CLIMATE VARIABILITY VERSUS AGRICULTURAL PRODUCTIVITY IN OGOJA, CROSS RIVER STATE, NIGERIA

J. N. Obiefuna[1*] and G. N. Njar[2]

[1]Department of Geography and Environmental Science, University of Calabar, Nigeria. JoeObiefuna@gmail.com [2]Department of Geography and Environmental Science, University of Calabar, Nigeria- HarjoGold01@yahoo.com
*Corresponding Author

ABSTRACT
The impact of the dynamics of climate on agricultural productivity in Ogoja, Northern Cross River was the main focal point of this research. The objectives of the study were to establish the trend of rainfall in the study area for a decade, establish the temperature pattern of the study area for a decade, to examine the relationship between the varying climatic conditions on crop (rice) yield, and to make recommendations based on the research findings. Temperature, rainfall and crop data were sourced for a period of 10 years (2005-2014) from Ministry of Works Meteorological Department, Ogoja L.G.A and International Fund for Agricultural Development, (IFAD), Calabar. The work collated and analyzed all available data which were needed for evaluating the implication of climate variability on agricultural productivity in Ogoja L.G.A. Statistical Packages for Social Science (SPSS) was used to critically collate and analyze the data using arithmetic mean, standard deviation, correlation and multiple regression model. Other descriptive statistics such as bar charts and line graphs were used for illustration with regards to the relationship between weather parameters and crop yield. The study reveals that 1% of the total variation in crop production is explained by variations in temperature and rainfall and there is no relationship between climate change and agricultural production given a table value of 0.389 which happened to be greater than the 0.05 level of significance. It was therefore recommended that Crop yield should be regressed with other independent variables such soil fertility, fertilizer application, irrigation, specie of crop etc and that the Government should provide machines for farmers to reduce the cost of production.

Key Words: Climate Variability, Climate Change, Agricultural Productivity, Rice Production, Crop yield, Ogoja

INTRODUCTION

Climate variability often generally baptized as climate change is a major constraint to agricultural development in Africa and the world at large. Climate change is not only a challenge to agricultural development but also to food security and the general livelihood conditions of any population (Ringler, Zhu, Cai, Koo, and Wang, 2010.; Ajetomobi, Abiodun, and Hassan 2010). Climate is the “average weather” condition of a place over a period of 30-35 years. The main elements of weather itself include temperature, rainfall, dew, humidity, wind, sunshine, mist, haze and cloud. Across the country, millions of farmers are already experiencing and reacting to seasonal patterns of rainfall, temperature and more frequently weather events, leading to drought, flooding and storm surges along the coast. (Intergovernmental Panel on Climate Change, IPCC 2007).

Agricultural activity which is one of the most weather-dependent of all anthropogenic activities is highly vulnerable to climate variability. In 2001, the IPCC reported that worldwide temperatures have increased by more than 0.6°C over the past century and it estimated that by 2100, average temperatures will increase by between 1.4 and 5.8°C. African countries are particularly vulnerable to climate change because of their dependence on rain-fed agriculture, high level of poverty, low level of human and physical capital, inadequate land distribution and poor infrastructure (Waston et al 1998). Vent and Fritze (1957) further pointed out that temperature is very important for accumulation of organic matter as well as ripening of fruits. Rainfall on the other hand is a determinant factor of the type of crop that is to be grown in different environments in Nigeria. The intensity, amount and duration of rainfall generally decreased from south to north and the crop yield follows the same pattern. Changes in rainfall pattern could cause soil erosion, storms, floods, drought leading to general land degradation which according to Eni, Upla, Oko, Obiefuna, and Njar 2010, would affect soil productivity and ultimately, agricultural productivity.

In less developed countries such as Nigeria, agriculture is the main source of food and major employer of labour engaging about 60 percent of the population. It is predominantly a rain-fed system and hence vulnerable to climate change (Nigerian's First Communication under United Nations Convention, NFNC 2003). Dominant crops cultivated in the country include yam, cassava, maize, rice, millet, sorghum etc. Evidence of climate change is manifest in the importation of food crops such as rice and wheat. Other evidences of climate change include increase evaporation, decrease rainfall, increasing rainfall in coastal areas, increasing disruption in climatic pattern and increasing frequency and intensity of unusual or extreme weather related events such as thunder storms, lightening, landslides, floods, drought, bush fire, unpredictable rainfall pattern, sea level rise, increase desertification and land degradation, disappearance of rivers and lakes and constant loss of forest cover and biodiversity (Odjugo, 2010).

Generally, it is believed that the overriding consequences of climate change would result in a decrease in agricultural production and in turn lead to food crisis. Food and Agriculture Organization, FAO 2006 stated that world population grows at 3 percent annually while yield of major crops grow at only 1 percent a year.

It is based on the above aforementioned facts that the researcher examines the impact of climate change on agricultural productivity in Ogoja, Northern Cross River.

The Problematic

Climate change has become a household nomenclature being that it is the talk of every nation including the developing ones such as Nigeria. Given the fundamental role of agriculture in human welfare, concern has been expressed by Federal and other agencies regarding the potential effect of the varying climatic conditions on agricultural productivity.

In 2012, there was an upsurge in the amount of precipitation in Cross River state which gave rise to flooding of the most part of the state causing destruction of lives properties and agricultural land. This posted a very huge impact on agricultural yield as many crops were swallowed by the flood and the few which were unable to withstand the flood were not able to provide for half the population it was intended for. It was also vehemently observed that the cost of agricultural commodities increased tremendously.

Apart from the flood of 2012, there have also been changes in climatic pattern with the rains coming either too early or too late. At times, sunshine intensity appeared as being too high. Generally, the basic knowledge is that different agricultural produce has a required amount of rainfall and temperature for it to perform maximally in terms of yield. It is for this purpose that this study was anchored.

Aim and Objectives of the Study

The aim of this study is to ascertain the impact of the varying weather elements on agricultural productivity in Ogoja, northern Cross River. The researcher achieved the following objectives:

1. Established the trend of rainfall in the study area for a decade (2005-2014).
2. Established the temperature pattern of the study area for a decade (2005-2014)
3. Examined the relationship between the varying climate condition and crop yield.
4. Made recommendations based on the findings.

The Research Hypothesis

H_0 = There is no significant relationship between climate change and agricultural productivity.

H_1 = There is a significant relationship between climate change and agricultural productivity.

The Study Area

The study is being carried out in Ogoja, northern Cross River, which is one of the Local Government Areas of the eighteen found in Cross River State. Its headquarters is Ogoja town in the north east of the area near the A_4 highway at 6^0 39'17"N, $8^0$47'51"E or 6.65472^{0}N and 8.79750^{0}E. It is bounded in the north by Obudu Local Government area, in the south by Boki local government area and in the east by Iyala local government area. It has an area of 912km^2 and a population of 171,901 at the 2006 census.
http://en.wikipedia.org/w/index.php?title=Ogoja&oldid=591933535

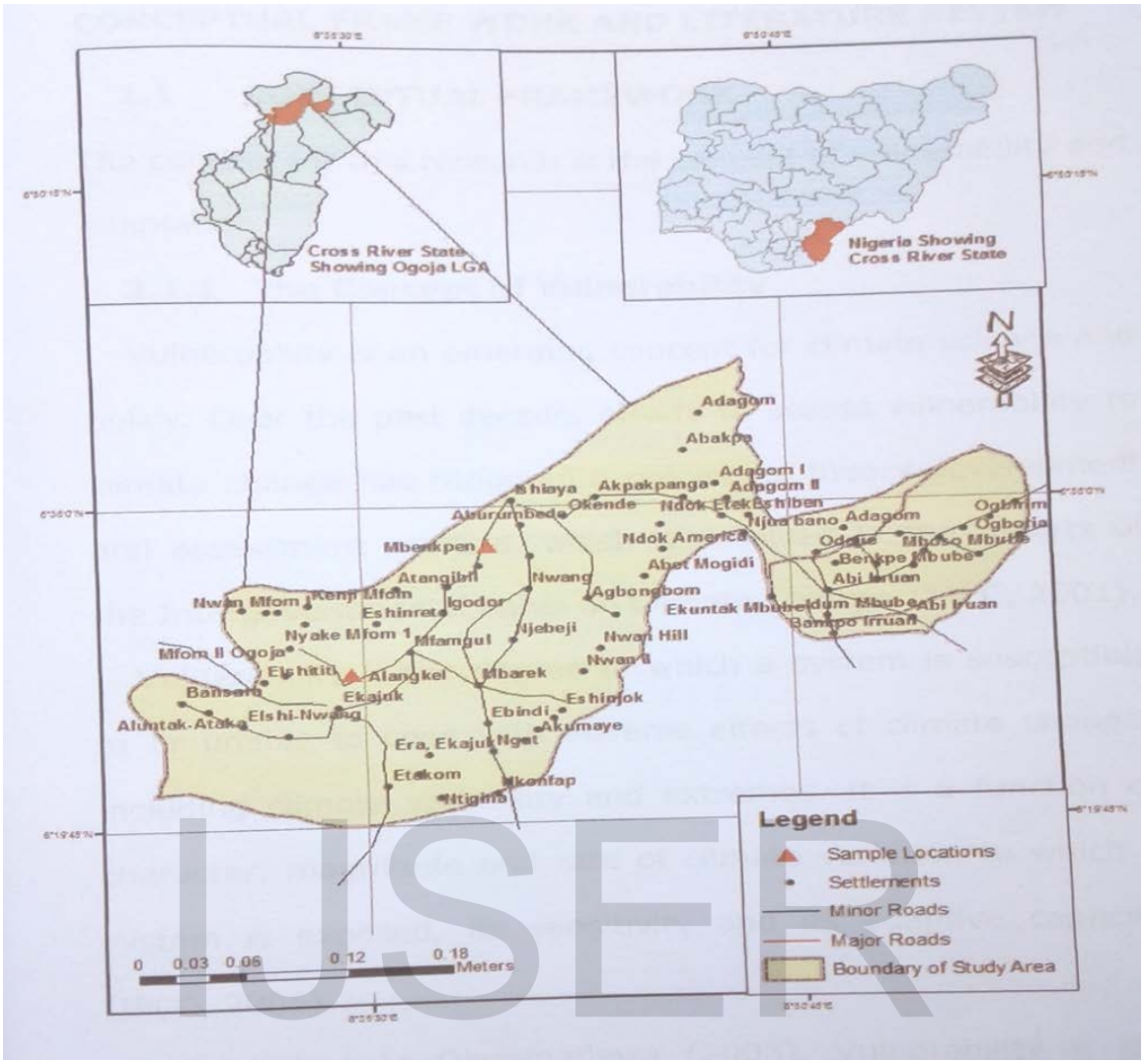

Figure 1. Map of Ogoja Local Government Area showing sample Locations Mbenkpe and Alangkel Communities
Source: Authors' GIS Visualization, 2015

RESEARCH METHODOLOGY

Datasets

The study acquired temperature data, rainfall data and crop yield data from the Metrological Department of the Ministry of Works, Ogoja Cross River State and the Agricultural Development Programme (A.D.P) Calabar office IFAD/FGN/NDDC Community Based Natural Resource Management Programme, Cross River State. The data covered farming seasons from 2005 to 2014. The data was spread across a period of ten years so that the changes in weather parameter can be easily observed. The crop selected for the study is rice (Oryza spp). This is because rice is the second staple food in Nigeria after cassava and is one of the most served delicacies.

Sampling Techniques and Procedure for Data Collection

The simple random sampling technique was used in the course of this research. The rice producing communities selected were Alankel community and Mbenkpen community. Based on on-site observation and oral interview, data were collected for the purpose of this research.

Techniques of Data Analysis

In light of the hypothesis of this study, the datasets were analyzed using simple averages, tables, graph, charts and parametric statistics. Statistical pack for social science (SPSS) was used to compute the multiple regression correlation. Multiple regression correlation was used because it can ascertain the degree of relationship that exists between multiple variables (crop production, temperature and rainfall).

This is given as

$$\mathbf{Y = a + b_1x_1 + b_2x_2 + b_3x_3 + \text{-----} + b_nx_n + e}$$

Where,

Y= dependent variable; a= regression constant; $b_{1,2,3}$= regression coefficient; b_2x_2 = the independent variable; σ_y , σ_x = standard deviation of x and y; $\bar{x}$ and $\bar{y}$ = mean of x and y

Results and Discussion

Table 1: Yearly Total and Average Rainfall in Ogoja L.G.A from 2005- 2014

Year	Total rainfall (mm)	Average rainfall (mm)
2005	1781.5	148.4
2006	1816.3	151.3
2007	2372.9	197.7
2008	2355.0	196.2
2009	2401.0	200.0
2010	2398.7	199.8
2011	2640.2	220.0
2012	3347.3	278.9
2013	2669.4	222.4
2014	2038.0	169.8

Source: Ministry of Works Meteorological Department, Ogoja, 2015

From table 1, the highest annual rainfall was recorded in 2012 with the value of 3347.3mm and lowest rainfall recorded in 2005 with the value of 1781.5mm rainfall.

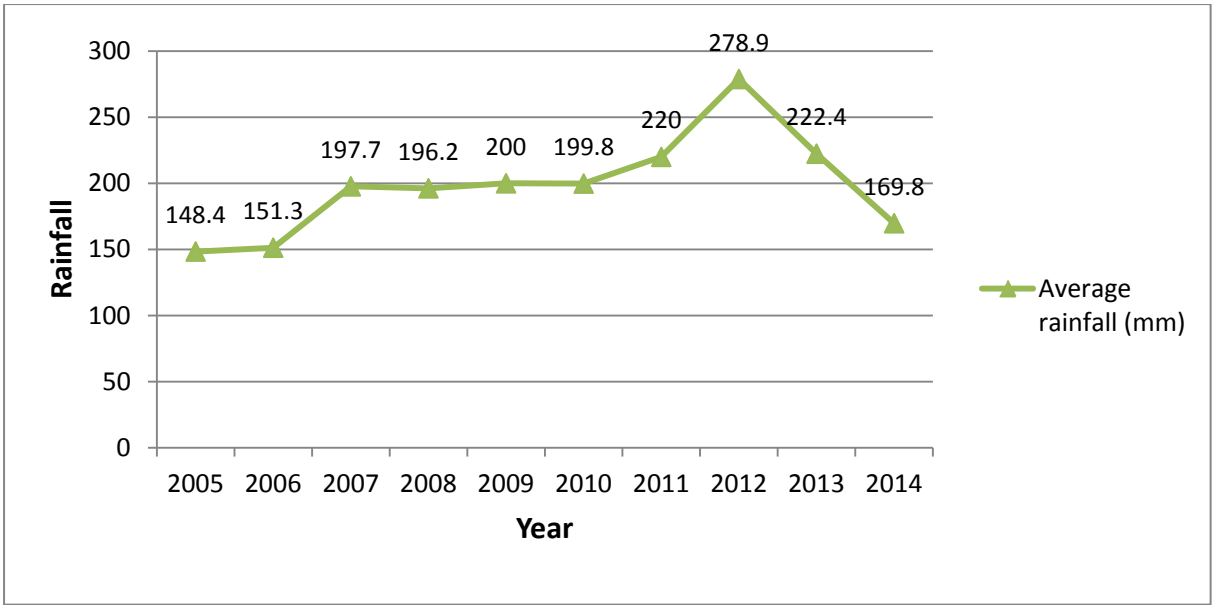

Fig. 2: Trend of rainfall from 2005-2014
Source: Analysis by the Author, 2017

Table 2: Yearly Minimum, Maximum and Average temperature in Ogoja L.G.A from 2005 –2014

Year	Minimum Temperature (˚C)	Maximum Temperature (˚C)	Average Temperature (˚C)
2005	22.9	33.5	28.2
2006	22.6	33.7	28.15
2007	22.1	33.4	27.75
2008	21.8	33.5	27.65
2009	22.2	33.7	27.95
2010	22.5	34	28.25
2011	22.1	33.6	27.85
2012	22.5	33.3	27.9
2013	21.1	32.9	27
2014	22.9	33.4	28.15

Source: Ministry of Works Meteorological Department Ogoja, 2015

Table 2 shows the temperature pattern over ten years in Ogoja L.G.A. The figure reveals that the temperature increases from 2005 with 28.2˚C and fall in 2008 and 2013 with 27.65˚C and 27˚C respectively. It also shows that the year 2010 experienced the highest temperature of 28.25˚C.

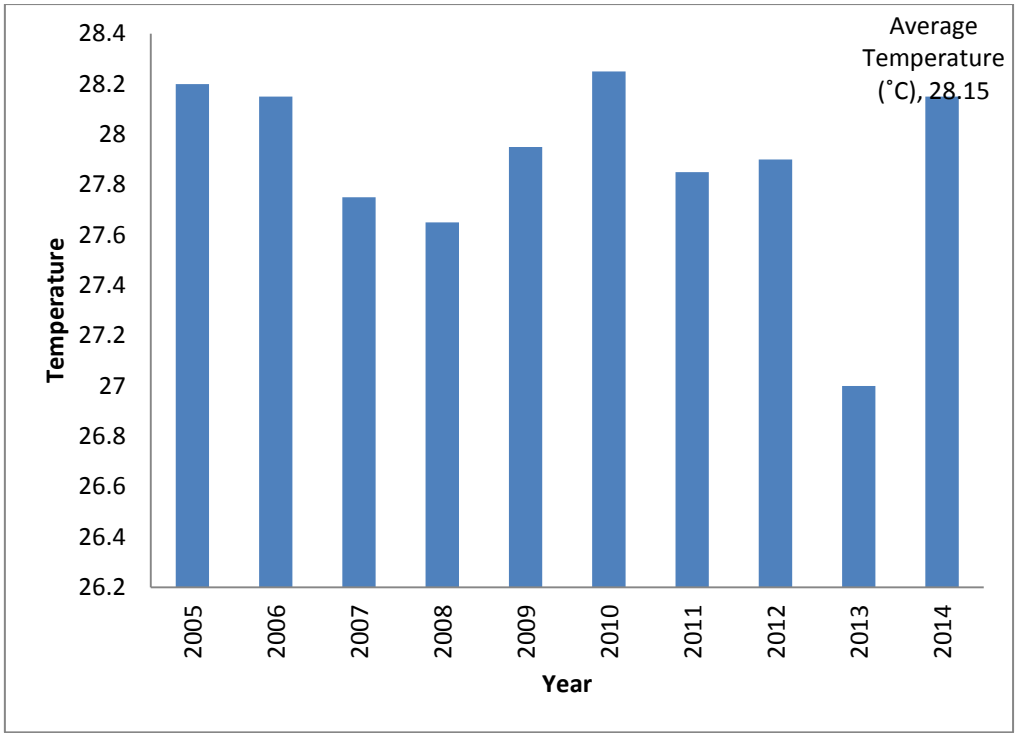

Fig. 3: Temperature pattern from 2005-2014
Source: Analysis by the author, 2017

Table 3: Yearly crop production in Alangkel Community in Ogoja LGA from 2005-2012

ALANGKEL COMMUNITY, OGOJA			
YEAR	**AREA CULTIVATED (Ha)**	**PRODUCTION (Mt)**	**PRODUCTIVITY Yield /Ha**
2005	2.0	3.0	1.5
2006	4.0	8.0	2.0
2007	6.0	12.0	2.0
2008	8.0	17.6	2.2
2009	10.0	25.0	2.5
2010	14.0	42.0	3.0
2011	15.0	51.0	3.4
2012	18.0	64.8	3.6
2013	20.0	80.0	4.0
2014	20.0	84.0	4.2

Source: IFAD/FGN/NDDC Community Based Natural Resource Management Programme, Cross River State, 2014

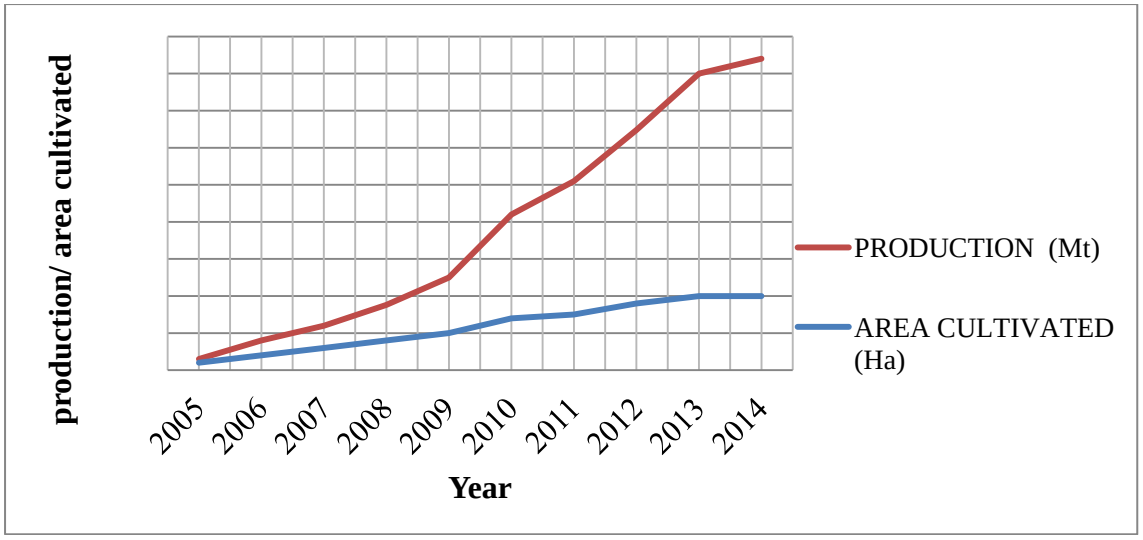

Fig. 4: Land area cultivated and production for Alangkel community from 2005-2014
Source: Analysis by the author, 2017

Table 4: Crop yield in Mbenkpen Community

MBENKPEN COMMUNITY, OGOJA			
YEAR	**AREA CULTIVATED (Ha)**	**PRODUCTION (Mt)**	**PRODUCTIVITY Yield /Ha**
2005	1.5	2.25	1.5
2006	3	5.4	1.8
2007	5	10	2
2008	6	12.6	2.1
2009	8	18.4	2.3
2010	10	25	2.5
2011	14	39.2	2.8
2012	17	51	3
2013	18	68.4	3.8
2014	20	86	4.3

Source: IFAD/FGN/NDDC Community Based Natural Resource Management Programme, Cross River State, 2015

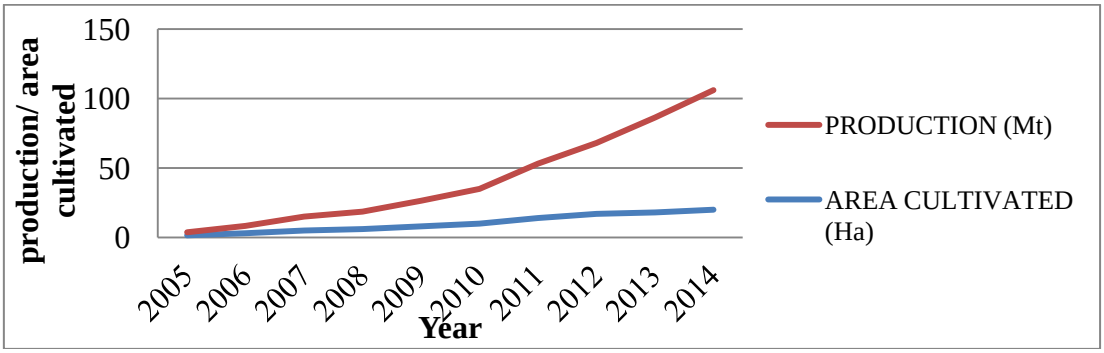

Fig. 5: Land area cultivated and production for Mbenkpen community from 2005-2014.
Source: Analysis by the author, 2017

Table 5: Land area cultivated and production for both communities

YEAR	TOTAL AREA CULTIVATED (Ha)	AVERAGE PRODUCTION (Mt)	TOTAL PRODUCTION (Mt)
2005	3.5	2.76	5.25
2006	7	6.7	13.4
2007	11	11.0	22.0
2008	14	15.1	30.2
2009	18	21.7	43.4
2010	24	33.5	67.0
2011	29	45.1	90.2
2012	35	57.9	115.8
2013	38	74.2	148.4
2014	40	85.0	170.0

Source: IFAD/FGN/NDDC Community Based Natural Resource Management Programme, Cross River State, 2015

Table 5 shows that as the area cultivated increased, the production (output) also increase. In 2005, the total area cultivated was 3.5 hectares with a total production (output) of 5.25 Metric tons. In 2011 the area cultivated was 29 hectares and the total production was 90.2 Metric tons.

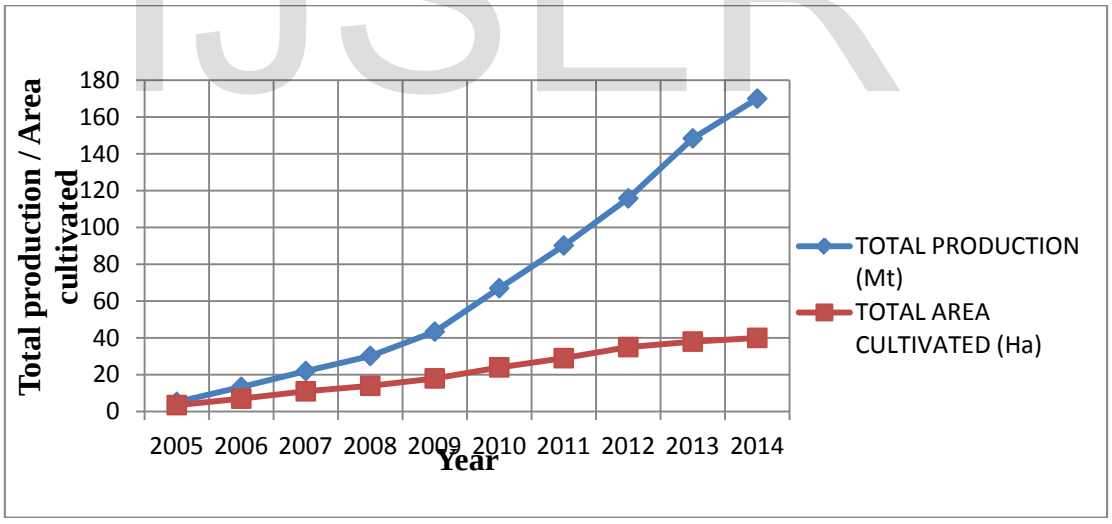

Fig. 6: showing the total area cultivated and production for both community from 2005-2014
Source: Analysis by the author, 2017

Test of hypothesis

H_0 = There is no significant relationship between climate change and agricultural productivity.

H_1 = There is a significant relationship between climate change and agricultural productivity.

TABLE 6: Temperature, Rainfall and Crop Production Data Averages

YEAR	Average Production (Mt) (y)	Average Temperature (˚C) (x_1)	Average Rainfall (mm) (x_2)
2005	2.76	28.2	148.4
2006	6.7	28.15	151.3
2007	11.0	27.75	197.7
2008	15.1	27.65	196.2
2009	21.7	27.95	200.0
2010	33.5	28.25	199.8
2011	45.1	27.85	220.0
2012	57.9	27.9	278.9
2013	74.2	27.0	222.4
2014	85.0	28.15	169.8

Source: Ministry of Works Meteorological Department, Ogoja, 2015

Table 8. ANOVAs

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1787.957	2	893.979	1.085	.389[a]
	Residual	5767.176	7	823.882		
	Total	7555.133	9			

a. Predictors: (Constant), Rainfall, Temperature

b. Dependent Variable: Crop production

Results and Discussion

For regression model, R^2 of 0.019 is interpreted to mean that 1% of the total variation in crop production is explained by variations in temperature and rainfall. Table 8 reveals that the calculated "F" is 1.085 and the sig. (table value) of 0.389, we therefore reject H_1 and accept H_0 that there is no significant relationship between climate change and agricultural productivity.

Based on observation and oral interview, the study locations are swampy areas, the farmers practice mechanized agriculture being that they use fertilizers such as Urea and NPK. These two types of fertilizers are applied by split application. The Urea is used to boost the vegetation while NPK is used to boost grain production. They also use improved rice varieties such as faro 44 and faro 52 which has high grain yield. Adaptive measures such as the use of nurseries instead of broadcast method helped to reduce the amount of grains loss by birds and rodents invasion. It also helps in keeping record of nurseries.

Summary of Findings

The study was focused on the impact of climate change on agricultural productivity, a case study of Ogoja LGA. The researcher used rice as the research crop. Based on the objectives of the study and the hypothesis which the research tested, it was discovered that

2005 and 2012 had the lowest and highest rainfall with 1781 mm and 3347.3 mm respectively and also temperature was at its peak in 2010 with 28.25˚C. The hypothesis tested showed that climate change has no significant relationship with agricultural productivity.

Conclusion and recommendations

Whereas all the objectives of this study have been treated and the hypothesis tested, with standard scientific methods of data collection and analysis, it is here concluded that climate change has no impact on agricultural productivity in the study area. This means that temperature and rainfall has no significant influence on crop yield in the study area but other factors such as soil fertility, fertilizer application, irrigation, species of crop and condition for cultivation should be put into consideration.

Finally, based on the findings of the research work, it is therefore recommended recommend that:

1. Regressively, crop yield should be juxtaposed with other independent variables such soil fertility, fertilizer application, specie of crop etc.
2. Government should provide machines for farmers to reduce the cost of production.

REFERENCES

Ajetomobi, J., Abiodun, A., and Hassan, R. (2010). Economic impacts of climate change on rice agriculture in Nigeria. Tropical and Subtropical Agroecosystems, 14(2011): 613-622.

Eni, D. I; Upla, J. I; Oko, C. O, Obiefuna, J. N. and Njar, G. N. (2010) Effects of Land Degradation on Soil Productivity in Calabar South Local Government Area, Nigeria**.** European Journal of Social Sciences Volume 18, Number 1: 166-171

Food and Agriculture Organization of the United Nations (FAO). (2006). The State of Food Insecurity in the World. Rome: FAO.

Intergovernmental Panel on Climate Change (IPCC), (2001). Climate Change 2001: Impact, adaptation and vulnerability. (McCarthy J.J. et al (eds). Contribution of working Group II to the third assessment report of the Intergovernmental Panel on Climate Change. Cambridge: University press Cambridge.

IPCC (2007). Climate change 2007. The fourth assessment report (AR4). Synthesis report for policy makers http://www.ipcc.ch/pdf/assessmentreport/ar4/syr/ar4-syr-spm.pdf. Accessed 10th August, 2009.

Ringler, C., Zhu, T., Cai, X., Koo, J., Wang, D. 2010. Climate change impacts on food security in sub-Saharan Africa. IFPRI Discussion Paper 01042

Vent, M.S. and Fritz, C.G.(1957), Weather Influence on the Size of US cord Soya beans.

Watson, R.T., Zinyoera, M.C., and Moss, R.H. 1998. The Regional Impacts of Climate Change: An Assessment of Vulnerability. A Special Report of IPCC Working Group II. Cambridge: Cambridge University Press.

http://en.wikipedia.org/w/index.php?title=Ogoja&oldid=591933535