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Assessment of Climate Variability on Poultry Production in Nigeria: 1990-2020

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A B S T R A C T

This study examined the influence of climate variability on poultry production in Nigeria from 1990-2020. State the broad objective only. This study adopted the quasi-experimental research design. Secondary data were used in the study. The method employed for analyzing the time series data was the Auto Regressive Distributed Lag (ARDL) model. Pre-estimation diagnostics tests were employed to check for stationarity of the data. From the results of the Error Correction Models (ECM's), average rainfall and Carbon dioxide emission have significant influence on poultry (egg and meat) production in Nigeria. A unit increase in average rainfall brought about -0.4% reduction in egg production, while a unit increase in carbon dioxide emission brought about a -0.27% reduction in egg production. Average rainfall had positive influence on broiler production a unit increase in rainfall increased broiler production by 0.41% and 0.52% at the current and two period lag, while carbon dioxide emission reduced broiler production by -0.16%. The study concluded that climate change do affect poultry production both negatively and positively and recommended that climate smart agricultural practices such as proper ventilation and vaccination should be applied in poultry production to mitigate the negative effects of climate change

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INTRODUCTION

Climate variability refers to long-term shifts in temperatures and weather patterns. These shifts may be natural, such as through variations in the solar cycle. But since the 1800s, human activities have been the main driver of climate variability, primarily due to burning fossil fuels like coal, oil and gas. Burning fossil fuels generates greenhouse gas emissions that act like a blanket wrapped around the Earth, trapping the sun's heat and raising temperatures. Examples of greenhouse gas emissions that are causing climate variability include carbon dioxide and methane. These come from using gasoline for cars or coal for heating a building, for example. Clearing land and forests can also release carbon dioxide, landfills with garbage are major sources of methane emissions. energy, industry, transport, buildings, agriculture and land use are among the main emitters (UN 2022).

Climate-Smart Agriculture (CSA) is an approach that helps guide actions to transform agricultural-food systems towards green and climate resilient practices. CSA supports reaching internationally agreed goals such as the Sustainable Development Goals (SDGs) and the Paris Agreement. It aims to tackle three main objectives: sustainably increasing agricultural productivity and income, adapting and building resilience to climate change, and reducing or removing greenhouse gas emissions, where possible (FAO, 2022).

As the COVID19 pandemic threatened the world economy in the face of climate change and extreme weather conditions, developing countries such as Nigeria slipped into economic recession in 2020. These events have led to increased food prices, loss of livelihoods, hunger, and malnutrition in Nigeria. The situation has reinforced the need to promote Climate-Smart Agriculture to feed the increasing population while considering the importance of greener recovery from global shocks (Adesina and Loboguerrero, 2021).

The domestication of birds such as chicken, ducks, quails, turkey, and geese with the intent of rearing them for meat, egg production as well as using their incidental products such as droppings and feathers in industries as natural unprocessed materials is known as poultry farming (Stiles, 2017). The rearing of birds originated many years ago, which emanated by collection of their eggs and young ones from their natural habitat which later resulted into domesticating them as farm animals with people. Cockfighting was initiated through rearing of chickens as well as taming of quails for their songs but were later ensnared and brought up as reared birds for consumption (Chakraborty and Chakrabarty, 2017; Chakraborty, 2018). Poultry production can be subdivided into three distinct parts namely; small, medium and large scale (Heise, Ritchie and Roser, 2020). These are also otherwise known as backyard, semi-commercial and commercial poultry farming (Omiti and Okute, 2008; Ricke, 2017; Rimi, et al., 2017). The country's standing poultry population as at 2020 is 166 million birds, a substantial decrease from about 184 million birds in 2018 (Sasu, 2022) most of which are domiciled in the southern part of the country either in semi-intensive farms or intensive ones (FAO, 2019).

Nigerian economy, although has been largely dependent on the oil sector, Agriculture remains its mainstay. Agriculture contributed about 21.2 of Nigeria's gross domestic product (GDP) as of 2019 (FAO, 2019). Agriculture is the second largest export earner after crude oil and employing over 70% of rural labour; thus, the sector ranks as a key contributor to wealth creation and poverty reduction (Okotie, 2018, FAO, 2019). Poultry, as an aspect of livestock production outnumbers all other forms of livestock in Nigeria and not surprisingly is found throughout the country (Adeyemo and Onikoyi, 2012).

When ambient temperature is high, chickens have higher energy (feed) needs than when in thermoneutral environments. Major losses result from a less efficient conversion offeed to meat, which detrimentally impacts poultry health and productivity (Olanrewaju et al.,2010).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 bodytemperature in their behavioural and physiological activities. Hence, birds can only tolerate narrow temperature ranges to sustain the peak of their production for human consumptionand any unpredictable climatic changes will therefore trigger a series of adjustment andreadjustments by livestock and poultry birds in the struggle for survival which may havenegative consequence on the viability of poultry production.The environmental conditions affecting the performance and health productivity of chicken include temperature, relativehumidity, light, sunshine prevailing at a given time, housing system and ventilation (Elijahand Adedapo, 2006). Ambient temperatures significantly influence the survivability andperformance of the poultry production. According to Indian Council for Agricultural Research(ICAR) (2010), as the ambient temperature increased to 34°C the mortality due to heat wassignificantly high in meat type chickens by 8.4%, the feed consumption of the chickensdecreases from 108.3g/bird/day at 31.6°C to 68.9g/bird/day at 37.9oC, the egg productionalso decreased by 6.4% as compared to their standard egg production.

LITERATURE REVIEW

Objective of the Study

The broad objective of this study was to determine the influence of climate variability on poultry production in Nigeria for the period under study (1990-2020). The specific objectives were to;

1. Determine the influence of rainfall, temperature and CO2 emissions on layer (egg) production in Nigeria from 1990-2020.
2. Determine the influence of rainfall, temperature and CO2 emissions on broiler (meat) production in Nigeria from 1990-2020.
3. Determine the forecasting ability of the data for future decision making

METHODOLOGY

Study Area

Nigeria is a tropical Country located in West Africa. It extends from about 4° to 14° north latitude, with a north–south span of about 700 miles (1,125 kilometers). In an east–west direction, the country extends from roughly 3° to 13° east?? longitude, also a distance of about 700 miles. The country has a total area of 357,000 square miles (925,000 Km2). The country is hot and soggy southern border faces toward the equatorial Gulf of Guinea on the Atlantic Ocean.

In the north, Nigeria extends into the Sahel region, nearly reaching the parched Sahara Desert. To the west is the country of Benin and to the north and northwest is Niger. Nigeria also shares a short border with Chad in the northeast and a much longer boundary with Cameroon to the east. The country's name comes from the Niger River, the country's major inland water feature. This river runs through the heart of Nigeria as it flows into the Gulf of Guinea. The Niger provides much of the country's hydroelectric power and also provides water for domestic use, industry, and irrigation (Douglas, 2004). The country is known for agricultural practices.

Figure 1. Map of Nigeria (Study Country)
Source: Hazen and Horner (2007)

Research Design

This study utilized a quasi-experimental research design approach. The choice of this approach stems from its suitability in assessing the impact of multivariate independent variables on a single dependent variable, (Donald and Julian, 1966).

Data Collection

This study employed secondary data in form of time series data on egg and meat output from 1990 - 2020gotten mainly fromFood and Agriculture Organization (FAO)Annual time series data and the Nigeria Bureau of Statistics, NBS while time series data on climatic variables such as annual temperature, annual rainfall and annual relative humidity from 1990 - 2020 were collected from the Nigeria Meteorological Agency (NIMET).

Data Analysis

The study used Auto Regressive Distributed Lag (ARDL) and Error Correction Model (ECM). The ECM was applied to gain insight into the long run dynamic estimates of the explanatory variables. The Augmented Dickey Fuller test (ADF) was adopted as test of stationarity of the time series. While, the ARDL was employed to establish the relationship between the variables. Also, the co-integration test (ARDL Bounds test) was used to test for the long run affiliation among the variables in the model.

Model Specification

In the regression equation, measures of average rainfall (ARF), annual temperature (ATEM), carbon dioxide emissions (CDEMIS) were the explanatory variables while poultry production was the dependent variable.

The functional forms of the models are expressed as:

Model One

It is expressed explicitly as

$$InLP_t = n_1 + a_1 InARF_t + a_2 InATEMP_t + a_3 InCDEMIS_t + u_{1t} \quad (1)$$

Incorporating the ARDL into the explicit model, we have:

$$InLP_t = \psi + \sum_{i=1}^{p} InLP_{t-1} + \sum_{i=1}^{q} \alpha_1 InARF_{t-1} + \sum_{i=1}^{q} \alpha_2 InATEMP_{t-1} + \sum_{i=1}^{q} \alpha_3 InCDEMIS_{t-1} + \sum_{i=1}^{p} \Delta InLP_{t-1} + \sum_{i=1}^{q} \beta_1 \Delta InARF_{t-1} + \sum_{i=1}^{q} \beta_2 \Delta InATEMP_{t-1} + \sum_{i=1}^{q} \beta_3 \Delta InCDEMIS_{t-1} + \lambda ECT_{t-1} + \mu_t \quad (2)$$

where;

LP = Layer Production (tons)
ATEMP= Average Rainfall(millimeter)
ATEMP = Annual Temperature (degree celcius °C)
CDEMIS= Carbon Dioxide Emissions(metric tons per capita)
n1and ψ = intercepts
a1 – a3 = long run parameter estimates of the regressors
β1 – β3 = short run parameter estimates of the regressors
u1 = stochastic error terms.
ECT= error correction term
In = natural log notation

Model Two

Model two is expressed explicitly as

$$InBP_t = n_1 + a_1 InARF_t + a_2 InATEMP_t + a_3 InCDEMIS_t + u_{1t} \quad (3)$$

Incorporating the ARDL into the explicit model, it is expressed as:

$$InBP_t = \psi + \sum_{i=1}^{p} InBP_{t-1} + \sum_{i=1}^{q} \alpha_1 InARF_{t-1} + \sum_{i=1}^{q} \alpha_2 InATEMP_{t-1} + \sum_{i=1}^{q} \alpha_3 InCDEMIS_{t-1} + \sum_{i=1}^{p} \Delta InBP_{t-1} + \sum_{i=1}^{q} \beta_1 \Delta InARF_{t-1}$$

$+\sum_{i=1}^{q} \beta_2 \Delta\, InATEMP_{t-1} + \sum_{i=1}^{q} \beta_3\, \Delta InCDEMIS_{t-1} + \lambda ECT_{t-1} + \mu_t$

(4)

where;

BP = Broiler Production (tons)
ATEMP= Average Rainfall(millimeter)
ATEMP = Annual Temperature (degree celcius °C)
CDEMIS= Carbon Dioxide Emissions(metric tons per capita)
n1and ψ = intercepts
a1 – a3 = long run parameter estimates of the regressors
β1 – β3 = short run parameter estimates of the regressors
u1 = stochastic error terms.
ECT= Error Correction Term
In = natural log notation

RESULTS AND DISCUSSION

Table1. Time series trends of Layer Production (LP), Broiler Production (BP) Average Rainfall (ARF), Annual Temperature (ATEMP), Carbon dioxide Emissions (CDEMIS) 1990-2020.

YEAR	BP (Tons)	LP(Tons)	ARF (milm.)	ATEMP (°C)	CDEMIS(mt/c)
1990	174000	337000	89.44	27.34	0.400572
1991	165000	359000	99.95	26.92	0.409453
1992	162000	378000	92.04	26.51	0.641477
1993	165000	397000	90.77	26.95	0.567027
1994	168000	418000	100.37	26.66	0.42585
1995	169000	390000	97.28	26.98	0.307995
1996	170000	325000	106.98	27.01	0.351623
1997	171000	279000	99.69	26.96	0.3539
1998	172000	419000	95.95	27.63	0.345099
1999	172000	435000	102.42	27.2	0.375221
2000	160000	400000	95.89	26.82	0.647072
2001	183500	440000	89.02	26.86	0.664257
2002	190000	450000	92.83	27.2	0.762546
2003	201000	460000	111.78	27.36	0.705683
2004	211000	476000	94.56	27.34	0.716724
2005	218750	500400	87.14	27.46	0.753488
2006	232100	526400	94.73	27.42	0.693421
2007	243300	552800	102.32	27.49	0.649214
2008	260000	581000	105.38	27.06	0.639511
2009	273000	612600	92.99	27.82	0.496985
2010	245000	609057	101.83	27.83	0.580256
2011	198303	636000	76.65	27.42	0.589977

2012	229129	640000	98.24	27.27	0.595563
2013	193153	650000	76.6	27.38	0.556657
2014	196350	640000	90.7	27.53	0.580732
2015	204416	660000	80.39	27.36	0.577651
2016	240123	650000	83.60	28.45	0.600757
2017	258163	660000	86.94	29.59	0.624787
2018	264322	640000	90.42	30.77	0.649779
2019	240030	640000	94.04	32.00	0.67577
2020	238250	646667	97.80	33.28	0.702801

Source: Food and Agriculture Organization (FAO)

Table 1 presents the time series data of both the dependent and independent variables, Layer and Broiler Production measured in tons, Average Rainfall measured in millimeters, Annual Temperature measured in degree Celsius and Carbon dioxide emissionsmeasured in metric tons per capita, all covering from 1990-2020.

Trends inClimate Smart and Poultry Production

The various trends for Layer Production (LP), Broiler Production (BP) Average Rainfall (ARF), Annual Temperature (ATEMP), Carbon dioxide Emissions (CDEMIS) from 1990-2020are shown in Fig. 1.

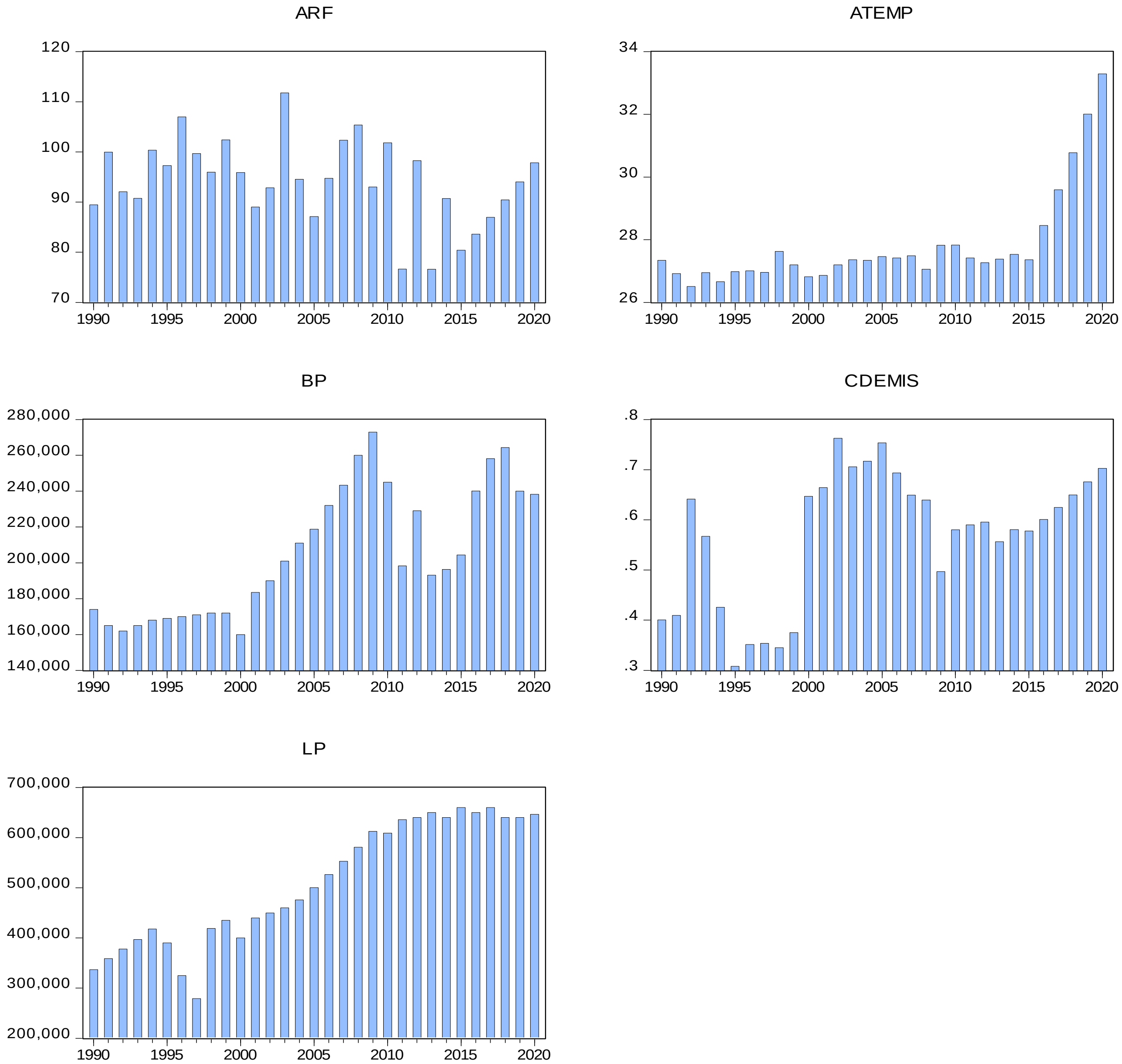


Figure 2. Trends inClimate Variability and Poultry Production over the period 1990-2020

Source: Graphical Representation of Climate Variability and Poultry Production

Figure 2 showed the trends in variables for the period under study, average rainfall was quite high during the period under study with slight fluctuations, but from 2016-2020, the average rainfall was constantly increasing, this might not be unconnected with the floods occurring globally coupled with global warming and increased gas flaring in the country. Average temperature was between the range of 26-27°C, from 2016, the temperature equally gained traction rising from 28°C to about 34°C in 2020. C02 emission was high all through the period under study, with slight fluctuations. Broiler production was low from 1990 to 2000, picked up in 2001 and the peaked in 2009 and have been going up and down since 2009 to 2020. Layer production on the average has been on consistent increase in the country, this may probably be because egg is a cheap source of protein to meet the dietary needs of the populace when compared to other sources of protein like fish and beef etc., hence investment in egg production also continue to increase.

Descriptive Analysis

This gives more detailed description of the characteristics of the variables observing theirskewness, kurtosis and normality. This is shown in table 2.

Table 2. Descriptive Analysis

	ARF	ATEMP	CDEMIS	LP	BP
Skewness	-0.259043	2.395024	-0.586345	-0.161006	0.352526
Kurtosis	2.938718	7.918475	2.120685	1.597990	1.737037
Jarque-Bera	0.351550	60.88394	2.775012	2.672878	2.702392
Probability	0.838807	0.000000	0.249697	0.262780	0.258930
Observations	31	31	31	31	31

Source: Author's Computation, 2022

The test for normality is shown in the JaqueBera test statistics. The null hypothesis is that all variables are normally distributed given that the probability value is greater than 0.05 level of significance. The probability value in table 2 showed that all variables except ATEMP are normally distributed. Therefore, the data sets will still be used as majority of the variables are normally distributed and the issue of non-normal distribution, the test for stationarity was carried out to resolve this.

Unit Root Test

The optimal order of lag for each of the variables was based on Schwartz Information Criterion (SIC) automatic lag selection procedure.The table showed that the variables were stationary at level I (0) and at first difference I (1).

Table 3. Results of Unit Root Test (using Intercept and Trend)

Variable	Unit root test	t-statistic	Critical value	Level (%)	Order of integration
LP	ADF	-3.534304	-2.976263	(5%)	I(1)
			-2.627420	(10%)	
BP	ADF	-5.287320	-3.679322	(1%)	I(1)
			-2.967767	(5%)	
			-2.622989	(10%)	
ARF	ADF	-4.701839	-3.670170	(1%)	I(0)
			-2.963972	(5%)	
			-2.621007	(10%)	
ATEMP	ADF	3.945187	-3.670170	(1%)	I(0)
			-2.963972	(5%)	

			-2.621007	(10%)	
CDEMIS	ADF	-5.075181	-3.679322	(1%)	I(1)
			-2.967767	(5%)	
			-2.622989	(10%)	

Source: Authors Computation (2021)

From the Unit root results in table 3, it was discovered that ARF and ATEMP were stationary at level while LP, BP and CDEMIS were stationary at first difference given that their t-statistics value were greater than their critical values. The stationarity of the variables here implies that the regression results are not spurious and the results obtained from the analysis are good for forecasting.

Cointegration Test

Since the order of integration are of mixed orders, before going to estimation, it is important toascertain if there will be long run relationship between the dependent and independent variables. TheARDL Bounds test is used since the order is a mixture of I(0) and I(1).

Table 4. ARDL Bounds Cointegration Test Result

Model	**F-statistic**	**Signif.**	**I(0)**	**I(1)**
Model 1	2.567177	10%	2.37	3.2
Model 2	2.688098	10%	**2.37**	3.2

Source: Researcher's Calculation (2021)

The ARDL bounds test showed that there is a long run relationship between the dependent and independent variables in Model 1. This is indicated by the results which shows the F- statistics value is greater than the critical value of I(0) bounds at 10% level of significance.

For Model 2, the ARDL bounds test showed that there is a long run relationship between the dependent and independent variables. This is indicated by the results which shows the F- statistics value is greater than the critical value of I (0) bounds at 10% level of significance.

Model Estimation

Estimation Result for Model One

Table 5. ARDL-ECM Regression Result Model 2

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
DLOG(LP(-1))	-0.319226	0.188317	-1.695150	0.1122
DLOG(LP(-2))	-0.300942	0.182598	-1.648114	0.1216
DLOG(LP(-3))	-0.506900	0.210730	-2.405443	0.0305
DLOG(ARF)	-0.193956	0.187192	-1.036137	0.3177
DLOG(ARF(-1))	**-0.437488**	**0.192686**	**-2.270470**	**0.0395**
DLOG(CDEMIS)	-0.177425	0.121714	-1.457725	0.1670
DLOG(CDEMIS(-1))	0.201092	0.114079	1.762747	0.0997
DLOG(CDEMIS(-2))	**-0.272098**	**0.094860**	**-2.868423**	**0.0124**

CointEq(-1)*	0.074555	0.028464	2.619241	0.0202
R-squared	0.572474	Mean dependent var		0.018070
Adjusted R-squared	0.382463	S.D. dependent var		0.099589
S.E. of regression	0.078261	Akaike info criterion		-1.996342
Sum squared resid	0.110245	Schwarz criterion		-1.564397
Log likelihood	35.95062	Hannan-Quinn criter.		-1.867902
Durbin-Watson stat	2.533141			

Source: Researcher's Computation (2021)

The parsimonious error correction model result for model 1 as presented in table 5 showed that the coefficient of determination R2 which measures the goodness of fit was 0.57. This implies that 57% of the total variations in layer production (egg) which is the dependent variable were explained by the regressors (ARF and CDEMIS), only 43% were not explained, but were accounted for by the error term.The Durbin –Watson value of 2.53 which is not far from 2.0 indicates that there was no problem of serial auto correlation in the model.This confirms the study of Albert and Okidim (2014) who studied climate change variability and mitigating measures by rural dwellers and concluded that climate change has negative effect on arable crop production and that climate variability leads to low yield.

The result showed that layer production (LP) has a significant but negative relationship with C02 emission (CDEMIS) (climate variability) in a two-period lag (CDEMIS (-2). This means carbon dioxide emission had a negative effect on layer production in the country during the period under study. A unit increase in C02 emission actually brought about a (-0.272098) Tons reduction in layer (egg) production. The economic implication of this findings is that the more the C02 emission, the greater the negative effect on layer production. This effect might not be limited to poultry production, but it can equally affect other areas of livestock production.

Carbon emission into the atmosphere can bring about changes in climatic conditions such as increase in temperature, rainfall, ozone layer depletion which can equally lead to flooding. The effect of rainfall on layer production was examined in the course of this research. Average rainfall had a negative effect on layer production (egg) in a one period lag (ARF (-1). This implies that an increase in rainfall brought about (-0.437488) Tons reduction in layer production. Aromolaran, Ademiluyi and Itebu, (2013), reported High rate of disease and pest attack as a major challenge in poultry production in Nigeria. Excessive rainfall can make the atmosphere very damp and provide very conducive environment for viruses and bacteria to thrive, this can increase disease in the farm and negatively affect production. This finding is in agreement with Adesiji, Baba and Tyabor (2015) who researched on the effect of climate change on poultry production in Ondo State Nigeria and realized based on the responses of the sampled respondent's, that temperature fluctuation, increased in sunshine intensity and global warming has a negative effect on poultry production,

Table 6. ARDL-ECM Regression Result Model 2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(BP(-1))	0.466876	0.141360	3.302739	0.0063
DLOG(BP(-2))	-0.233891	0.161756	-1.445954	0.1738
DLOG(BP(-3))	0.278786	0.128092	2.176451	0.0502
DLOG(ARF)	**0.413181**	**0.120574**	**3.426784**	**0.0050**
DLOG(ARF(-1))	0.300594	0.152106	1.976211	0.0716
DLOG(ARF(-2))	**0.527415**	**0.123641**	**4.265699**	**0.0011**
DLOG(CDEMIS)	-0.120515	0.063079	-1.910525	0.0802
DLOG(CDEMIS(-1))	**-0.163406**	**0.074819**	**-2.184021**	**0.0495**
DLOG(CDEMIS(-2))	0.129346	0.066452	1.946471	0.0754
DLOG(CDEMIS(-3))	-0.109636	0.067355	-1.627730	0.1295
CointEq(-1)*	-0.287503	0.067915	-4.233279	0.0012
R-squared	0.812606	Mean dependent var		0.013606
Adjusted R-squared	0.695485	S.D. dependent var		0.085366
S.E. of regression	0.047107	Akaike info criterion		-2.981216
Sum squared resid	0.035505	Schwarz criterion		-2.453282
Log likelihood	51.24641	Hannan-Quinn criter.		-2.824234
Durbin-Watson stat	2.094664			

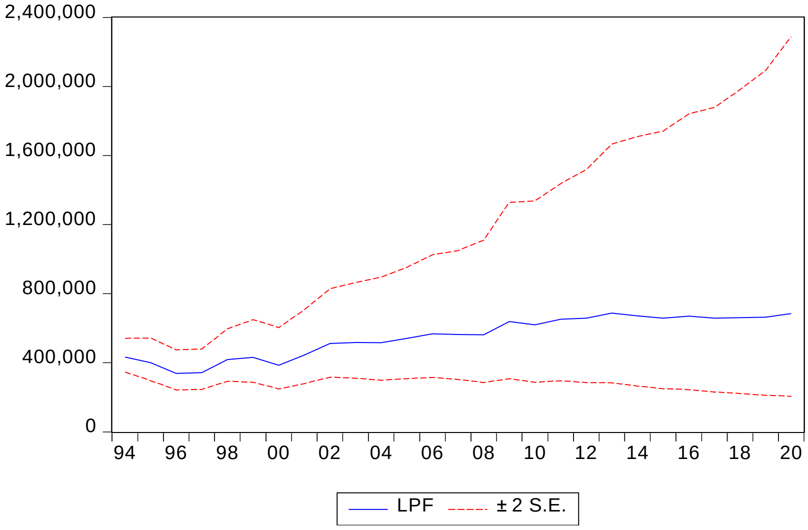
Source: Researcher’s Computation (2021)

The parsimonious error correction model result for model 2 as presented in table 6 showed that the coefficient of determination R2 which measures the goodness of fit was 0.81. This implies that 81% of the total variations in Broiler production (meat) which is the dependent variable were explained by the regressors (ARF and CDEMIS). The Durbin –Watson value of 2.09 indicates that there was no problem of serial correlation in the model, which means that regression could be applied.

The effect of rainfall on Broiler production was determined in this research. Average rainfall had a negative positive effect on Broiler production (meat) in its current and two period lag (ARF) and (ARF (-2). This implies that an increase in rainfall brought about (0.413181) and (0.527415) Tons reduction in broiler production. Excessive rainfall can make the atmosphere cool, since poultry birds normally suffer heat stress, this cool temperature would increase their chances of survival to maturity hence reducing mortality, which will culminate in increase in output.

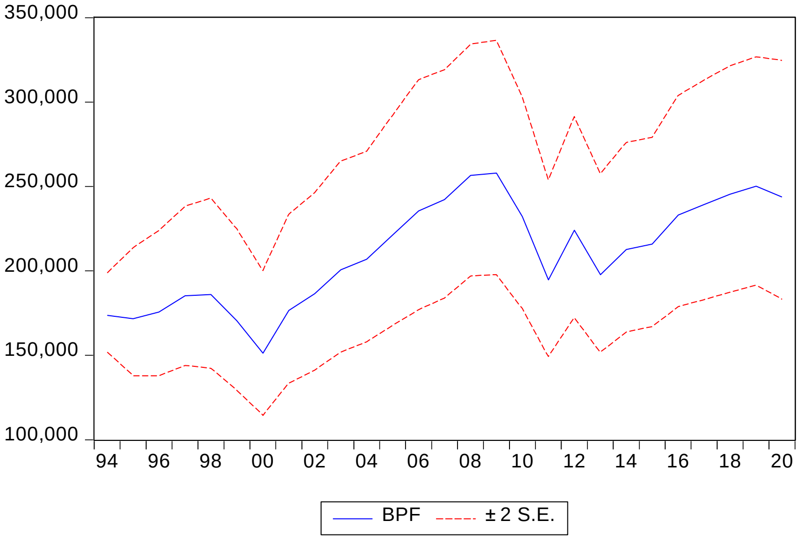
On the other hand, C02 emission (CDEMIS) in a one period lag (CDEMIS (-1) shows a significant negative relationship with broiler production. This means carbon dioxide emission had a negative effect on broiler production in the country during the period under study. A unit increase in C02 emission actually brought about a (-0.163406) Tons reduction in broiler (meat) production. The weather implication of this findings is that the more the C02 emission, the greater the negative effect on broiler meat production. This will reduce income and profitability.

The forecast test was used to determine whether the model can be used for forecast.



Forecast: LPF	
Actual: LP	
Forecast sample: 1990 2020	
Adjusted sample: 1994 2020	
Included observations: 27	
Root Mean Squared Error	29931.41
Mean Absolute Error	23914.05
Mean Abs. Percent Error	4.950623
Theil Inequality Coefficient	0.027052
Bias Proportion	0.483557
Variance Proportion	0.000248
Covariance Proportion	0.516195
Theil U2 Coefficient	0.586986
Symmetric MAPE	4.734905

Figure 3. Forecast Test Result for the Parsimonious ECM Model 1
Source: Researcher's Estimation



Forecast: BPF	
Actual: BP	
Forecast sample: 1990 2020	
Adjusted sample: 1994 2020	
Included observations: 27	
Root Mean Squared Error	9432.827
Mean Absolute Error	7685.079
Mean Abs. Percent Error	3.643028
Theil Inequality Coefficient	0.022106
Bias Proportion	0.003273
Variance Proportion	0.163946
Covariance Proportion	0.832781
Theil U2 Coefficient	0.527089
Symmetric MAPE	3.634834

Figure 4. Forecast Test Result For The Parsimonious ECM Model 2
Source: Researcher's Estimation

The Theil inequality coefficient is used for evaluating the forecasting ability of the model. It found from the Theil inequality coefficient (0.027) and (0.022) which are less than one (1) that the models are good and can be relied upon in forecasting changes in layer and broiler production in Nigeria, as a result of climate variability. This finding is further verified by the plot of the forecast samples with the two standard error bounds. It was clear that the plot of the forecast samples falls within the two standard errors bounds. This implies that the trend is tracked reasonably well as no pointis located outside the critical point.

CONCLUSIONS AND RECOMMENDATIONS

The study concluded that the climate variability factors like rainfall and carbon dioxide emission had significant negative effect on poultry meat and egg production, the study recommended that climate smart agricultural practices such as proper ventilation and vaccination should be applied in poultry production to mitigate the negative effects of climate variability on their output.

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