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CLIMATE CHANGE AND AGRICULTURAL PRODUCTION IN BAYELSA STATE, NIGERIA

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ABSTRACT----------
The study investigated the impact of climate change on agricultural production in Bayelsa State, Nigeria. A correlational research design was adopted to ascertain the extent climate change influence agricultural sector performance in Bayelsa State. The population of this study consists of 3399 farmers in Bayelsa State. The sample size of 359 respondents were drawn from the entire population using Taro Yamen's formula. The result from the study revealed that climate change to a very high extent influence crop production in Bayelsa State by 74%. Also, the result of the study showed that climate change to a high extent influence livestock production in Bayelsa State by 67.7%. Based on these findings, the study recommends among others that policy makers should adopt proactive and innovative approaches through the involvement of key stakeholders in order to substantially address the challenges of changing climate on crop and livestock production. Also, the Ministries of Environment at both State and Federal levels should ensure strict adherence to environmental laws to minimize the extent of environmental pollution to reduce the intensity of climate change and its associated negative implications on crop and livestock production.
KEYWORDS: *Climate Change, Agricultural Production*----------

INTRODUCTION

Climate Change has been, unarguably, one of the most challenging environmental issues in human history. The discourse on climate change reveals that it has evolved from a purely scientific concern to a public agenda that is nowadays more inclined to be development problem. With increasing public involvement in the Climate Change discourse and ensuing awareness regarding the potential risks and uncertainties attached to the issue, it has been debated and problematized from diverse standpoints (Rahman, 2012). Experts argue that the changing dimensions of climate change have posed threat to climate sensitive sectors, such as agriculture with attendant implications on food security. McGuigan, et al (2002) also posit that the dampening effect of climate change on agricultural productivity has remained a popular view in both academic and business cycles. Food security, poverty reduction and sustainable growth amongst others across the globe are expected to face greater challenges amidst climate change. The Food and Agricultural Organization, FAO (2009) forecast reveals that to meet the increasing food demands across the globe, food production should increase by at least 60 percent from 2007 to 2050.

However, changes in agricultural sector performance due unpredictability of climatic outcomes have remained a dominant issue in low income countries including Nigeria as both flora and fauna are sensitive to climate change. For instance, annual report of Weather, Climate and Catastrophe Insight, natural disasters alone have caused economic loses in tune of USD 225 billion across the world in 2018 and since 2016 the losses due to natural calamities have crossed USD 200 billion per year. About 95% of these losses are attributed to weather related incidences, of which cyclones, floods and droughts are the key players and are directly related to climate change. Altogether, the impact of climate change is very comprehensive but its far reaching effects are now clearly visible on agricultural sector, on which relies the food production and economy of the world. Jones and Thornton (2017) predicted that that crop yield in Africa may decline by 10 to 20 percent or even up to 50 percent by 2050 due to climate change. In spite of

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technological improvements in agricultural production through genetically modified crops or irrigation systems, climatic conditions and weather patterns remain key determinants of its food production potentials (Trapp, 2014).

Undoubtedly, inconsistency of climatic conditions or changing weather events can alter the productive capacities of farmers and in some instances, especially when the potential capacity to adapt to changing weather conditions are lacking, affect agricultural output severely. Increasing atmospheric carbon dioxide emissions, higher temperature, variation in annual and seasonal precipitation patterns amongst others seem to threaten the quantity of food production and natural environment (Brussel, 2009). The German Council on Climate Change (2003) identified climate change as a major threat to human welfare and the natural eco-system in both developed and developing economies but at varying degrees. The severity of the effects of climate change agriculture depends largely on the vulnerability of the existing technologies and adaptive capacity considering the dynamism of environmental conditions. Abinbola, et al (2015) argued that the effect of climate change seem to be less severe in developed economies due to high adaption techniques, endowed advantage, high technology, mechanized agricultural system and income status. They further argue that developing economies including Nigeria are at the risk of adverse effects of climate change considering the prevalent high level of temperature, poor adaptation capacity, absence of early warning and poor income status.

It is remarkable that African countries including Nigeria have in recent time experienced some adverse effects of climate change due to the dynamics of drought, rainfall, relative humidity and temperature amongst others. Emete and Amusa (2010) outlined the post-primary effects with climate change in Africa to include spread of pests, rising competition for available resources, and extinction of biodiversity. Agricultural sector in many African countries has been endangered by variability in climatic conditions. The Intergovernmental Panel on Climate Change, IPCC (2017) predicts that countries in sub-Sahara Africa are likely to be most vulnerable to climate change by 2100, with a projected agricultural loss of 2 to 7 percent of the countries' gross domestic product. Considering the adverse effects of climate change on agricultural performance and economic growth, adaptation strategies are becoming highly integrated into policy actions geared towards stimulating agricultural production. This could be put forward to the important role played by agriculture in food security and poverty reduction in most developing economies.

Furthermore, aside from being very vulnerable to climate change, agriculture has equally been identified as one of the causes of climate change in recent years. The traditional and seemingly outdated agricultural methods employed by farmers tend to worsen the incidences of climate change in developing economies. These activities increases the tendencies of greenhouse gases (GHGs) concentrations in the atmosphere which cause global warning, climate change and rise in sea level (Medugu, 2009). Additionally, Huang and Wang (2014) remarked that increase in emissions of greenhouse gases will continue as long as farming and other climate change driven agricultural activities did not from the model of business-as-usual.

Investment in agriculture under climate change is identified in economic literature as key to agricultural adaptations to climate change. Additionally, Huang and Wang (2014) opine that the commitment made at both global and national levels seems inadequate to engender efficient adaptations of the agricultural sector to climate change scenarios. More importantly, the policy environment required for the development of dynamic agricultural systems in view of the growing climate change seems to be sub-optimal in Nigeria. Weak infrastructural development and inconsistent policies have been identified as major impediments to agricultural development in Nigeria (Atser, 2017). This has remained a major concern to stakeholders in the agricultural sector considering the adaptability of this climate sensitive sector to varying dimensions of climate change. It is against this backdrop that this study intends to deepen the understanding of the impact of climate change on agricultural production in Bayelsa State, focusing mainly on crop and livestock productions as key indicators of agricultural performance.

Statement of the Problem

Agriculture in Nigeria has been identified as a high climate sensitive sector, thus drawing attention to the impact of climate change on its performance. The rising temperature, variability of rainfall resulting to flood and increasing carbon dioxide concentration are key indicators of climate change in Nigeria that constrain effective performance of agricultural sector. Whilst acknowledging the efforts made by successive governments in Nigeria towards improving irrigation and access to fertilizer, the adverse effects of inconsistency in rainfall on rain-fed crops and other agricultural

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yield has remained a major source of worry to stakeholders in the agricultural sector. It is noteworthy that food security in Nigeria is vulnerable to climate change because of the dependence on rain-fed agriculture which relies directly or indirectly on climate change and variability.

Besides, large proportions of agricultural activities in Nigeria from planting to harvesting are dependent either directly or indirectly to climate change and variability, thus drawing attention to issues of climate change. Besides varying rainfall, rising average temperature has been identified in existing literature as a limiting factor to medium and long term objectives of output growth and agricultural development respectively in Nigeria. Among the countries in the tropical zone, Nigeria has remained outstanding in terms of rise in minimum and maximum temperature. This is partly linked to the crude oil exploitation and exploration in the country, especially in the Niger Delta area. Various programmes and policy initiatives, especially the Green Revolution and River Basin Development Authorities have been embarked upon by previous governments in Nigeria with probable sub-optimal outcomes, thus constraining adequate adaptability of agricultural sector to incidences of climate change. Consequent upon these, agriculture's share of the gross domestic product seem to be threatened. The growing concern about long term variations in climatic conditions in Nigeria and the response of climate sensitive sectors, especially agriculture to these changes, has triggered questions as: How has crop production been influenced by changing climatic conditions? How sensitive is livestock production to climate change? It is against this backdrop that this study explores the climate change impacts on agricultural productivity.

Aim and Objectives of the Study

The aim of this study was to examine the overall impact of climate change on agricultural production in Bayelsa State. Specifically, this study is designed to:

1. Determine the influence of climate change on crop production in Bayelsa State.
2. Ascertain the influence of climate change on livestock production in Bayelsa State.

Research Questions

1. To what extent does climate change influence crop production in Bayelsa State?
2. To what extent does climate change influence livestock production in Bayelsa State?

Hypothesis

1. Climate change does not significantly influence agricultural production in Bayelsa State.

LITERATURE REVIEW

This section will deal with review of literatures under the following sub-headings: Conceptual Clarifications, Theoretical Framework and Review of Empirical Literature

Concept of Clarifications

Climate Change

Climate change refers to changes beyond the average atmospheric condition that are caused both by natural factors such as the orbit of earth's revolution, volcanic activities and crustal movements and by artificial factors such as the increase in the concentration of greenhouse gases and aerosol. In other words, it is the observable variations in the climate system that are attributable to human (anthropogenic) activities, especially those that alter the atmospheric composition of the earth and ultimately lead to global warming (Awosika, et al. 1992). Climate change by global warming denotes an average increase in global temperature. It has become a megatrend that leads to significant global changes.

Overview of Agricultural Sector Performance in Nigeria

The agricultural sector in Nigeria consists of the subsectors of crop production, livestock, forestry and fishing. It is the main driver of the growth process through the provision of food for local consumption and supply of human capital to the industrial sector (Olaniyi, et al, 2015). Yusuf (2014) notes that livestock production in Nigeria before the colonial era was predominantly nomadic in nature which made investment in the sub-sector unattractive. However, the establishment of the Nigerian Veterinary Department provided the required roadmap for profitable investment in

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the livestock subsector. Many development economists have described the agricultural sector as the bedrock of the Nigerian economy since the actualization of political independence in 1960 and as such has remained the sustainer of the large population despite its relegation to the background by successive governments in Nigeria due to discovery of crude oil.

The sector has been characterized by several unexploited potentials which are necessary ingredients for growth and development. This is evident in the availability of arable land, water resources, human capital and expanding internal markets. Notably, only 40 percent out of the 84 million hectares of arable land in Nigeria are cultivated (Federal Ministry of Agriculture and Rural Development, 2018). In spite of efforts by relevant stakeholders to boost performance of the sector, the output has always fallen below expectation due to the predominance of small farm holdings and non-mechanization of the process. Consequently, importation of most food items and livestock has continued to increase thereby undermining the inward looking policy initiative of the government. Additionally, this worsens the structural macroeconomic problem prevalent in Nigeria due to deficits in the balance of payment position. Furthermore, the agricultural sector in Nigeria has been viewed by key stakeholders as immensely endowed with varying potentials. Apart of the abundance of vegetation necessary for livestock production, the sector was described by Chauvin, et al (2012) as potentially endowed with 267.7 billion cubic metres of surface water and 57.9 billion cubic metres of underground water which are essential for irrigation. It is noteworthy that the agricultural subsectors in Nigeria which comprises food production, livestock, forestry and fishing activities have the capacity to boost growth in the sector in particular and the overall economy. Crop production accounted for an average of 83.2 percent of the agricultural sector gross domestic production from 1960 to 2011. In 2020, crop production made the largest contribution to agricultural sector, which generated 21.8 percent of the country's GDP (Central Bank of Nigeria, 2021). Thus, crop production has remained the largest sub-sector in the Nigerian agricultural sector as all staple foods and other food production activities in Nigeria depends on it.

Tolulope and Etumnu (2019) opine that crops mainly cultivated in Nigeria range from cassava, yam, millet, maize, rice, sweet potatoes, beans and groundnut. These indicate that crop production integrates both food and cash crops. The food crops have remained outstanding in meeting the needs of the domestic economy and help in promoting food security. Also, the cash crops have provided basis for foreign exchange earnings and promotion of balance of payment surplus. Livestock production has remained the second largest agricultural subsector in Nigeria given its share of the agricultural gross domestic product and the overall output in Nigeria. Its share of agricultural gross domestic product stood at 19 percent between 1983 and 1984, but declined to 6 percent from 2004 to 2018 (Tolulope & Etumnu, 2019). Again, the livestock subsector has been of great economic importance to the Nigeria economy despite poor policy actions to transform it in accordance with the growing demand for food security. This is evident in its contribution to wealth creation, provision of raw materials for local industries, food supply and expansion of export base. Small farm holders have relied on livestock as a means of livelihood, thereby making the subsector an important driver of growth and development in Nigeria. Regardless of the laudable contributions, Ojiako and Olayode (2018) posit the livestock subsector has in recent time performed below expectation due its share of the aggregate domestic product in Nigeria. Unfortunately, the agriculture sector has not been adequately tapped and developed notwithstanding the enormous potentials that abound in Nigeria. Considering these bottlenecks, the sector continued to attract the attention of the relevant stakeholders for the required transformation given its predominant role in the process of growth.

Theoretical Review

Crop Growth Model

The Crop Growth Model is the theory supporting this study, and it was developed by De Wit in 1965. De Wit (1965) proposed the crop growth model in an effort to capture the implications of climate change on crop yield. It assumes that changes in weather conditions are important determinants of crop productions. This is because environmental conditions are believed to vary across regions. Wheeler and Tiffin (2009) remarked that the crop growth model is one of the approaches in economic literature of climate change that provides basis for understanding the resultant effect of climate change on agricultural production. The model provides insights into weather impacts as well as input intensities for varying technologies of production and crops.

Gbetibouo and Hassan (2003); and Sands and Edmonds (2005) argue that the crop growth model theoretically relates the climate, farm inputs and other environmental economic factors to output of crops. Focusing on the climate, crop

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yields are predicated on climate change indicators such as variability of temperature, average rainfall and other weather events. Notably, the crop growth model offers a straightforward approach to the assessment of the implications of weather changes on agriculture. Thus, climate change and weather variability are identified as important sources of crop yield changes. For rain fed crops, variability in rainfall is expected to cause crop production to decline and induce hike in the market price of the associated crop.
Additionally, alternative sources of water may be relied upon in the short run in the incidence of unexpected decline in rainfall. This often increases the production costs and loss of profit amongst others. The major drawback of the crop growth model as identified in literature lies in the difficulty associated with its application for assessing the long-term impacts of climate change on crop production. Again, the crop growth model is equally criticized for under estimating the potentials of crop adaptation in the long run. This underestimation technically ignores other and seemingly severe implications of climate on crop yield.

Review of Empirical Literature
This section is founded on the review of some economic studies related to this work. The economic literature on climate change has been characterized by numerous studies on the impacts of climate change on agricultural sector performance. Most of the studies show evidence of net negative effects of climate change on agriculture (Kurukulasuriya, et al. 2006; Galindo, et al. 2015; Ladan, 2014 amongst others) while very few of these studies show evidence of positive relationship between variability in climate change and agricultural output, especially crop growth (Adejuwon, 2006; and Trapp & Schneider, 2014). Again, some of the previous studies indicate that the dampening effects of climate change on agriculture tend to be concentrated in low income countries (Kurukulasuriya et al., 2006; Gebreegziabher & Holden, 2011; Barrios, et al. 2008).

Barrios, et al (2008) explored the impact of climate change on aggregate production of agricultural sector in Sub-Sahara Africa (SSA) and non-sub-Sahara Africa (NSSA) economies. The datasets utilized for the empirical analysis centered on new cross -country panel climatic data based on agricultural production. It was uncovered from the findings that rainfall and temperature are key divers of agricultural production in Sub-Sahara Africa. On the contrary, the non-sub-Sahara African countries seem not to be affected in the same degree. The study concluded that detrimental changes in climate change is responsible for the largely substantial variation in• agricultural production between SSA and the rest of the world.

Zhai and Zhuang (2009) employed global computable general equilibrium (CGE) model in investigating the potential effect of climate change on agricultural production and trade in China up to 2080. The result indicates that climate change has moderate impact on the aggregate economy. This is mirrored through the declining of the contribution of agriculture to gross domestic product. The study concludes that food processing subsectors are to adversely affect agricultural output variability due to climate change.

Apata (2011) examined the effects of climate charge on agriculture and drivers of adaptation in the Nigerian agricultural sector. Combinations of primary and secondary data were utilized for the empirical analysis. Specifically, the secondary data used for the estimation spans through Scenarios of 1971 to 1980, 1981 to 1990 and 1991 to 2000. The primary data on the other were elicited from 850 respondents. Multinomial choice and stochastic simulation model was employed to examine the effects of rapid climate change on grain production and the human population in Nigeria. The result reveals that there is likelihood of increasing hunger —related deaths if the production of grain lags behind population growth in the event of unfavourable weather outcomes. Thus, the study concluded that climate change adaptation generated significant effect on productivity of farmers.

Gebreegziabher et al (2011) investigated the effect of climate change on agricultural productivity in Ethiopia. The study strictly relied on countrywide computable general equilibrium model. The result indicates that relatively high effect of overall climate change on agricultural output productivity. Based on the empirical findings, the study concludes that fall in agricultural output will impose cost on the economy in the form of loss of income.

Onuoha (2011) analyzed the threats posed by the climate change to agricultural production in developing economies focusing mainly on the Nigerian economy. The study detailed on the sustainable development model to capture the

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net effects of climate change on agricultural sector. It however concluded that the issue of climate change requires productive and innovative approaches through the involvement of key stakeholders in order to substantially address the challenges.

Trapp and Schneider (2014) examined the regional weather impacts on the European agriculture. They specifically utilized a highly disaggregated 20-year panel data covering over 50.000 agricultural holdings and combine it with high resolution weather data. The estimation approach followed the production Function model. The impact of temperature and precipitation is estimated on irrigated and rain fed crops and the results indicate that both the Southern and Central European countries are vulnerable to variations in climatic conditions with over 55 percent losses while the climate change tends to create some benefits for the Northern Europe.

Ladan (2014) used secondary data on weather outcomes from notable sources to examine the link between climate change and agricultural production in Nigeria. The results show that climate change and extreme weather outcome in Nigeria are largely attributed to human activities. The findings equally indicate that agriculture is adversely affected by extreme weather events and variability of climatic conditions. Therefore, the study recommended for proactive measures in ensuring that the net negative effects of climate change on agriculture is mitigated.

Galindo, et al (2015) employed the Ricardian model in analyzing the potential impacts of climate on agriculture in Mexico using panel data. The study covered 2,431 municipalities between 2003 and 2009, distinguishing between irrigated, rainfed and mixed farms. The findings reveal that the vulnerability of the irrigated farms manifests more during temperature changes. However, rainfed farms are more vulnerable to changes in precipitation and extreme weather outcomes. It was specifically uncovered from the findings that rise in temperature and precipitation by 2.5°C and 10% respectively causes between -18.6 and -36.4 percent losses in net revenue.

Dallerba and DomInguez (2016) assessed the impact of climate change on agriculture in the South Western United States using the Ricardian model of farmland value. They focused on a particular climate zone and include the presence of extreme weather conditions and subsidies to farmers as explanatory variables. The empirical findings indicate that the tendency of high climatic impacts in highland is low compared to lowland.

METHODOLOGY

This study adopted a correlational research design to ascertain the extent climate change influence agricultural production in Bayelsa State, Nigeria. The population for this study consist of 3,399 farmers (i.e 2,066 crop producers and 1,333 livestock producers) in Bayelsa State. (Source: Ministry of Agriculture and Natural Resources, 11th May, 2021). The sample size of 359 respondents were drawn from the entire population using Taro Yamen's formula. The researcher employed a simple random sampling technique to draw respondents from different local government areas in Bayelsa State. The research instrument for this study is title: Climate Change Scale (CCS) and Agricultural Sector Performance Scale (ASPS). The instruments have two sections (A and B). Section A elicited demographic information from the respondents, while section B elicited information on climate change and agricultural sector performance respectively. Climate Change Scale (CCS) comprises fifteen items (15), while Agricultural Sector Performance Scale (EJPS) has ten (10) items only. The items of the instrument are responded on a 4-point Likert scale of Very High Extent (VHE), High Extent (HE), Low Extent (LE), and Very Low Extent (VLE). Data used for this study were sourced primarily by the researcher and with the help of two research assistants. 359 questionnaires were administered to the respondents, after which some questionnaires were retrieved from the respondents on the spot after they have duly responded to them, while some were collected after some days after due to the busy nature of the respondents. As part of data collection efforts, 327 copies were retrieved and found suitable for analysis resulting in 91% response rate. The internal consistency method using Cronbach Alpha reliability statistics was used to calculate the reliability coefficients of the two instruments. The reliability coefficients of Climate Change Scale and Agricultural Sector Performance Scale are 0.73 and 0.78 respectively. For the data that were analyzed, research questions one and two were answered with the use of simple regression while SPSS generated P-value was used to test for the hypothesis at 0.05 level of significance.

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RESULTS AND ANALYSIS

Research Question 1: To what extent does climate change influence crop production in Bayelsa State?

Table 1: Simple Regression on the Extent Climate Change Influence Crop Production in Bayelsa State?

Model	R	R Square	Adjusted R Square	Extent of Influence	Decision
1	.911[a]	.774	.775	77%	Very High Extent

Decision rule: 100%- 75% (Very High Extent), 74% - 50% (High Extent), 49%-25% (Low Extent) and 0% - 24% (Very Low Extent)

Table 1 revealed that the regression (R) and regression square (R^2) coefficients are .911 and .774 respectively. The extent of influence (coefficient of determinism) is 77% (.774 ×100). The result showed that climate change to a very high extent influence crop production in Bayelsa State by 77%.

Research Question 2: To what extent does climate change influence livestock production in Bayelsa State?

Table 2: Simple Regression on the Extent Climate Change Influence Livestock Production in Bayelsa State?

Model	R	R Square	Adjusted R Square	Extent of Influence	Decision
1	.814[a]	.677	.676	67.7%	High Extent

Decision rule: 100%- 75% (Very High Extent), 74% - 50% (High Extent), 49%-25% (Low Extent) and 0% - 24% (Very Low Extent)

Table 2 revealed that the regression (R) and regression square (R^2) coefficients are .814 and .677 respectively. The extent of influence (coefficient of determinism) is 67.7% (.677 ×100). The result indicated that climate change to a high extent influence livestock production in Bayelsa State by 67.7%.

Research Hypothesis

$H0_1$: Climate change does not significantly influence agricultural sector performance in Bayelsa State.

Table 3: T-test Associated with Simple Regression on Climate Change Influence on Agricultural Sector Performance in Bayelsa State

Model		Unstandardized Coefficients		Standardized Coefficients	T	p-value	Alpha level	Decision
		B	Std. Error	Beta				
1	(Constant)	3.635	1.549		2.347	.019		
	Climate Change	.868	.044	.665	19.671	.000	0.05	Hypothesis is Rejected

Table 3 showed that the standard beta coefficient is .665 with t-test associated with simple regression value of 19.671. The hypothesis is rejected because the probability value of 0.00 is less than the alpha level of 0.05. Therefore by implication, climate change significantly influence agricultural sector performance in Bayelsa State.

Discussion of Findings

The first result of the revealed that climate change to a very high extent influence crop production in Bayelsa State by 74%. This result is in consonance with Food and Agriculture Organization (FAO) data published in 2019, which noted that if the current situation of GHG emissions and climate change continue by the year 2100 there will be decline in the production of major cereal crops (45–20% in maize yields, 50–5% in wheat and 30–20% in rice). Hence if the trends continue, in very near future crop losses may increase at an unprecedented rate which will substantially contribute to reduced production, spiked food prices, and it will become difficult to cope up with rising needs of growing population. In support of this view, Idowu et al. (2018) opined that climate change is resulting into a very high rate of land degradation causing enhanced desertification and nutrient deficient soils for crop production. According to them, the menace of land degradation is increasing by the day and has been characterized as a major

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threat to agricultural sector performance in Nigeria especially in the area of decline in crop and food production. Also in agreement with result, Report by Nigeria Meteorological Agency (NMA) as cited in Idowu et al. (2018) suggests that extreme events including floods have increased more than 50% in the last 10 years in Nigeria and are now occurring at rate of four times higher than in comparison to 20 years back. According to this report, heavy floods experienced in Nigeria, in 2012 and 2018 especially in South-South and the coastal regions of the country are a glaring example. These floods have resulted in washout of top soil and nutrients from the soil, resulting in low crop productivity for several years to come, unless and until corrective and pro-active remediation strategies are adopted.
Finally, the second result of the study showed that climate change to a high extent influence livestock production in Bayelsa State by 67.7%. This result is in line with Boyazoglu and Nardone (2003); and Baylis and Githeko (2006) who stated that major components of the natural factors that affect livestock production are the climate change with its various characteristic variables such as temperature, rainfall, humidity, solar radiation and airflow which determine not only the quality and quantity of cultivated and spontaneous animal feed resources (grain, forage and pasture crops) but also the quality of life and performance of each animal species. Concurring to this, Morghan (2005) and Hatfield et al. (2008) noted that the unprecedented rise in anthropogenic carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), ozone (O3), halocarbons (e.g. carbon fluoro chloride), etc are fingered as mostly responsible for negative shifts in the earth climatic systems which has resulted to complex interactions with its environment, nature and nurture; specifically on the behaviour and performance attributes of each animal species or breed. Similarly, in contract with this result Nienaber and Hahn (2007) observed that the southern parts of the Nigeria country which have more rainfall and more grasses for grazing now suffer from irregularities in rainfall and have more parasites and endemic diseases that have reduced the growth of grasses for grazing. In view of this, Idowu et al. (2018) stressed that climate change reduces feed, water intake, grazing time and hence rate of growth and productivity of livestock. According to them, high temperature have hindered livestock (sheep, goat, cattle, poultry and piggery) production through retard reproductive cycles, reduced meat and milk outputs, as well as their grazing lands. Livestock mortalities (stock losses) have increased in poultry and piggery production systems to the level of at least 15% per annum.

CONCLUSION

The changing dimensions of the climate and the concern for sustained performance of the agricultural sector triggered this investigation. From the result of the study it can be established that vary levels of climatic conditions contribute to mixed outcomes in the productivity of agriculture. Given this development, it is concluded that changes in climatic factors such as rainfall, temperature and greenhouse emissions plays important role in determining the level and depth of performance in the agricultural sector in Bayelsa State, Nigeria.

POLICY RECOMMENDATIONS

Based on the result and the conclusion of the study the following are hereby recommended:

1. Policy makers should adopt proactive and innovative approaches through the involvement of key stakeholders in order to substantially address the challenges of changing climate on crop and livestock production.
2. The Ministries of Environment at both State and Federal Levels should ensure strict adherence to environmental laws to minimize the extent of environmental pollution to reduce the intensity of climate change and its associated negative implications on crop and livestock production.
3. The State Ministry of Agriculture and Rural Development should employ strategies such as early warnings and other appropriate alerts that are capable of helping farmer respond effectively to incidences of climate change to mitigate their negative consequences on agricultural performance.
4. The government should prioritize climate forecast and enlightenment programmes in order to keep the farmers informed on the modern adaption strategies and to improve their resistance to changing climatic outcomes.

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