CLIMATE CHANGE EFFECTS AND PERCEPTION ON SMALL-HOLDER POULTRY FARMS IN LOKOJA LOCAL GOVERNMENT AREA OF KOGI STATE, NIGERIA: IMPLICATIONS FOR POLICY INTERVENTION

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ABSTRACT

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The study examined Climate Change Effect and Perception on Small- Holder Poultry Farms in Lokoja Local Government Area of Kogi State, Nigeria: Implications for Policy Intervention. The study sought to ascertain poultry farmers' awareness of climate change; identify farmers' perceived effects of climate change on poultry production; and to determine the factors that affected the choice of adaptive measures employed by farmers. Multistage and proportionate sampling was used for the selection of 71 poultry farmers. The data were analysed using descriptive analysis, likert scale and Multinomial Logistic Regression. The study concluded that high rainfall resulting in disease outbreaks ranked 1st with a mean value of 4.68, as the most challenging effect of climate change perceived by poultry farmers. Farmers probability of choosing cooling technique as a mitigating adaptive measure against climate change increased by gender and the level of poultry farm experience which were positive and significant at 10% and 1%. Partial elasticities of level of education, farmers association and extension service were inelastic while gender, poultry farming experience and access to credit were elastic. The study recommended that the Federal Government of Nigeria through its Agricultural Transformation could subsidize cooling technique equipment to boost farmers' production strategies. Drugs and vaccines should be made readily available to poultry farmers to combat disease outbreaks. Poultry farmers are advised to be more involved in associations and cooperatives be kept abreast with current information on poultry production system.

Keywords: *Climate change, Poultry Farmers, Adaptive measures, Multinomial Logistic Regression*

INTRODUCTION

Intergovernmental Panel on Climate Change (IPCC, 2007) referred to climate change as any change in climate with time whether due to natural changes or as result of human activities. The fact that climate has been changing in the past and continues to change in the future calls for the need to understand farmers opinion on climate change and adaptation in order to guide strategies for adaptation in subsequent years. Studies indicate that farmers do perceive that climate is changing and adapt to reduce the unfavourable impacts of climate change (Ishaya and Abaje, 2008). Studies further show that the perception or knowledge of climate change and taking adaptive measures are influenced by several socio-economic and environmental factors (Hassan and Nhemachena, 2008).

Climate change is a persistent change in the mean of climate parameters (temperature, rainfall, humidity and soil moisture) as a result of change in the composition of atmospheric gases. Krishna, (2011) reported that the change in the atmospheric composition is attributed to the release of greenhouse gases (GHG) such as Carbon dioxide (CO_2), Methane (NH_4), Nitrogen oxide (N_2O) and other gases. Climate change occurs over a period of time which may range from several decades to centuries. It is obvious that climate change in many parts of the world negatively affects socioeconomic sectors which include water resources, agriculture, forestry, fisheries and animal husbandry. It is a phenomenon that will keep occurring and mitigating its effects is the only way out. Mitigation activities are structured to reduce the sources and enhance the sinks of greenhouses gases in order to limit the negative effects of climate change (IPCC, 2001).

The environmental conditions affecting the performance and health productivity of chicken include temperature, relative humidity, light, sunshine prevailing at a given time, housing system and ventilation (Obayelu and Adedapo, 2006). Good climatic conditions enhance livestock production. Several researches carried out on the interaction between climate change and livestock production has shown that there is an impact, this threatens poultry production. According to Obayelu and Adedapo (2006), climate variables (temperature, rainfall, wind-speed and relative humidity) in Ilorin contributes about 81%, 96% and 43% to the variance in poultry egg production, feed intake and outbreak of disease of poultry production respectively.

Poultry plays an important economic, nutritional and socio-cultural role in the livelihood of rural households in many developing countries, including Nigeria. When ambient temperature is high, chickens have higher energy (feed) needs than when in thermo-neutral environments. Major losses result from a less efficient conversion of feed to meat, which detrimentally impacts poultry health and productivity (Olanrewaju *et al.*, 2010). Climate change affects poultry production by reducing poultry yield and nutritional quality of feeds, increasing disease and disease-spreading pests, reducing water availability and making it difficult for birds to survive (Spore, 2008).

Additionally, Guis *et al.*, 2011 and Rowlinson, 2008 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. This was further corroborated by Obayelu and Adedapo (2006) who reported that high rainfall and relative humidity provided a conducive environment for breeding of parasites causing outbreak of diseases which reduces egg production. They reiterated further that temperature reduces the feed intake of poultry birds because more energy was needed to conserve the heat caused by high temperature, hence, a decrease in the rate of feed intake.

Adaptation on the other hand, is the adjustment or intervention which takes place in order to minimize potential damages or take advantages of opportunities presented by or cope with the consequences of climate change (IPCC, 2007). It is one of the policy options for mitigating the negative impact of climate change (Dinar et al, 2006). It deals with the various adjustments that each farmer adopts to cushion the effect of climate change in production. There is no one-size-fits-all solution for adaptation; measures need to be tailored to specific contexts, such as ecological and socioeconomic patterns, and to geographical location and traditional practices.

Some of the adaptive measures in poultry production include the following, livestock farming system, adaptation of different livestock breed, etc. Others include cooling techniques (i.e. use of industrial fans in poultry pens, use of ice block in birds drinking water, planting of trees as sheds near poultry pens, use of asbestos roofing sheets as against galvanized, adequate ventilation of pens etc.), administration of vaccines, anti-stress and antibiotics; introduction of required sources of heat and proper storage of feeds etc. Adaptation to climate change is also influenced by different factors like the availability of extension agents, educational level of the farmers, location of the farm, income level of the farmer, etc.

Poultry flocks are particularly vulnerable to climate change because there is a range of thermal conditions within which animals are able to maintain a relatively stable body temperature in their behavioral and physiological activities. The perceived threats and weaknesses of poultry production due to climate change includes more heat stress in both housed and outdoor flocks, reduced 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. As climate change Progresses there is an increasing need for creating increased perception of farmers and embracing current adaptive measures employed by these farmers. Given that the effects of climate variation can only be mitigated, it is pertinent to ascertain the perceived effect of the trend by the people most involved. This study seeks to ascertain poultry farmers awareness of climate change; identify farmers' perceived effects of climate change on poultry production; and to determine the factors that affect the choice of adaptive measures employed by farmers in mitigating effects of climate change on poultry production in the study area.

METHODOLOGY

The study was carried out in Lokoja area of Kogi State Nigeria. The state lies at the confluence of the Niger and Benue rivers and is the capital of Kogi State. Lokoja is situated on the coordinates between latitudes 7°49' North and longitude 6° 45' East of the hemisphere. The State had a population of 3,278,487 with Lokoja Local government area (LGA) having a population of 195,261 at the last population census in 2006 (NPC, 2006). Going by the population growth rate in Nigeria of 2.5% (World Bank, 2013), the population of the State was projected to 9,773,032 and that of Lokoja was 582,065 as at 2014. Lokoja is a trade centre for its agricultural region because it sits at the confluence of the Niger and Benue rivers and is about 200 km to Abuja, Nigeria's Federal capital. Lokoja boasts of so many trade activities especially in the area of agricultural food production, fishing, livestock farming, and poultry production. The study employed a multistage sampling in which firstly districts were randomly selected from the North East, North West, South East and South West zones of Lokoja. At the second stage 5 wards were randomly selected from each district giving a total of 20 wards. At the third and final stage a random selection of small-holder poultry farmers was obtained. This was carried out proportionate to size following Yamane (1967). A sample frame of small holder poultry farmers was obtained from the Kogi State Agricultural Development project (KADP) which was adapted and used for the study. Proportionate to size sample size selection according to Yamane (1967) is given by the formula:

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

Where

n = Sample size; N = Total frame/population; e = Limit of tolerable error at 0.05% confidence interval.

The outcome of the computation was a presented in Table 1.

Primary data were obtained from respondents through the use of structured questionnaire and interview schedule. Data were analyzed using descriptive statistics, frequency tables and percentages, Likert Rating Scale (LRS) and

Table 1: Schedule for sampling of farmers

Zones	Districts	Wards selected at random	Total sample frame	Number of farmers randomly selected
North-east	Lokoja Rural	Ahubana	6	5
		Lokon-Goma	3	2
		Meme	5	4
		Adankolo	4	3
		Kpata	6	5
South-east	Oworo	Adogbe	6	5
		Agboja	1	1
		Ehinkin	5	4
		Emda	7	6
		Ayinoke	1	1
South-west	Kakanda	Abezunwa	7	6
		Doji	4	3
		Eddo	6	5
		Buge	5	4
		Kompale	1	1
North-west	Kupa	Abugi	5	4
		Bagi	1	1
		Agini	3	2
		Arakpo	6	5
		Batake	5	4
Total			87	72

Source: Adapted from Koji State Agricultural Development Project (KADP).

Multinomial logit regression

Farmers perceived effects of climate change on poultry production and farmers perceived determinants of climate change on poultry production were measured through the use of a 5- point Likert Rating Scale (LRS). Poultry farmer's responses was measured by providing respondents with a set of statements about perceived effect and perceived determinants of climate change on poultry production. The 5- point LRS was on a scale of strongly agree (SA) = 5 points; agree (A) = 4 points; undecided (U) = 3 points; disagree (D) = 2 points and strongly disagree (SD) = 1 point. To achieve the final ranking order for respondents perception, responses were computed as 5+4+3+2+1= 15, the sum of 15 was then divided by 5 to arrive at a mean value of 3.The cut-off mean value of 3 was considered as the decision point which indicated that a statement with a mean value greater than 3, ranked as a significant effect perceived by the farmer and a mean of less than 3 was not considered as an immediate underlying effect perceived by the farmers.

The Multinomial Logit Regression was used to determine the factors that affect the choice of adaptive/mitigating factors employed by these farmers. The study identified some adaptive measures commonly carried out against climate change threat in poultry production as;

1. Putting of industrial fans in the poultry house
2. Putting of ice block in the drinking water
3. Planting trees to create shade around poultry pen
4. Use of asbestos roofing sheet instead of galvanized roofing sheets
5. Introduction of anti-stress such as vitalite
6. Introduction of required heat source
7. Giving the birds plenty of fluids/water
8. Administration of vaccines and antibiotics
9. Proper storage of feeds

These variables were grouped together under common mitigating/adaptive measure as;

1. Cooling techniques (Items: 1, 2, 3 & 4)
2. Management techniques (Items: 6,7 & 10)
3. Medication techniques (Items: 5, 8 & 9)

Multinomial logit model was used to determine the factors that affect the choice of adaptive/mitigating factors employed by these farmers. This model attempts to explain the relative effect of different independent variables on more than one outcome (adaptive measures). Behavioural response models involving more than two possible outcomes are either multinomial or multivariate. Multinomial logit is appropriate when individuals can choose only one outcome from among the set of mutually exclusive, collectively exhaustive alternatives. The multinomial Logit model permits the analysis of decisions across more than two categories of mitigating/adaptive measures employed by farmers. Thus this approach becomes more appropriate than the Logit or probit models that have been conventionally used. The aim of multinomial logistic regression is to construct a model that explains the relationship between the independent variables and the outcome, so that the outcome of a new category of dependent variable can be correctly predicted from the same independent variables (Ayinde *et al.*, 2010; Nmadu *et al.*, 2012). The choice of this method was based on the fact that the adaptive measures (dependent variable) is a categorical variable which can take three (3) levels (0, 1, and 2) of classifications namely:

1. Respondents who used cooling technique as a mitigating/ adaptive measure against climate change on poultry production.
2. Respondents who used management technique as a mitigating/adaptive measure against climate change on poultry production.
3. Respondents who used medication technique as a mitigating/adaptive measure against climate change on poultry production.

The generalized multinomial model is expressed as;

$$P_{ij} = \frac{e^{\beta_j X_i}}{1 + \sum_{k=0}^{j} e^{\beta_k X_i}} \quad (1)$$

The probability that the *i*th farmer belongs to the *j*th adaptive group reduces to:

$$P_{ij} = \frac{e^{\beta_j X_i}}{1 + \sum_{k=1}^{j} e^{\beta_k X_i}} \quad (2)$$

While the probability of being in the base outcome group or group 0 is

$$P_{i0} = \frac{1}{1 + \sum_{k=0}^{j} e^{\beta_k X_i}} \quad (3)$$

Where i = 1, 2 ….. n variables

k = 0, 1, j groups;

βj = a vector of parameters that relates Xi's to the probability of being in group *j* where there are *j*+1 groups.

The independent variables included in the model are:

X_1 = Gender (1 if male, 0 otherwise)
X_2 = Marital Status
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 = Access to credit (dummy variable 1 if having access, 0 otherwise)
X_7 = Access to feed material (dummy variable 1 if having access, 0 otherwise)

To estimate the model, the coefficients of the base outcome are normalized to zero (0). This is because the probabilities for all the choices must sum up to unity. Hence, for 3 choices only (3-1) distinct sets of parameters can be identified and estimated. The natural logarithms of the odd ratio of equations (1) and (2) give the estimating equation as;

$$\ln \frac{P_{ij}}{P_{i0}} = b_j X_i \quad (4)$$

Where ln = natural logarithm

P_{ij} = probability of the *i*th farmer belonging to the *j*th mitigating/adaptive group

P_{i0} = probability of the *i*th farmer belonging to the base outcome group.

This denotes the relative probability of each of groups 1 and 2 to the probability of the base outcome. The estimated coefficients for each choice therefore reflects the effects of Xi's on the likelihood of the farmers choosing that alternative relative to the base outcome. The coefficient of the base outcome was then recovered in line with Hill (1983) as:

$$\beta_3 = -(\beta_1 + \beta_2) \quad (5)$$

Where β3 = coefficient of the variable of the base outcome (medication technique group)

β1 = estimated coefficient of the cooling technique group

β2 = estimated coefficient of the management group.

After the estimation, the partial derivatives or marginal effects and quasi-elasticities of the model were obtained from the software (STATA 10) (Kimhi, 1994). Finally, McFadden's (1974) likelihood ratio index (LRI) also known as pseudo R^2, similar to the R^2 in a conventional regression, were also computed as

$$LRI = 1 - \frac{\ln L}{\ln L_0} \quad (6)$$

Where, lnL = log-likelihood function
lnL_0 = log-likelihood computed with only the constant term

RESULTS AND DISCUSSION

Descriptive statistics

The basic summary statistics for the relevant variables used in the studies revealed a mean age of 42 years. The mean household size of farmers was 6 persons and 67.6% of farmers were male. The average flock size of poultry farmers was 82 birds.

Farmers' awareness of climate change

Respondents were asked to react to their awareness of climate change on poultry production in the past 5- 10 years. Awareness dimensions were categorized into awareness of climate change, pattern of change in rainfall, pattern of change in temperature and number of times of occurrences of drought and flood. Findings from Table 2 revealed that 100% of the farmers were aware of climate change phenomenon in the past 5- 10 years. In the aspect of pattern of rainfall change 49.29% of the respondents agreed rainfall had increased, 16.90% were of the opinion it had decreased while 14.08% revealed that there were fluctuations. In the case of the pattern of change in temperature 45.07% agreed to an increase in pattern of temperature change. This finding agrees with that of De-wit (2006), and Deressa et al. (2008), who reported that in Sub-saharan Africa temperature has increased over the years. This was further supported by the India Council Agricultural Research [ICAR], (2011) who indicated that temperature fluctuation and increased sunshine intensity has negative consequences on poultry production hence, predisposing poultry birds to high mortality, low egg production and low feed intake. On the number of times of occurrence of drought, 100% of the respondents revealed zero incidence of drought in the past 5-10 years. On the other hand 100% of the respondents agreed that there had being more than 5 occurrences of flood in the past 5 – 10 years. Climate change which is attributed to natural climate cycle and human activities adversely affects generally agricultural production and consequently poultry production. As the planet warms rainfall patterns shift, extreme events such as floods, droughts etc. become more frequent having adverse effects on poultry production.

Table 2: Farmers awareness of climate change

Variable	Frequency	Percentage
Awareness of climate change		
Yes	71	100
No	-	-
Pattern of change of rainfall		
Decreasing	12	16.90
Increasing	35	49.29
Same	8	11.23
Fluctuates	10	14.08
Don't remember exactly	6	8.50
Pattern of change of temperature		
Decreasing	14	19.72
Increasing	32	45.07
Same	13	18.31
Fluctuates	-	
Don't remember exactly	12	16.90
Number of times of occurrence of drought	-	
None	71	100
At least 1-5	-	-
Greater than 5	-	-
Number of times of occurrence of flood		
None	-	-
At least 1-5	-	-
Greater than 5	71	100

Respondents perceived effects of climate change on poultry production

Results from Table 3 indicated varying levels of perceptions with regards the effects of climate change on poultry production by the respondents. Respondents perceived the effect of high rainfall resulting in disease outbreaks and its spread as the most challenging effect of climate change on poultry production experienced by poultry farmers. This ranked 1st with a mean value of 4.68 and is in agreement with Guis *et al.* (2011), who reported that climate change alters global disease distribution, outbreak of diseases, poultry feed intake which affects poultry output and costs of production.. High temperature and low rainfall conditions reducing egg production and growth rates of poultry production (i.e. live weight of birds) ranked 2nd with a mean of 4.48. Climate change affects egg and meat production of birds ranked 3rd with a mean of 4.38. Given that these poultry farmers are basically into poultry production as a business, it is not surprising that respondents would naturally perceive the effects of any change on the produced and also the meat produced, this is because according to Demek (2004), climate change variability affects the size of the eggs, the thickness of the shells, the weight of the birds and also threatens protein production and utilization. These are qualities consumers would like to pay for. In other words climate change reduces the value of poultry products as a result affecting profit to be made by the farmers involved. The negative effect of extreme climate change leading to high mortality in poultry birds ranked 4th with a mean value of 4.33. The position of the respondent is supported by ICAR (2011), which reported that high ambient temperatures affected the survival and performance of birds. Additionally they reiterated that as ambient temperatures exceeded 34°c mortality due to heat stress was significantly high especially in heavy meat type chickens. High temperature makes birds feed less and drink more water ranked 5th with a mean of 4.29.

It is apt to note that respondents do not strongly perceive climate change as impacting negatively at all times given that the scores under some of the variables/statements where below the mean of 3.0. These variables included climate change affects prices of feed-grains and its nutritional quality with a mean value of 2.73 ranking 6th high energy costs for operating cooling/ ventilation system to counteract higher temperatures had a mean value of 2.71 ranking 7th and climate change results in expensive housing to withstand storms and temperature fluctuations having a mean value of 2.63 ranked 8th. It is possible that respondents have not necessarily perceived these occurrences as a serious threat to poultry production in the study area.

Table 3: Perceived effects of climate change on poultry production

Perceived effect	Strongly agree Frequency (%)	Agree Frequency (%)	Undecided Frequency (%)	Strongly disagree Frequency (%)	Disagree Frequency (%)	Weighted sum	Weighted mean	Rank
Climate change affects egg and meat production of birds.	39 (54.93)	23 (32.39)	6 (8.45)	3 (4.23)	0 (0)	311	4.38	3rd
High temperature & low rainfall conditions reduces egg production and growth rates of poultry birds.	42 (59.15)	21 (29.57)	8 (11.26)	0 (0)	0 (0)	318	4.48	2nd
High temperature makes birds feed less and drink more water.	35 (49.29)	27 (38.03)	5 (7.04)	3 (4.23)	1 (1.41)	305	4.29	6th
High rainfall results in outbreaks and spread of diseases.	48 (67.61)	23 (32.39)	0 (0)	0 (0)	0 (0)	332	4.68	1st
Climate change affects prices of feed-grains and its nutritional quality.	23 (32.39)	39 (54.93)	6 (8.45)	3 (4.23)	0 (0)	295	4.15	7th
High energy costs for operating cooling/ventilation system to counteract higher temperatures	23 (32.39)	27 (38.03)	6 (8.45)	13 (18.31)	2 (2.81)	269	3.78	8th
Climate change produces more heat stress in both housed and outdoor birds.	37 (52.11)	23 (32.39)	9 (12.67)	0 (0)	2 (2.81)	306	4.31	5th
Extreme climate change leads to high mortality in poultry birds.	40 (56.34)	21 (29.58)	7 (9.86)	0 (0)	3 (4.23)	308	4.33	4th
Climate change results in expensive housing to withstand storms and temperature fluctuations	19 (26.76)	14 (19.72)	27 (38.03)	3 (4.23)	8 (11.26)	246	3.46	9th

Source: Field Survey, 2014.

Mitigating/ adaptive measures used by farmers against climate change

The mitigating/ adaptive measures used by farmers against climate change in the study area were determined using the Multinomial Logit Model as detailed in Table 4.

Table 4: Multinomial logit model for the determinant of farmers choice of adaptive/ mitigating measures against climate change

Variables	Cooling Technique	Management Technique	Medication Technique (Reference group)
Gender	2.374039 (1.81)*	1.962594 (1.28)	-4.336633
Marital Status	0.3606437 (0.58)	-1.776583 (-0.94)	1.4159393
Household size	0.8735135 (1.04)	0.1313766 (0.12)	-1.0048901
Poultry farm experience	1.647699 (2.86)***	0.8855193 (1.11)	-2.5332183
Level of education	0.9398868 (1.0)	2.26934 (2.60)***	-3.2092268
Farmers Association	1.943119 (1.49)	2.501224 (2.21)**	-4.444343
Extension Services	-3.834913 (-1.75)*	-0.0607807 (-0.05)	3.8956937
Access to Credit	-1.379253 (-0.71)	-4.085491 (-2.18)**	5.464744
Access to major feed Material	2.165799 (1.06)	2.888187 (1.60)*	-5.053986
Constant	12.7398 (2.50)	-7.664953 (-1.74)	-5.074847
No. of Observation	13	25	33

Source: Field Survey, 2014

No. of Obs =71. Number in parenthesis are z-values. Log likelihood = 29.069115, LR chi2 (18) = 43.48, Prob> chi2 = 0.0007, Pseudo R2 = 0.2806. * = significant at 10% level of probability; ** = significant at 5% level of probability; *** = significant at 1% level of probability

The results of the estimated equations are discussed in terms of significance and signs of the parameters. Result showing the factors that influence the choice of the adaptive/mitigating measures against climate change adopted by poultry farmers is presented in Table 3. The effect coefficients were estimated with respect to the medication group as the reference group. This was estimated according to Hill (1983) from the formula $B_3 = -(B_1 + B_3)$, (with variables as previously defined in equation (5).

Therefore the inference from the estimated coefficients for each choice category is made with reference to group (3) i.e. (medication group). A likelihood ratio ($\chi 2$) value of 43.48 was obtained and was significant at 0.01 level of probability. This test confirms that all the slope coefficients are significantly different from zero. The pseudo R^2 value of 0.2806 also confirmed that all the slope coefficients are not equal to zero. In other words the explanatory variables collectively are significant in explaining the choice of mitigating/adaptive measures to climate change by poultry farmers in the study area. Zapede (1990) and Rahji and Fakoyed (2009) reported R^2 values of 0.25 and 0.3145 respectively as representing a relatively good fit for a multinomial logit model. Hence the result of R^2 value from this analysis is indicative of a good fit for the estimated model. Evidence from the model as contained in Table 3 shows that the coefficients of gender, poultry farming experience, level of involvement, farmers association, and access to major feed materials were the only positive and significant determinants of farmers choice of mitigating/adaptive measures, while extension services and access to credit were negative and significant determinants of farmers choice. The positive sign of gender and poultry farm experience were associated with the classification of cooling technique measure relative to the reference group. This implies that the probability of choosing cooling technique as a mitigating/adaptive measure against climate change increases by gender and the level of poultry farm experience. It follows a priori expectation that as a farmer has stayed long in poultry production he must have acquired some experiences in long term observations of climate change effect on poultry production. This invariably influences the choice of the cooling technique as a mitigating/adaptive measure against climate change on poultry production. The result thus reveals this situation appropriately.

The level of education, access to major feed materials and farmers membership of association were also positive and significant at 1% and 5% levels and were associated with the classification of management technique measure relative to the reference group. This suggests that the probability of choosing management technique as a mitigating/adaptive measure against climate change increases with the farmers' level of education, access to major feed materials and membership of association. This agrees with Ewuola and Ajibefun (2000) who asserted that technological change is achieved through formal education, which aids farmers' knowledge and capacity to adapt to climate variability. Farmers who are members of poultry farmers association are usually more privy to information and also have the corporate advantage to accessing loans and inputs thereby enjoying economics of scale. The negative sign and significant parameter for extension services was associated with the classification of cooling technique measure relative to the reference group. This indicates that as the extension services (i.e. dissemination of information) increases the probability of the farmer choosing cooling technique decreases. This is contrary to a priori expectation, however it may suggest that farmers may choose other options available to them probably due to high cost involved in cooling technique measures. Access to credit parameter was negative and significant at 5% level and was associated to the classification of management technique measure relative to the reference group. This implies that as access to credit increases the probability of the farmers choosing the management technique decreases.

Table 5: Estimates of marginal effects and partial elasticities

Variables	Cooling Technique (Group 1)	Management Technique (Group 2)	Medication Technique (Reference group)
Gender	2.374039	1.962594	-4.336633
	(-0.0774714)	(-0.9962329)	(0.2518751)
Poultry farming experience	1.647699	0.8855193	-1.776583
	(-0.1033403)	(-0.0689082)	(-0.1877812)
Level of education	0.9398868	2.26934	0.1443261
	(0.7178131)	(-0.4811621)	(0.3643588)
Farmers association	1.943119	2.501224	0.1046958
	(0.6114965)	(-0.5111497)	(0.1195689)
Extension service	-3.834913	-0.0607807	0.0982108
	(0.1881261)	(-0.0951548)	(0.0649362)
Access to credit	-1.379253	-4.085491	0.1445793
	(-0.8276412)	(-0.0137795)	(0.243332)

Source: Field Survey, 2014
*= Marginal effects are above while partial elasticity's are in parentheses

Marginal effect and partial elasticity's estimates
Table 5 contains the values of the estimated marginal effects and partial elasticities calculated for the significant variables. The significant variables affect the probability of choosing an enterprise by farmers in their decision making process. Estimates not significantly different from zero indicates that the regressor or explanatory variables concerned does not affect the probability of choosing a mitigating/adaptive measure by farmers. According to Basant (1997) and Rahji and Fakayode (2009), the partial elasticities rather than the marginal effects are used for explanatory purposes because they are easier to interpret. The partial elasticities of level of education, farmers association and extension service 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 inelasticity of the variables suggests that the probability of classifying the farmers into any particular group is not greatly affected by marginal changes in the variables as a 1% change in the variables leads to a less than proportionate change in the probability of classification. The partial elasticities for gender, poultry farming experience and access to credit 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.

CONCLUSION

The study concluded that high rainfall resulting in disease outbreaks and its spread was the most challenging effect of climate change on poultry production perceived by poultry farmers. It also showed that farmers probability of choosing cooling technique as a mitigating/adaptive measure against climate change increases by gender and the level of poultry farm experience. The probability of farmers choosing management technique as a mitigating/adaptive measure against climate change increased with the farmers' level of education, access to major feed materials and membership of association. The partial elasticities of level of education, farmers association and extension service are inelastic while gender, poultry farming experience and access to credit were elastic.

RECOMMENDATION

Following the outcome of the study it was recommended that i) The Federal Government of Nigeria through its current emphasis on Agricultural Transformation could subsidize cooling technique equipment in order to boost their production strategies to suit forecasted climatic conditions for poultry farmers. ii) Access to drugs and vaccines should be made readily available to poultry farmers in the study area as a measure to combat disease outbreak which usually follows change in climate. iii) 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.

REFERENCES

Abaje, I. B. 2008. Urban flooding and Environmental Safety: A case study of Kafanchan Town in Kaduna State. Apaper presented at the Golden Jubilee (50^{th} Anniversary) and 49^{th} Annual Conference of the Association of Nigerian Geographers (ANG) held on 15^{th} – 19^{th} October, 2008 at the Department of Geography, University of Abuja, Gwagwalada- Abuja.

Ayinde, O. E., Muchie, M., Omotesho, O. A., Ayinde, K. and Adewumi, M. O. 2010. Multi-risk model of Small Scale Agricultural Entrepreneurs in Central part of Nigeria. *International Journal of Academic Research in Economics and Management Science, 1(2): 224-236.*

Basant, R. 1997. "Technology Strategies of Large Enterprise in Indian Industry: Some Explorations" World Development . 25 (10):1683 – 1700

Demeke, S. 2004. Egg production Performance of Local and White Leghorn hens under intensive and rural household conditions in Ethiopia. Livestock Research for Rural Development, 16, (2): 1-5

Deressa, T. T. and Hassan, .R. M. 2008. Economic impact of climate change on crop production in Ethiopia: Evidence from cross section measures. *Journal of African Economies 18(4): 529-554*

De Wit, M. and Stankiewicz, J. 2006. Changes in surface water supply across Africa with predicted climate change. *Science* 311: 1917–1921.

Dinar, A, Hassan, R., Kurukulasuriya, P, Benhin, J. and Mendelsohn, R. 2006. The policy nexus between agriculture and climate change in Africa. A synthesis of the investigation under the GEF / WB Project, *Regional Climate, Water and Agriculture: Impacts on and Adaptation of Agro-ecological Systems in Africa.* CEEPA Discussion Paper No 39, Centre for Environmental Economics and Policy in Africa, University of Pretoria.

Ewuola, S. O. and Ajibefun, I. A. 2000. Selected media and socioeconomic factors influencing innovation adoption among small scale farmers: Empirical evidence from Ondo and Ekiti States, Nigeria. *Applied Tropical Agriculture : 24-26*

Greene, W. H. 1993. *Econometric Analysis.* 5^{th} Edition Macmillan Pp 756-822

Guis, H., Caminade, C., Calvete, C., Morse, A.P., Tran, A. and Baylis, M. 2011. Modelling The effects of past and future climate on the risk of bluetone emergence in Europe. *Journal of Rural Sociology Interface. 10. 1098/rsif.2011.0255.*

Hassan, R. and Nhemachena, C. 2008. Determinants of African farmers' strategies for adapting to climate change: Multinomial choice analysis. *AFJARE 2(1):*83-103

Hill, M. A. 1983. "Female Labour Force Participation in Developing and Developed Countries: Consideration of the informal Sector". *Review of Economics and Statistics, 63 (3): 459-468*

India Council of Agricultural Research (ICAR). 2010-11 *Annual Report Pp 13.*

Intergovernmental Panel on Climate Change (IPCC), 2007. Climate Change 2007: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Parry, Martin L., Canziani, Osvaldo F., Palutikof, Jean P., van der Linden, Paul J., and Hanson, Clair E. (eds.)]. Cambridge University Press, Cambridge, United Kingdom.

Intergovernmental Panel on Climate Change. (2001). Climate Change: Synthesis Report. In R. T. Watson & the Core Writing Team (Eds.), A Contribution of Working Group I, II and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, USA.

Ishaya, S. I and Abaje, I. B. 2008. Indigenous people's perception on climate change and adaptation strategies in Jemaa local government area of Kaduna State, *Nigeria. Journal of Geography and Regional Planning 1 (8): 138-143*

Kimhi, A. 1994. "Participation of farm owners in farm and off-farm work including the option of Full-Time" *Journal of Agricultural Economics, 45(2):232-239*

Krishna, P. P. 2011. Economics of climate variation for small holder farmers in Nepal: A review. *Journal of Agriculture and Environment. 12:6-13*

McFadden, D. 1976. Quantal choice analysis: A survey. *Annals of Economic and social measurement,* 5, 363-390.

National Population Commission (NPC). 2006. Population Data in Nigeria.

Nmadu, J. N. Eze, G. P. and Jirgi, A. J. 2012. Determinants of Risk Status of Small Scale Farmers in Niger State, Nigeria. *British Journal of Economics, Management and Trade 2(2):92-108*

Olanrewaju, H. A., Purswell. J. L., Collier, S. D. and Branton, S. L. 2010. Effect of Ambient temperature and light intensity on prowth Performance and carcass Characteristics of heavy broiler chickens at 56 Days of Age. *International Journal of Poultry Science*, 9 (8): 720-725.

Obayelu, A. E. and Adedapo, A. 2006. The effect of climate on poultry productivity in Ilorin Kwara State, Nigeria. *International Journal of Poultry Science 5(11):1061-1068*

Rahji, M. A. Y. and Fakayode, S. B. 2009. A multinomial logit analysis of Agricultural Credit rationing by commercial banks in Nigeria. *International Research Journal of Finance and Economics 24:90-100*

Rowlinson, P. 2008. Adapting Livestock Production Systems to Climate Variation- Temperate Zones. *Livestock and Global Change Conference Proceeding*, May 2008, Tunisia.

Spore Magazine. 2008. Climate Variation: Pests and Diseases Page 5-6.*Spore Magazine*, August Special Issue: CTA.

World Bank, 2012. World Bank indicators- Nigeria-Population.

Yamane, T. 1997. *Statistics; An introductory Analysis* 2nd edition, New York: Harper and Row.

Zepeda, L. 1990. "Adoption of Capital versus Management intensive Technologies". *Canadian Journal of Agricultural Economics, 38:457- 469.*