage sampling technique with the aid of a structured questionnaire, and analyzed using descriptive and inferential Statistics. The result of the study showed that dehydration of birds was the most challenging effect of climate change on poultry production perceived by poultry farmers with the mean value of 4.77. Giving plenty of water and providing heat source in poultry house were the mostly used adaptation strategy with 99% and 86% respectively. Double-log function was the lead equation with R-square (0.7882) and Feed, stock capacity, hired labour, depreciation, adaptation strategies, and age were the significant variables that affects adaptation strategies. The probability of farmers choosing management/medication adaption strategies against climate change increased with the farmers' years of experience and number of birds, the severe constraints faced by poultry farmers in the study area include high cost of feed and limited capital. The study recommends involvement in cooperatives by poultry farmers in order to be kept abreast with new innovations and have easy access to loans to better their poultry production.

Keywords: Climate change, poultry farmers, adaptation strategies

INTRODUCTION

Climate Change occurs over a long period of time ranging from decades to centuries. Krishna, (2011) in his studies on climate change has reported that the change in the atmospheric composition is attributed to the release of greenhouse gases (GHG) such as Carbon dioxide (CO2), Methane (NH4), Nitrogen oxide (N2O) and other gases. Change in climate has increased over the years due to certain human activities. This theory has been proved during the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). According to USAID (2019) prediction, Nigeria is set to experience a projection rise in temperature of 1.1 to 2.5 °C by 2060 and an increase in the number of extreme heat days to 260 by 2100 compared with 10 days in 1990. Climate change is the primary determinant of various agriculture productivity and its adaptive capacities and knowledge are low (Apata *et al*., 2009). In the last 30 years, climate change has reduced global agricultural production by 1% to 5% per decade (Thornton *et al.,* 2015). Agricultural responses to climate change depend on the specific environmental and agro ecosystem conditions, in combination with the characteristics of a given agricultural product.

Poultry are group of domestic birds raised for their meat and egg. It also refers to all birds of economic value to man. These domestic birds include duck, chickens, quail, geese etc. Among all poultry birds, chickens are mostly farmed in great numbers and more than over 60 billion of them are killed annually by

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consumers. This sub sector of agriculture offers a range of importance to human which include: research and medicinal purposes, provision of meat and egg, production of manure which help in soil fertility, the feathers also provides human with aesthetic value.

According to Nasiru *et al.* (2012) the Nigeria's livestock population consists of 16.3 million cattle; 40.8 million goats; 27 million sheep; 3.7 million pigs and 151 million poultry. Following this statistic, poultry constitutes more than 60% of the total livestock population, indicating the dominance and importance of poultry sub-sector in the livestock industry. Poultry is an important sub-sector of the Nigeria livestock industry providing significant portion of the needed animal protein to the populace as well as creating employment for a considerable percentage of the population. USDA (2013) has rated Nigeria as the leading Africa country with respect to egg production but the fourth in broiler production. Poultry production is gaining popularity in most developing countries due to the role it plays in bridging the protein malnutrition in their diets. Due to lack of religious or cultural discrimination against the products unlike pig, dog and some other livestock poultry products (meat and egg) is the most consumed animal protein. Poultry production is practiced in all levels ranging from the subsistence (small scale) to the commercial (large scale) operations. Poultry birds are particularly vulnerable to climate change because birds can only tolerate narrow temperature range. Guis *et al*. (2011) affirmed that climate change alters global disease distribution, affects poultry feed intake, encourage outbreak of diseases which invariably affects poultry output (egg and meat) and also cost of production. The perceived threats and weaknesses of poultry production due to climate change includes more heat stress in both housed and outdoor flocks, decrease in egg production and growth rate at higher temperatures, higher mortality rates in outdoor flocks result from extreme weather events, more expensive housing to withstand storms and temperature fluctuations, more effective ventilation and cooling systems to counteract higher temperatures, higher energy cost in operating ventilation system more frequently, increased persistence of some endo-parasite and ecto-parasite with associated increase in medication are big challenges to consider. Poultry farming is a lucrative and profitable profession. There has been increase in livelihood of those who engage in poultry farming and as well increased the nation's economic growth. Nonetheless the poultry industry in Nigeria has suffered a great deal of losses, which has affected both farmers and consumers. Birds in general are prone to disease attack. A single attack can wipe out thousands of birds or even the entire farm. An example of poultry attack was the attack on poultry industry in Nigeria by avian influenza in 2006 which has forced many small and medium scale poultry farms to close down. Some of this challenge faced by poultry farmer is lack of quality feed, inadequate recourses, outbreak of disease, as well as climate change.

This is however the reason why this study is aimed at researching on the analysis of climate change adaptation strategies in small-scale poultry production in selected local government area of Kwara State. The specific objectives are to:

1. describe the socio-economic characteristics of poultry farmers in the study area.
2. assess the perceived effect of climate change on poultry production
3. describe the climate change adaptation strategies adopted by the poultry farmers.
4. analyze the effect of adaptation strategies on the poultry output.
5. determine the factors that affect the choice of adaptation strategies adopted by poultry famers
6. examine the constraints of poultry production in the study area.

METHODOLOGY

The study was conducted at Kwara State referred to as "state of harmony" Ilorin the state capital of Kwara is located on latitude 30 and 50N and longitude 20 and 35E of the equator. It occupies an area of about 74256km square of the total area of Nigeria. It is one of the North central States and shares boundaries in the North with Niger state, in the South with Oyo State, Osun State and Ekiti State, in the East with Kogi State

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and in the west with Benin Republic (international boundary). The State comprises of sixteen (16) local government areas National Bureau of statistics (NBS, 2009). Kwara State is situated at the transitional zone within the forest and the guinea savannah regions of Nigeria. The climate of the State is tropical under the influence of the two trade winds (i.e. the South West wind during rainy season and the dry North East continental during the dry season). Kwara State is a summer rainfall area, with an annual rainfall range of 1000mm to 1500mm. The rainy season starts in March and lasts till early September with an August break. However, in dry year the rain usually starts very late (late April or early May) and ends early around October. The temperature change is uniformly high and ranges between 25^{o}C and 30^{o}C in the wet season throughout the season except in July- August, while in the dry season the temperature range is between 33^{o}c to 34^{o}C. (Akpenpuun and Busari 2013). The major occupation of the residents in the State is agriculture. The State is divided into four agricultural zones (Zones A-D) by the Kwara State Agriculture Development Project. (KWADP 1998), with their headquarters at Kaiama, Patigi, Malete and Igbaja respectively, based on the agro ecological and cultural characteristics of the State as well as for effective administration of agricultural intervention programmes. Additionally, cassava is commonly produced across all the ADP zones in the state.

Sampling Techniques

A multi-stage sampling technique was used to carry out the research. First stage involves a purposive selection of two (2) Local governments in the State which includes; Offa and Irepodun. All selected local government area belongs to zone D of the Agricultural zones in the state because of the high concentration of poultry farmers in the zone compared to other zones. The second stage involves a random selection of two districts (towns and villages) each from the selected LGAs. This includes, Offa, Ojomu Central, Oro, and Ajase – ipo. The third stage involves selection of poultry farmers within the four districts using Yamane formula at 5% precision level and 95% confident interval. A total of 100 questionnaires were administered to the respondents. The Yamane formula is mathematically represented as:

$$n = \frac{N}{1 + N(e)^2}$$

Where; n= sample size, N = the finite population, e = limit of tolerable error at 0.05 probability level and 1 = unity.

Primary data was collected with the help of questionnaire that was administered to the poultry farmers. Other information was collected from Journals, poultry bulletins, textbooks, magazines as well as News lines.

Analytical techniques

Descriptive statistics such as mean, percentage, frequency distribution table were used to describe the socio economic characteristics of poultry farmers, describe climate change adaptation strategies adopted by poultry farmers and examine the constraints of poultry production. A 5 – point likert scale was used to assess the perceived effect of climate change on poultry production, multiple regression analysis was used to analyze the effect of adaptation strategies on poultry output. This model can be depicted as:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10})$.

Where:

Y = poultry output, and the explanatory variables are;

X_1 = Feed (kg)

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X_2 = stock capacity (no of birds)

X_3 = Family labour (Man-day),

X_4 = Hired labour (man- day)

X_5 = Drug/Medication cost

(Naira)X_6 = Depreciation (Naira)

X_7 = No of Adaptation

strategies.X_8 = Educational

level (years) X_9 = Age

X_{10} = Tax

The multinomial logit regression (MNL) was employed to determine the factors that affect choice of adaptation strategies adopted by poultry farmers. The adaptation strategies were grouped into:

1. Cooling/Management
2. Management/medication and
3. cooling/management/medication.

The generalized multinomial model is given as:

$$P_{ij} = \frac{e^{b_j X_i}}{1 + \sum_{k=0}^{j} e^{b_k X_i}}$$

The explanatory variables included in the model are as follows:

X_1 = Gender (1 if male, 0 otherwise)

X_2 = Marital Status (married =1 otherwise = 0)

X_3 = Household size (number)

X_4 = Poultry Farm experience (years)

X_5 = Level of Education (in years)

X_6 = Farmers Association (dummy variable 1 if member, 0 otherwise)

X_7 = Extension Services (number of visits)

X_8 = Flock size (numbers)

X_9 = Land ownership (Owned = 1, otherwise = 0)

X_{10} = Access to climate change (perception score).

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RESULTS

Table 1 Distribution of Socio economic Characteristics of Poultry farmers in Kwara State.

Variables	Frequency	Percentage	Cum. Frequency	Mean
Age				
21 – 30	27	27.00	27	
31 – 40	16	16.00	43	
41 – 50	32	32.00	75	
51 – 60	22	22.00	97	
Above 60	3	3.00	100	**42.26**
Gender				
Female	35	35.00	35	
Male	65	65.00	100	
Marital status				
Married	65	65.00	65	
Single	22	22.00	87	
Widow(er)	13	13.00	100	
Household Size				
3– 5	83	83.00	83	
6 – 10	17	17.00	100	**4**
Educational Level				
No formal education	9	9.00	9	
Primary education	4	4.00	13	
Secondary education	16	16.00	29	
Tertiary Education	71	71.00	100	**14.13**
Association Membership				
No	73	73.00	73	
Yes	27	27.00	100	
Extension service				
No	88	88.00	88	
Yes	12	12.00	100	
Years of Experience				
1 – 10	89	89.00	89	
11 – 20	9	9.00	98	
Above 20	2	2.00	100	**6.89**

Source: field survey 2021

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Table 2: perceived effect of climate change on poultry production

Climate change effect perception statements	Weighted Sum	Weighted Mean	Remark
It causes dehydration of birds	477	4.77	1st
Climate change increases water intake	476	4.76	2nd
High temperature makes birds feed less and drink more	453	4.53	3rd
In worst cases, causes death of birds	419	4.19	4th
Climate change causes water stress	395	3.95	5th
Climate change alter appropriate timing of rearing birds	389	3.89	6th
Intense heat reduces potency of vaccines	379	3.79	7th
It brings about poultry vices	375	3.75	8th
High temperature and low rainfall lead to low egg quality	367	3.67	9th
Intense heat increases poultry disease	366	3,66	10th
It increases cost of production	365	3.65	11th
Climate change brings about cold related infection	358	3.58	12th
It reduces hatchability of eggs	350	3.50	13th
It reduces poultry fertility	344	3.44	14th
It affects the rearing pattern of birds	322	3.22	15th
Intense heat reduces poultry disease	224	2.24	16th

Source: field survey 2021

Table 3: Adaptation strategies used by poultry farmers

Adaptation strategies	Frequency	Percentage
Better feed and feed management	99	99
Providing heat source in poultry house	86	86
Covering the poultry house with trampoline	78	78
Proper hygiene /medication	75	75
Rearing breed of birds tolerant to weather and climate variation	70	70
Extensive Management System	61	61
Proper roofing and ventilation	58	58
Use of early maturing breed	50	50
Practice mixed farming	41	41
Selling of birds	39	39
Planting trees around poultry house	36	36
Giving plenty of water	15	15
Grass straws placed on metal roofing sheets	2	2
Use of asbestos roofing sheet	4	4
Dipping birds inside water	9	9
Change from poultry to non-poultry production	8	8
Migration	6	6

Source: field survey, 2021

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Table 4: Effect of Adaptation strategies on poultry output in Kwara State

Variables	Coefficient	Standard error	T. Value
Feed (kg)	0.184205	0.0552112	(3.34)***
stock capacity (no of birds)	0.3038603	0.0717036	(4.24)***
Family labour (Man-day)	0.0450013	0.0292456	(1.54)
Hired Labour (man- day)	0.0507823	0.0223654	(2.27)**
Drug/Medication cost (Naira)	0.0227112	0.0323752	(0.70)
Depreciation (Naira)	0.2903294	0.0965238	(3.01)***
No of Adaptation strategies.	0.9314426	0.1614483	(5.77)***
Educational level (years)	0.0091508	0.0145994	(0.63)
Age	0.3563557	0.2127892	(1.67)*
Tax	-0.0068396	0.010835	-(0.63)
Constant	4.023093	1.144295	(3.52)***
Diagnostics statistics			
R-Squared	0.7882		
Adjusted R-Squared	0.7644		
F-value	33.12***		

Source: field survey, 2021

Figures in parentheses are t-values *** = significant at 1% probability level, ** = significant at 5% probability level * = significant at 10% probability level

Table 5: Adaptation strategies adopted by farmers

Adaptation strategies	Frequency	Percentage	Cumulative Freq.
Cooling/management	30	30.00	30
Cooling/management/Medication	56	56.00	86
Management/Medication	14	14.00	100

Source: field survey, 2021

Table 6: Multinomial logit model for factors that affects farmers' choice of adaptation strategy against climate change

Variables	Adaptation strategies 1 (cooling/management)	Adaptation strategies 2 (management/Medication)	Adaptation strategies 3 (cooling/Management/ Medication) Reference group.
Gender	– 1.8544 (- 2.86)***	0.2214 (0.26)	1.6330

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Marital status	2.4766 (2.71)***	– 0.0579 (- 0.07)	– 2.4190
Household size	– 0.5577 (- 1.90)*	– 0.3203 (- 1.03)	0.8780
Educational level	– 0.1454 (- 2.53)**	– 0.1358 (- 2.13)**	0.2812
Years of experience	0.1437 (1.64)*	0.1776 (1.95)*	– 0.3213
Land ownership	0.0965 (0.13)	1.4031 (1.15)	– 1.4996
Production System	0.7359 (1.00)	0.1094 (0.13)	– 0.8453
Extension service	– 1.2378 (- 1.87)*	– 0.3088 (- 1.70)*	1.5466
Association	– 0.5171 (- 0.57)	– 1.6630 (-1.65)*	2.1801
Number of birds	0.0029 (1.64)*	0.0033 (1.90)*	– 0.0062
Access to climate change information	-1.7565 (-2.31)**	– 1.4719 (-1.70)*	3.2284
Constant	2.7808 (1.7061)	0.3896 (0.20)	-3.1704
Observations	30	14	56

Source: Field data analysis, 2021. Figures in parenthesis are z – values. ***, **, and * implies significance at 1%, 5%, and 10% respectively. Number of Observation = 100, Log likelihood = 69.844342, LR chi (22) = 52.54, Prob > chi2 = 0.0003 Pseudo R2 = 0.2733.

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Table 7: Marginal effects and partial elasticity of significant variables

Variables	Average marginal effect			Partial elasticity		
	Strategy 1	Strategy 2	Strategy 3	Strategy 1	Strategy 2	Strategy 3
Gender	-0.3533		-0.2171	-0.1694		-0.1307
Marital status	0.4583		0.2847	0.3830		0.2202
Household size	-0.0843		-0.0568	-0.3580		-0.2391
Education	-0.0190	-0.0135	-0.0136	-0.2494	-0.1888	-0.2003
Years of Experience	0.0163	0.0101	0.0125	0.1012	0.0379	0.0795
Extension visits	-0.2099	-0.1767	-0.1349	-0.0106	-0.0277	-0.0193
Association membership		0.0385	-0.0226		0.0115	-0.0103
Number of birds	0.0003	0.0002	0.0003	0.0262	0.0282	0.0269
Access to climate change	-0.2393	-0.1751	-0.1686	-0.1780	-0.1479	-0.1448

Source: Field data analysis, 2021.

Table 8 Constraints of poultry production

Constraints	Weighted Sum	Weighted Mean	Remark
High cost of feed	456	4.56	Severe
Limited capital	431	4.31	Severe
High cost of acquiring breed stock	413	4.13	Severe
Difficulty in getting good quality breed	385	3.85	Severe
Climate change variability	382	3.82	Severe
High cost of acquiring credit facilities	380	3.80	Severe
Low and unattractive prices for produce	371	3.71	Severe
High cost of medication	345	3.45	Severe
Inadequate extension and advisory services	333	3.33	Severe
Poor feed quality	312	3.12	Severe
High incidence of disease	264	2.64	Not Severe
High mortality rate	264	2.64	Not Severe
No co-operative or farm association	261	2.61	Not Severe
Middlemen exploitation	251	2.51	Not Severe
Inadequate processing/storage facilities	236	2.36	Not Severe
Inadequate market information	218	2.18	Not Severe
Limited livestock capacity	213	2.13	Not Severe
Pilfering/theft	210	2.10	Not Severe
Inadequate access to quality water	162	1.62	Not Severe

Source: Field data analysis 2021

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DISCUSSIONS

Socio economic characteristic of poultry farmers

Table 1 presents the socio-economic characteristics of small scale poultry farmers in the study area. Results of the table indicate that majority (75%) of the farmers were within the age range of 21-50 years with the mean age of 42.26. This implies that young people are actively involved in the poultry production, they have the ability to supply the required labour needed in the production process. This is similar to the findings of Ibrahim *et al.* (2016), Osuji (2019) and Abimbola *etal.* (2018) who a1l affirmed to the fact that poultry farmers in Nigeria are between the age of 42 to 45 and are energetic to go through poultry farming activities. Result also reveals that majority (65%) of the respondents in the study area were male. Implying that male participation in poultry production enables them to go through rigorous activities of poultry farm. This finding agrees with those of Ibrahim *et al*. (2016) and Abdullahi *et al.* (2019) who also noted that about 70% of poultry farmers who are actively involved in poultry farming were male. Majority of the respondents (65%) were married, indicating that married households were more involved in poultry farming in the study area. As a result of this, they have more hands for various poultry activities. This study corroborates those of Osuji (2019) and Maikasuwa *et al*. (2011) who in separate findings observed that most of the poultry farmers were married. Majority (83%) of the poultry farmers had a family size of 1 to 5 persons per house, with mean the household size of 4 which serve as good source of labour for the poultry keepers in the study area because they are involved in small scale production of poultry birds. This agrees with the research conducted by Ibrahim *et al.* (2014) who discovered that bulk of poultry farmer's household size ranges between 2 – 5 in Kwara State. All the sampled poultry farmers had one form of education or the other ranging from (Formal and Informal). Bulk (71%) of the respondents had tertiary education. This is to say the farmers are most likely to have better ability to keep records and make observation on effects of climate change on their farms. This finding corresponds with Abimbola *et al.* (2018) who noted that bulk (72.6%) of respondents had tertiary education and further affirmed that education raises the technical competence of an entrepreneur and enables them cope the adverse effect of climate change. The result of this research as shown in table 1 reveals that majority (73%) of the respondents do not belong to any farm associations, while 23% of respondent belongs to a farm association. The implication of this is that only few of the poultry farmers had access to agricultural benefits coming from the government or extension agencies. This agrees with Ibrahim *et al*. (2014) who observed that 67.8% of the respondents in Kwara State were not members of any farm association this limited their access information and other benefits from government agencies. Results from Table 1 also shows that only few (12%) of the respondents had access to extension services. The implication of this is that only few have access to climate information and other agricultural information coming from extension agencies. This finding agrees with that of Abimbola *et al.* (2018). Who reported that more than half (55%) of poultry farmers in the study area do not have access to extension services. The result on poultry farming experience revealed a mean experience of 6.89 years, with majority (89%) having 10 and below years of experience. The implication is that most of the producers have acquired production experience and are likely to be profitable in their production and also have perception of the effect of climate change on poultry production. This finding agrees with Osuji (2019), that most (47.62%) of the respondents had a farming experience of between 1 – 7 years with a mean of 9.3.

Perceived effect of climate change on poultry production

Table 2 presents the farmers perception on the effect of climate change on poultry production. The result shows that all the perception statements have their weighted mean of equal to or greater than 3 which is the mean, with the top four (4) being climate change as contributing to dehydration of poultry birds having ranked first with a mean of (4.77), increases water intake ranked second with a mean of (4.76), high temperature makes birds feed less and drink more ranked third with a mean of (4.53), decrease feed intake

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and causes death in worse cases ranked fourth with a mean (4.19). This suggests that most of the rural farmers in the study area nowadays experience climate variability and have to cope with the risk and uncertainty associated with it. This finding corroborates the assertion of Adesiji *et al.* (2013) who in their separate studies observed that there is a remarkable decline in agricultural productivity arising from severe drought that experts linked with climate change. They further affirmed that farmers' awareness of changes in climate attributes such as temperature and precipitation is key in influencing adaptation decision making of the farmers.

Climate change adaptation Strategies used by farmers

Table 3 presents the distribution of poultry farmers according to various adaptation strategies adopted by poultry farmers in order to mitigate climate change effects in Kwara State. The table depicts the almost all the farmers (99%) give plenty of water to birds especially during hot weather condition. The study also shows that 66% of the respondent uses anti stress such as multi vitamin, these adaptation strategies is used based on the level of education of respondent. Also in the research carried out, 41% of respondents adopt putting ice block in water. The research also showed that 96% of farmers do not adopt the use of ceiling fan in poultry house this is due to cost of acquiring ceiling fans and also due to the small number of birds raised. More so, 77% of respondents do not adopt the placing of grass straws on metal roofing sheets because of view that it is an old adaptation strategy, this are only practiced by aged people involved in poultry production. This agrees with the research carried out by Abimbola *et al*. (2018). Where most of the respondent used management strategies such as giving plenty of water, providing heat source for poultry birds, use of trampoline among others because of their low cost of affordability. Putting ceiling fans in poultry house, wetting the floor and reduce birds' population were the least adaptation strategies adopted by poultry farmers in the study area and were ranked 17^{th}, 17^{th} and 19^{th} respectively.

Effect of adaptation strategies on poultry output

The results of the regression analysis that was used in the estimates of the effect of adaptation strategies on poultry output in Kwara State is presented in Table 4. The results of regression analysis gave an R^2 value of 0.7882. This implies that 78.82% variation in the poultry farmers' output was explained by the explanatory variables included in the model, while the remaining 21.18% not explained by the explanatory variables Moreover, the coefficient of independent variables, such as feed, stock capacity, hired labour, depreciation, no of adaptation strategies and age were statistically significant (at levels ranging from $P<0.1$ to $P<0.01$).

The coefficient of feed was 0.184205 and positively significant at 1%. This implies that for every unit increase in the quantity feed will lead to an increase poultry output by 18.4201kg holding other variables constant. The coefficient stock capacity was also positively significant at 1% level of probability with the estimated coefficient of 0.3038603. This implies that increase in stock capacity of birds will results to an increase in poultry output by 30.38603% holding other variables constant. The estimated coefficient of hired labour was 0.0507823 and was positively significant at 5%. The implication of this is that a unit increase in the quantity of hired labour leads to an increase in poultry output by 5.07823%. Likewise, the estimated coefficient of depreciation was 0.2903294 and positively significant at 1%. Implying that a unit increase in depreciation will lead to increase in poultry output by 29.03294% holding other variables constant. The Table 4 also shows that the number of adaptation strategies adopted by poultry farmers was significant at 1% with the estimated coefficient of 0.9314426. This implies that increase in the number of adaptation strategies used results to increase in poultry output holding other variables constant.

Age of poultry farmers was as well significant at 10% probability level with the estimated coefficient of 0.3563557. The implication of this is that increase in the age of poultry farmers' leads to an increase in poultry output provided that other variables are held constant.

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Factors affecting choice of adaptation strategies

From the research, result shows that most (56%) of the respondent in the study area adopted at least of the three adaptation category namely; the management category, cooling category and medication category. 30% of respondent adopted cooling and management techniques while 14% adopted management and medication techniques. The summary of this result is given in the table 5.

Result showing the factors that affects the choice of adaptation strategies adopted by poultry farmers to cope with climate change is presented in Table 6. The effect coefficients were estimated with respect to the cooling/management/medication category as the reference group, and inference from the estimated coefficients for each choice category is made base on the reference group which was chosen by most of the poultry farmers. The result reveals that the likelihood ratio (χ 2) value of 52.54 was obtained and was significant at 0.01 level of probability (i.e. 1%). This suggests that the model had a strong explanatory power. This test confirms that all the slope coefficients are significantly different from zero. The pseudo R^2 value of 0.2733 also confirmed that all the slope coefficients are not equal to zero. In other word the explanatory variables collectively are significant in explaining the choice of adaptation strategies to climate change by poultry farmers in the study area.

Results from the model as shown in table 6 reveals the set of significant explanatory variables varies across the adaptation groups in terms of the level of significance and signs. Years of experience, and number of birds were positive and significant to cooling/management and management/medication group with respect to the reference group. Furthermore, educational level, extension service and access to climate change information were negative and significant to cooling/management group and management/medication group with respect to cooling/management/medication as the reference group. Gender of poultry farmer and household size were as well negative and significant to the cooling/management while marital status was positive to the same group with respect to the reference group. Membership association was also significant and positive to the management/medication group relative to the reference group.

The positive coefficient of years of farming experience and number of birds on cooling/management and management/medication group indicates that a year increase in the years of experience of poultry farmers and number of poultry birds increases the likelihood of farmers adopting cooling/management and management/medication adaptation strategy group respectively relative to the reference group. This means that poultry farmers tend to adopt and maintain one adaptation strategy as the years of their experience in poultry farming increases. This corroborates with the findings of Abimbola *et al* (2018) that the effect of the positive significance of years of farming experience increases the likelihood of poultry farmers to adopt management adaptation strategy relative to the reference group. Which means that farmers with longer farming experience and more number of birds have gain a lot of information on climate change and as well as on cooling/adaptation strategy.

The coefficient of the marital status was also positive and significantly associated with the cooling/management adaptation group with respect to cooling/management/medication group as the reference group. This suggests that as the number of married poultry farmers increases the likelihood of married poultry farmers adopting cooling/management adaptation strategy increases relative to the reference group.

The coefficient of educational level, extension service and access to climate information were negative and significantly associated with the cooling/management adaptation strategy and management/medication strategy relative to cooling/management/medication as the reference group. This implies that the likelihood of poultry farmers adopting cooling/management and management/medication strategies decreases as the educational level, extension services (no of visit) and access to climate change increases relative to the

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reference group. This contrary to a priori expectation, nonetheless farmers are likely to adopt other adaptation strategies available due to the cost and stress that cooling/management and management/medication strategies.

The coefficient of gender was negative and significantly associated with the cooling/management adaptation strategy. This suggests that the likelihood of male poultry farmers to switch from cooling/management group increases with respect to the reference group. This finding disagrees with the study of Abimbola *et al* (2018) which showed that the positive significance of gender implies that male poultry farmers had a higher likelihood of using the management adaptation strategy. Further, the coefficient of household size was negative and significantly associated with the cooling/management adaptation strategy. The implication of this is that the likelihood of poultry farmers adopting cooling/management strategy decreases as the household size increase relative to reference group. This is contrary to a priori that a larger house size enables the adoption of adaptation strategies. This agrees with the findings of Abimbola *et al* (2018) who showed that the negative significance of household size decrease the likelihood of poultry farmers adopting management adaptation strategies as the household size increase.

Association membership was as well negative and significantly associated with the management/medication adaptation group. This implies that as farmers' association membership increases, the likelihood of poultry farmers adopting management/medication strategy decreases. Contrary to a priori expectation that poultry farmer who belong to farmers association have access to climate change information.

Marginal effects and partial elasticity of significant variables

Table 7 shows the estimated marginal effects and partial elasticity for the significant variables from the multinomial logit model for factors that influence poultry farmers choice of adaptation strategy use to cope with the effect of climate change on poultry production in Kwara State. The partial elasticities of marital status, years of experience in poultry farming and number of birds are inelastic. This implies that a 1% change in these explanatory variables leads to a less than proportionate change in the probability of classification into the two other groups relative to the reference group. These variables are also inelastic for the reference group. The partial elasticities for gender, household size, educational level, extension visits, and access to climate change on the other hand are elastic revealing that a 1% change in these variables will result to more than proportionate change in the probability of classification relative to the reference group.

Constraints of poultry production

This section presents the constraints faced by poultry farmers in poultry production in Kwara State. Results in Table 8 shows that 10 out of the constraints itemized severely affect poultry production in the study area, but the 3 most severe constraints were high cost of feed with a mean of (4.56), limited capital with a mean of (4.31) and high cost of acquiring breed stock with a mean of (4.13). The implication of this is that these severe constraints have the tendency of reducing poultry output leading to low income of poultry farmers. This agrees with the findings of Nebiyu *et al.* (2016), who observed that the major constraints of poultry production were high cost of feed, shortage of land, high cost of getting breed stock, and feed quality respectively.

CONCLUSION AND RECOMMENDATIONS

The study concluded that climate change causes dehydration was the most perceived effect of climate change on poultry production by poultry farmers. It also showed that farmers' probability of choosing cooling/management strategies against climate change increases by marital status, and the years of poultry farm experience and number of birds reared. The probability of farmers choosing management/medication adaption strategies against climate change increased with the farmers' years of experience and number of

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birds. The study also concluded that adaptation strategies used is very important to poultry output production. Feed, stock capacity, depreciation, adaptation strategies, hired labour and age were the factors significant for the effect of adaptation strategies on poultry output of farmers in Kwara state. The partial elasticity of marital status, years of experience in poultry farming and number of birds are inelastic while the partial elasticity for gender, household size, educational level, extension visits, and access to climate change on the other hand were elastic. The factors the influences farmers' choice of adaptation strategy include: gender. Marital status, household size, educational level, years of farm experience, extension service, membership association, number of birds, and access to climate change information.

Based on the findings of the study, it was recommended that:

1. Small scale poultry farmers are advised to be more involved in associations and cooperatives in order to be kept abreast with new innovations and how to use them to better their poultry production system
2. Drugs and vaccines should be made readily available and accessible to poultry farmers in the study area as a measure to combat disease outbreak which usually follows change in climate.
3. The Federal Government of Nigeria as well Non-governmental organizations (NGOs) are urged to subsidize cooling technique equipment in order to boost their production strategies to suit forecasted climatic conditions for poultry farmers.

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