INTERNATIONAL JOURNAL OF CONTEMPORARY ACADEMICS (IJCA) ISSN 2536-7110 © 2019 VOL. 3(1),

Pp.29-41, APRIL 2019

CLIMATE CHANGE AND PALM KERNEL PRODUCTION IN ONDO STATE

BY

OMOSUYI O. BUKOLA and EMMANUEL O. AKINFISOYE

www.guildaa.org

CLIMATE CHANGE AND PALM KERNEL PRODUCTION IN ONDO STATE

BY

OMOSUYI O. BUKOLA and EMMANUEL O. AKINFISOYE

DEPARTMENT OF GEOGRAPHY

ADEYEMI COLLEGE OF EDUCATION

ONDO, NIGERIA

07033263850 emmanuelakinfisoye@yahoo.com

ABSTRACT

There is an increasing awareness that the climate is changing and its changing impact has been significant on agricultural produce. This change is posing a major threat to agricultural development in Nigeria. Oil palm cultivation is one of the major cash crops in Ondo state. The production of palm kernel which is also a product of oil palm over the years has been marked with fluctuation which could be attributed to the change in climate over the years. This study made use of secondary data which included data on climatic variable (mean annual temperature, mean annual rainfall and mean annual humidity) and palm kernel output from 1976 – 2016. Trend analysis was used to display climatic variables and palm kernel production. Also, regression analysis was used to evaluate the effect of the climatic variables on palm kernel production. Trend analysis reveals fluctuations in climatic variables and palm kernel output over the years of study. Regression analysis shows that there is a positive relationship between mean annual temperature and palm kernel yield. Similarly, mean annual rainfall has a positive but weak linear relationship with palm kernel output. On the other hand mean annual relative humidity shows an inverse relationship with palm kernel production. For a sustainable palm kernel production, it is recommended that both governmental and non-governmental organizations should employ more extension agents to guide and enlighten palm kernel farmers on the use of different palm tree chemicals and seed varieties that can cope with different climatic conditions.

KEYWORDS: Climate change, palm kernel

INTERNATIONAL JOURNAL OF CONTEMPORARY ACADEMICS (IJCA) ISSN 2536-7110 © 2019 VOL. 3(1),

Pp.29-41, APRIL 2019

CLIMATE CHANGE AND PALM KERNEL PRODUCTION IN ONDO STATE

BY

OMOSUYI O. BUKOLA and EMMANUEL O. AKINFISOYE

www.guildaa.org

Introduction

Climate change is a major challenge facing the global environment now. It is arguably the most threatening environmental issue of our time. According to the United Nation Framework Convention on Climate Change (UNFCCC, 2007) climate change is defined as a change of climate which is attributed directly or indirectly to human activities that alter the composition of the global atmosphere and which are in addition to natural climate variability, observed over comparable time periods.

Climate change challenges manifest themselves in the form of drought, flooding and inundation of coastal lands, low agricultural productivity, and alteration of surface and ground agricultural production depend on the balance of these impacts (Fischer *et al*., 2007). Climate change effect is more pronounce in Africa because of its location, its sole dependence on agriculture and its generalized incapacity to cope and adapt to climate extreme (FAO, 2003; Bolaji-Olatunji *et al*., 2010). Adverse effect of climate change continues to be a major threat to rural livelihoods (Pouliott *et al.*, 2009). It imposes constraints to development especially among small holder farmers whose livelihoods mostly depend on rain-fed agriculture (IPCC, 2007a; Tanner and Mitchell, 2008).

In Nigeria, increased agricultural production is very essential for rural poverty alleviation. Any change in climate will definitely affect agricultural production in Nigeria since agriculture in Nigeria is mostly rain-fed. The impact could however be measured in terms of effects on crop growth, availability of soil water, soil erosion, incidence of pests and diseases and decrease in soil fertility (Adejuwon, 2004).

The popularity and earnings from the agricultural sector of the economy has made the sector an area of interest to individual group, government and policy makers. This is as a result of its contribution to the Gross Domestic Product (GDP) as well a route to achieving Sustainable Development Goals, most especially goals 1 and 2 which emphasizes on "No poverty" and "No hunger". The discovery and exploitation of crude oil has relegated the importance attached to the agricultural sector in the time past. Nevertheless, agricultural sector still remain the second largest foreign exchange earner after crude oil (Adegeye, 1998). It is also a means of conserving foreign exchange.

Of all the cash crops produced in both old and new Ondo State (1976-2016), records have shown that Palm Kernel is the second largest revenue generator after cocoa. Palm kernel production is very sensitive to changes in climatic factors; stages of development are influenced by climate. Every stage of its production from seedling to processing stage requires adequate weather conditions just like every other cash crop. This paper therefore studies the way climate change affect palm kernel production in Ondo State.

INTERNATIONAL JOURNAL OF CONTEMPORARY ACADEMICS (IJCA) ISSN 2536-7110 © 2019 VOL. 3(1),

Pp.29-41, APRIL 2019

CLIMATE CHANGE AND PALM KERNEL PRODUCTION IN ONDO STATE

BY

OMOSUYI O. BUKOLA and EMMANUEL O. AKINFISOYE

www.guildaa.org

Statement of the Problem

There is an increasing awareness that the climate is changing and its changing impact has been significant on agricultural produce. The Intergovernmental Panel on Climate Change (IPCC, 2007b)**,** World Meteorological Organization (WMO, 2008) and United Nations Environment Programme (UNEP, 2008) established that the earth has become warmer over the last century. They submitted that average surface temperature of the earth has increased during the twentieth century by about 0.6 ± 0.2^0C. The change in climate is posing a major threat to agricultural development in Africa. Also there has been an increasing awareness of the negative effect of climate change on the oil palm industry (Paterson *et al*., 2017). Both biotic and abiotic conditions for cultivation of oil palm are affected detrimentally in most cases. Among the most limiting factor to palm kernel production is climate change. This is because every stage of its cultivation requires adequate weather condition. The continuous decline in the country's crude earnings is significantly affecting the GDP of Nigeria. The Organization of Petroleum Exporting Countries (OPEC) in its annual statistical bulletin (2016) indicated that the country's crude earnings have been on a decrease since 2012 with year 2016 having the lowest record of revenue ($40bn). The dwindling crude revenue has a great effect on the economy and quality of lives of the citizenry (increase in poverty and hunger) and this has necessitated the call for economy diversification in all sectors with much emphasis on agriculture. This is set to meet the Sustainable Development Goals (SDGs) number 1 and 2.

However, the production of palm kernel in Ondo state over the years is marked with fluctuation and this could be attributed to changes in climate along the year path. This has invariably affected the revenue generation of the agricultural sector and the quality of lives.

Aim and Objectives

The importance of Palm kernel as an economic crop cannot be overemphasized in Ondo state. It is a commercial product of great value but dependent on weather and climate. In this view, this paper aimed to assess the effect of climate change on palm kernel production in Ondo state. The specific objectives are to:

i. examine the variation in the trend of some climatic variables (mean annual – temperature, rainfall, and relative humidity) from 1976-2016;
ii. examine the variation in the trend of Palm kernel production from 1976-2016; and
iii. determine the effect of these climatic variables on palm kernel production for the same period under review.

Methodology

CLIMATE CHANGE AND PALM KERNEL PRODUCTION IN ONDO STATE

BY

OMOSUYI O. BUKOLA and EMMANUEL O. AKINFISOYE

www.guildaa.org

Study Area

Ondo state was created on the 3rd of February, 1976 and it is made up of 18 LGAs. The state lies between Longitude 4^0 30'' and 6^0 East of the GMT and Latitude 5^0 45'' and 8^0 15''N of the Equator. It has land area of 15,500km^2. It is located in the Southwestern part of Nigeria. The climate of the state is of the tropical rainforest type with distinctive wet and dry seasons with mean annual temperature of 27^0C and mean annual rainfall of 2000mm associated with relative humidity of not less than 70%. The natural vegetation is of the high forest composed of many varieties of hard timber such as Melicia excels, Antaris Africana, Terminalia superba, Lophira procera, Hevea brasiliensis and Symphonia globulifera. Over most of the state, the natural vegetation has been very much degraded due to human activities. Tree crops cultivated in the study area include cocoa, kola, coffee, rubber, oil palm and citrus while food crops include cassava, yam, maize, plantain, cocoyam, okro and vegetables. Large proportion of the population of the study area engages mainly in agriculture with few in the public service employment.

Source of Data

Secondary data was used mainly for this study. Data on climatic variables were collected from the Agro-climatological department, Ondo state Ministry of Agriculture, Fisheries and Forest Resources, Akure. Also data on Palm Kernel output was obtained from the Department of Produce services, Ondo state Ministry of Natural Resources, Akure.

Method of Data Analysis

Inferential statistics was employed mainly for this work. Trend analysis was used to examine the trends of climatic variables and Palm Kernel output from 1976-2016. Regression analysis was used to estimate the effect of these climatic variables on Palm kernel output.

Thus:

$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e_i$

Where:

Y_i = Palm kernel output (MT)

β_0 = constant

β_i = estimated coefficients of the explanatory variables

X_i = explanatory variables

Where

$X_i = X_1 \ldots . X_3$

X_1 = Mean annual temperature (0C)

X_2= Mean Annual Rainfall (mm)

X_3 = Mean Annual Relative Humidity (%)

e_i =Error Term

INTERNATIONAL JOURNAL OF CONTEMPORARY ACADEMICS (IJCA) ISSN 2536-7110 © 2019 VOL. 3(1),

Pp.29-41, APRIL 2019

CLIMATE CHANGE AND PALM KERNEL PRODUCTION IN ONDO STATE

BY

OMOSUYI O. BUKOLA and EMMANUEL O. AKINFISOYE

www.guildaa.org

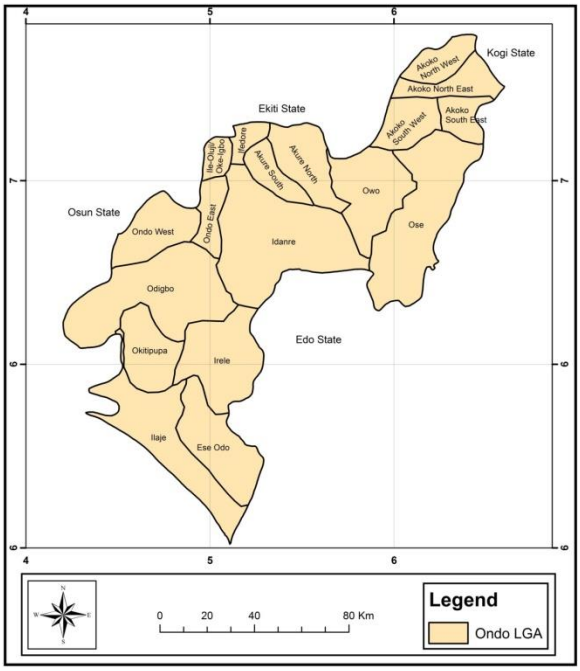

Figure 1: Map of Ondo State Showing the Eighteen Local Government Areas

Source: Ondo State Survey Office, 2018

RESULTS OF FINDINGS AND DISCUSSION

TREND ANALYSIS OF SOME CLIMATIC VARIABLES IN THE STUDY AREA FROM 1976-2016

The mean annual record of temperature of Ondo state in figure 2 reported the trend of mean annual temperature from 1976-2016. It showed a slight increase from year 1976 to 1979 and a sudden drop in 1980. A stable temperature trend was experienced between years 1981 and 1985 but declined in year 1986. The mean annual temperature pattern fluctuated with the year 2001 recording the lowest value of 21.52^0C. The lowest records observed occurred in the year 2001. Also there was a sharp rise in 2014 (29.93^0C) which marked the highest mean annual temperature ever recorded in the study area.

The trend of mean annual rainfall from 1976 to 2016 in Ondo State is reflected in figure 3. Rainfall pattern fluctuated throughout the study period. It showed an increasing trend from year 1976 to 1978 then dropped in 1979 while on a decrease from 1981 to 1984. The highest mean annual rainfall of 2542.30mm was recorded in the year 1985. The lowest mean annual rainfall was recorded in the year 1983 (1257.30mm).

The mean annual relative humidity of the study area as shown in figure 4 reflects a decreasing trend from the year 1979 to 1985 and relatively stable between 1986 and 1989. The figure also showed dwindling and fluctuating occurrences along the year path with year 2008 recording the lowest (70.13%) while 1979 had the highest mean annual relatively humidity (86.08%).

CLIMATE CHANGE AND PALM KERNEL PRODUCTION IN ONDO STATE

BY

OMOSUYI O. BUKOLA and EMMANUEL O. AKINFISOYE

www.guildaa.org

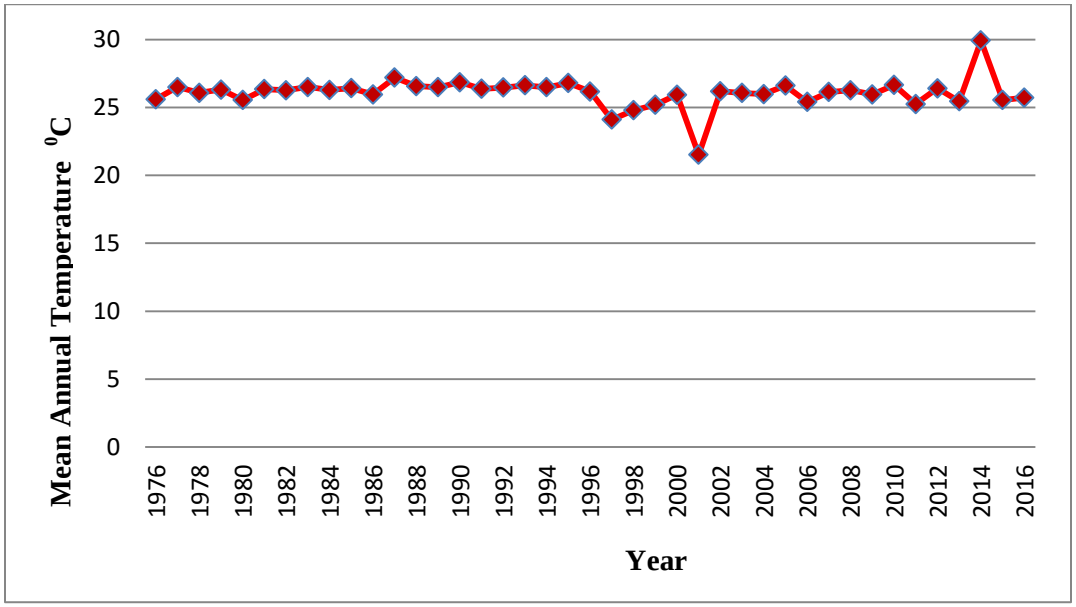

Figure 2: Trend of Temperature in the Study Area

Source: Authors' Compilation, 2018 (*Department of Agro-climatology, Ondo state Ministry of Agriculture, Fisheries and Forest Resources, Akure*)

CLIMATE CHANGE AND PALM KERNEL PRODUCTION IN ONDO STATE

BY

OMOSUYI O. BUKOLA and EMMANUEL O. AKINFISOYE

www.guildaa.org

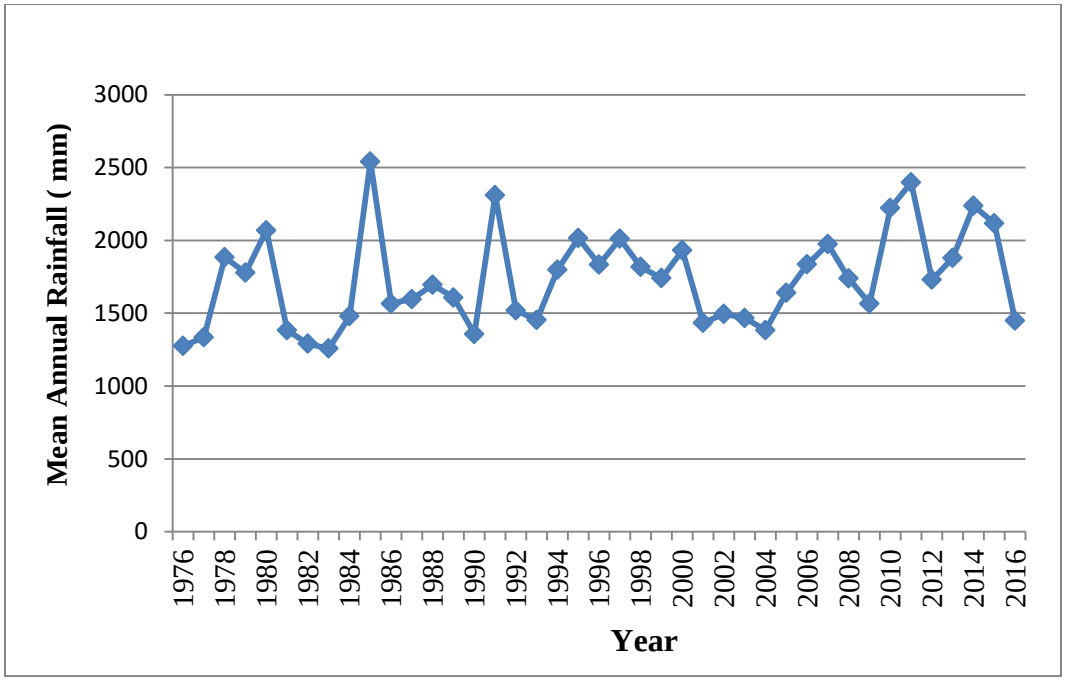

Figure 3: Trend of Rainfall in the study Area

Source: Authors' Compilation, 2018 (*Department of Agro-climatology, Ondo state Ministry of Agriculture, Fisheries and Forest Resources, Akure*)

The fluctuations in these climatic variables could be said to be caused by the changes in the atmospheric constituents. This is related to the amount of particulate matters (aerosols) present in the atmosphere as well as carbon dioxide, water vapour and variation in ozone layer. Atmospheric constituents have a significant role in the energy budget of the earth through regulating energy exchange between the earth and the sun (Matsui and Pielke Sr., 2006). Also these fluctuations could be attributed to changes in the vegetal cover of the earth. Vegetal surfaces have different albedo compared to the bare surfaces, changes in the vegetal cover of the earth surface means changing the amount of energy recipient on the earth. This period of drastic rainfall decline corresponded with the period of sharp temperature rise (Odjugo, 2010). For instance year 1982 recorded a high mean annual temperature of 26.27^0C with one of the lowest mean annual rainfall record (1290.80mm). On the contrary, in 2010 the study area recorded a mean annual temperature high of about 27^0C with one of the highest mean annual rainfall of 2222.59mm. This is not unconnected with the Nigeria Meteorological Agency (NIMET, 2011) report that in August 2010, some places in the Southwest including Ondo state recorded rainfall

CLIMATE CHANGE AND PALM KERNEL PRODUCTION IN ONDO STATE

BY

OMOSUYI O. BUKOLA and EMMANUEL O. AKINFISOYE

www.guildaa.org

values that were 200-300% higher than normal. On the other hand Relative Humidity (RH) is dependent on temperature. When temperature is low then relative humidity would be high and this makes evaporation to be slow and vice versa. Between year 1976 and 1995 when the mean annual temperature was never above 27^0C, the mean annual RH recorded in the study area was never below 80% except for year 1994 when the mean annual RH of 78.75% was recorded. In the same vein between year 1996 and 2016 there was dwindling and fluctuation in the mean annual RH recorded. This coincided with the period of temperature increase. During this period of 21years (1996-2016) mean annual temperature never went below 25^0C except for years 1997, 1998 and 2001 respectively while mean annual RH recorded during these period also was not less than 80%.

TREND ANALYSIS OF PALM KERNEL PRODUCTION IN THE STUDY AREA FROM 1976-2016

The trend of palm kernel production in Ondo state between 1976 and 2016 is shown in figure 5. Palm Kernel production in the study area showed a fluctuating pattern throughout the year under review. It showed a decreasing trend from year 1979 to 1984 with a sharp increase in the year 1985. Also it showed an increasing trend from 1986 to 1993.

From the year 1984 to 2000, Palm Kernel production in the study area witnessed a decreasing trend in output. Year 2001 to 2016 witnessed alternate increase and decrease production trend. The highest Palm Kernel production was witnessed in the year 1993 with year 2000 having the lowest record of production in the study area. Meanwhile year 1986 to 1993 marked the highest increasing trend in production (Eight years streak).

The fluctuations recorded in the trend of Palm Kernel production in the study area is not unconnected from the fluctuations recorded in the trends of mean annual – temperature, rainfall and relative humidity along the year path. They play a significant role along with other factors in determining the extent of palm kernel output.

REGRESSION ANALYSIS OF THE EFFECT OF CLIMATE CHANGE ON PALM KERNEL PRODUCTION (1976-2016)

From table 1, the adjusted R value is .096 while the R^2 value is .164 (16.4%). This means that the independent variables (Mean Annual – Temperature, Rainfall and Relative Humidity) contributed only 16.4% to the variability of the dependent variable (Palm Kernel) from 1976-2016. This result is statistically non-significant. This is line with Ajadi *et al*. (2011) whose result of findings on the impact of climate change on Urban Agriculture using Ilorin as a case study showed that climate has little impact on crop productivity within the years under review.

CLIMATE CHANGE AND PALM KERNEL PRODUCTION IN ONDO STATE

BY

OMOSUYI O. BUKOLA and EMMANUEL O. AKINFISOYE

www.guildaa.org

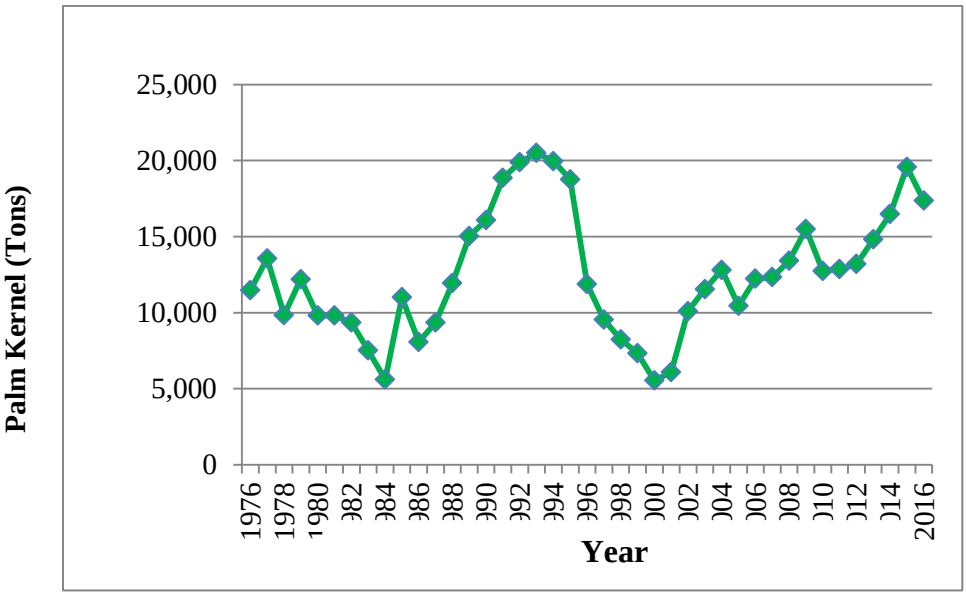

Figure 5: Trend of Palm Kernel Production in the Study Area

Source: Authors' Compilation (2018) (*Department of Produce services, Ondo state Ministry of Natural Resources, Akure*)

Table 1: Model Summary of Regression Analysis of the Effect of some Climatic Variables on Palm Kernel Production from 1976-2016

Model	R	R. Square	Adjusted R Square	Std Error of the Estimate	Durbin-Watson
1	.405	.164	.096	3896.44959	.689

Predictors: (Constant), Temperature, Rainfall and R. Humidity

ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	109966746.787	3	36655582.262	2.414	.082[b]
	Residual	561745817.994	37	15182319.405		
	Total	671712564.780	40			

a. Dependent Variable: Palm Kernel

b. Predictors: (Constant), Hum, Rain, Temp

CLIMATE CHANGE AND PALM KERNEL PRODUCTION IN ONDO STATE

BY

OMOSUYI O. BUKOLA and EMMANUEL O. AKINFISOYE

www.guildaa.org

Table 2: Regression Result of the Independent variables on Palm Kernel Production

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	-18995.438	18023.217		-1.054	.299		
Temp	1371.116	563.716	.375	2.432	.020	.952	1.050
Rain	1.543	1.916	.123	.805	.426	.966	1.035
Hum	-86.772	163.956	-.082	-.529	.600	.946	1.057

Dependent Variable: Palm Kernel

Table 2 showed the significance relationship of the three (3) climatic variables reviewed to Palm kernel production from 1976-2016 in the study area. The result showed that temperature had a significant and positive regression weight of .375, p= .020 while rainfall had a non-significant positive regression weight of .123, p= .426. The implication of this is that increase in temperature and rainfall are expected to increase Palm Kernel production in the study area. On the other hand Relative Humidity showed a non-significant and negative regression weight of -.082, p= .600. This means that increase in relative humidity will lead to decrease in palm kernel production.

Summary

The trend analysis of some climatic variables (mean annual - temperature, rainfall and relative humidity) and palm kernel production revealed that there have been fluctuations in the trend of these variables and palm kernel production. The lowest and highest mean annual temperature was recorded in the year 2001 (21.52^0C) and 2014 (29.93^0C) respectively. In the same vein least and highest mean annual rainfall was recorded in the year 1983 (1257.30mm) and 1985 (2542.30mm) respectively while the highest and lowest mean annual relative humidity was recorded in the year 1979 (86.08%) and 2008 (70.13%) respectively. On the other hand the highest palm kernel production was recorded in the year 1993 (20,500 MT) while the lowest production was recorded in year 2000 (5,531 MT). This indicates that the fluctuations recorded in the trend of palm kernel production from 1976-2016 was as a result of the anomalies recorded in climatic variables.

The regression analysis showed that there was degree of relationship between palm kernel production and climatic variables. It appeared that there is a positive and strong relationship between mean annual temperature and palm kernel yield. Similarly mean annual rainfall has a positive but weak linear relationship with palm kernel output. On

the other hand mean annual relative humidity showed an inverse relationship with palm kernel production. This means that as temperature and rainfall increase, palm kernel output tend to increase while increase in relative humidity will decrease palm kernel output. Also that mean annual – temperature, rainfall and relative humidity contributed 16.40% to the variability of palm kernel production in the study area.

Conclusion

The study concluded that the change in climate of Ondo state has little effect on palm kernel production and this among other factors has brought about fluctuation in palm kernel production in the study area. The study also concluded based on the result of the regression analysis that mean annual temperature and mean annual rainfall had considerable effect on palm kernel production with temperature being the most important factor.

Recommendation

Evidence shown in this research reveals the effect of climate change on palm kernel production. Recommendations that stem from this finding include the following:

- Both the governmental and non-governmental organizations should employ more extension agents to guide and enlighten palm kernel farmers on the use of different palm tree chemicals and seed varieties that can cope with different climatic conditions.
- Palm kernel farmers need to be educated on climate change, its causes and effects as well as the appropriate coping strategies to cope with it. This could be made realistic by the involvement of relevant stakeholders.
- Access to loans and credits should be made available to palm kernel farmers in order to purchase required chemicals and seed varieties needed to adapt to climatic variability.
- Government should ensure that fungicides for spraying palm tree to prevent incidence of diseases stemming from climate change are available to farmers at affordable prices.

REFERENCES

Adegeye S. O. (1998): "An evaluation of food crop farming inside old Cocoa Groves" Nigerian *Journal of Agriculture* 14(1). 483-493

Adejuwon, S.A. (2004). Impact of Climate Variability and Climate Change on Crop Yield in Nigeria. *Contributed paper to Stakeholders Workshop on Assessment of Impact and Adaptation to Climate Change (AIACC)*: 2-8.

Africa Partnership Forum (APF), (2007), *Climate Change and Africa*. 8th Meeting of

CLIMATE CHANGE AND PALM KERNEL PRODUCTION IN ONDO STATE

BY

OMOSUYI O. BUKOLA and EMMANUEL O. AKINFISOYE

www.guildaa.org

Africa Partnership Forum, Berlin, Germany, 22nd-23rd May, 2007. 4-19

Ajadi, B.S., Adeniyi, A. and Afolabi, M.T. (2011). Impact of Climate Change on Urban Agriculture: Case Study of Ilorin City. *Global Journal of Human Social Science*. Double Blind Peer Reviewed International Research Journal Publisher. Globa1Journals Inc. (USA), 11(1). 1-6.

Bolaji-Olatunji, K.A., Olufolaju, A.D. and Awe, F. (2010). Climate Change, Adoption and Sustainability Natural Resources Management in Nigeria. *Proceedings of the 44th Annual Conference of Agricultural Society of Nigeria (ASN)*. 1449-1451.

Fischer, G., Tubiello, F., van Velthuzien, H., and Wiberg, D. (2007). Climate Change Impacts on Irrigation Water requirements: Effects of Mitigation, 1970-2080. *Technology, Forecast and Social Change*, 74,1083-1107, doi:10.1016.techfore. 2016.12.20. Retrieved 20th February, 2018

Food and Agricultural Organization, (2003), FAOSTAT, *http:/faostat/fao.org/default.htm.* Retrieved 12th February, 2018

IPCC, (2001). Climate Change 2001: impacts, Adaptation and Vulnerability. *Third Assessment Report*. Cambridge University Press.

IPCC, (2007a); Section 18 'Inter-relationships between adaptation and mitigation' in climate change 2007: Impacts, Adaptation and Vulnerability. Working Group II. *Fourth Assessment Report of the IPCC*. Cambridge University Press, United Kingdom.

IPCC, (2007b). Impacts, Adaptation and Vulnerability. *Contribution of Working Group II to the Third Assessment Report of the IPCC*. In: Parry, Martin, L., Canziani O.F., van der Lindel P.J., Hanson, C.E (Eds.). Cambridge University Press, United Kingdom, 14: 369-383

Matsui, T.and Pielke Sr., R.A. (2006). Measurement-based estimation of the spatial gradient of aerosol radiative forcing, *Geophysical Research Letter*. 33:L11813, doi:10.1029/2006GL025974. Retrieved 8th January, 2018

Nigeria Meteorological Agency (NIMET) (2011). *Nigeria: Climate Review Bulletin*

CLIMATE CHANGE AND PALM KERNEL PRODUCTION IN ONDO STATE

BY

OMOSUYI O. BUKOLA and EMMANUEL O. AKINFISOYE

www.guildaa.org

2010: NMA Abuja. Economic Sustainability held at Nnamdi Azikwe University, Enugu, Nigeria, 12th-14th June, 2011. 1-51.

Odjugo, P. (2010). General Overview of Climate Change Impacts in Nigeria. *Journal of Human Ecology*. 291(1), 47-55

Paterson, M., Russell, R., and Lima, N. (2017). Climate change affecting oil palm agronomy, and oil pal cultivation increasing climate change, require amelioration. *Ecology and Evolution*, 8(1). 361-363.

Pouliotte, J., Smit, B., and Westerhoff, L. (2009). Adaptation and Development: Livelihood and Climate Change in Subarnadad, Bangladesh. *Climate Change and Development*, 1, 31-46.

Tanner, T., and Mitchell, T. (2008). Entrenchment or Enhancement: Could Climate Change Adaptation Help to Reduce Chronic Poverty? *Institute of Development studies Bulletin*, 39 (4), 6-15.

UNEP (2008). Scoping Paper for Export Group Meeting on Climate Change Adaptation. Africa Minister Conference on the Environment, 12th Meeting of the Export Group. *http://www.unep.org/roa/About_AMCEN/default.asp*. Retrieved 25th February, 2018

UNFCCC (2007). Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries. *United Nation Framework Convention on Climate Change, Germany*. 1-68.

World Trade Organization and the United Nations Environmental (WTO-UNEP) Report (2008), On Trade and Climate Change. Switzerland. World Trade Organization. *www.wto.org/english/res_e/booksp_e/trade_climate_change_e.pdf*. Retrieved on 10th July, 2017