The Effect of Agroclimatic Factors on Cash Crops Production in Nigeria.

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ABSTRACT

This study examined the effects of agroclimatic factors on the yield of cash crops in Nigeria and other variables such as producer prices, exchange rate and level of national income (GDP). The effects of total rainfall, mean temperature, sunshine hour, relative humidity, radiation, exchange rate and GDP on the yields of three cash crops (Cocoa, Palm Kernel and Palm Oil) were estimated for the period 1970-2003 in Nigeria. The methods of analysis employed in the study were mainly error-correction model (ECM) within the context of co-integration theory. The results showed that all the variables are not stationary at their levels and thus, a need for differencing once to attain stationary. Statistical significance of the error-correction terms for the three produce validates the existence of an equilibrium relationship among the variables in each of these co-integrating vectors. However, producer price, temperature and GDP were the most significant factors influencing the yield of cocoa while only exchange rate was the most significant factors for the palm produce.

Keywords: cocoa, palm kernel, palm oil, Nigeria, agroclimatic factors, cointegration and error correction mechanism

INTRODUCTION

The vulnerability of Nigerian agricultural sector to climate change is of particular interest to policy makers because agriculture is a key sector in the economy accounting for between 60-70% of the labour force and contributing between 30-40% of the nation's GDP. The sector is also the source of raw materials used in several processing industries as well as a source of foreign exchange earnings for the country. How much one can hold climate responsible for changes in agricultural productivity in Nigeria will, for a long time, remain a subject of research as long as other factors are at interplay in determining agricultural productivity (Ajetomobi et al., 2011). Omonona and Akintunde (2009) observed that weather and climate influence most of the processes involved in crop production for example: solar radiation produces energy for warming the soil, plants and for metabolic processes, rainfall and its characteristics in terms of amount of intensity, reliability and distribution influence crop growth and soil erosion. Atmospheric evaporation determines the performance and survival of crops. Planting and dates are determines by the start of rains.

Smith and Skinner (2002) asserted that climate plays a dominant role in agriculture having a direct impact on the productivity of physical production factors, for example the soil's moisture and fertility. Adverse climate effects can influence farming outputs at any stage from cultivation through the final harvest. Even if there is sufficient rain, its irregularity can affect yields adversely if rains fail to arrive during the crucial growing stage of the crops (Mowa and Lambi, 2006, Rudolf and Hermann 2009). High temperatures and atmospheric pressure are capable of causing health hazards to cash crops production household, leading to reduced productivity of labour and consequent loses associated with neglect of farm operations (Forest, 1989). Obasi (1997) observed that the consequential effect of weather risks result in considerable loses in income of the farmers.

Akintola (1983) examined the effects of agro climatic factors on some selected food crops such as cowpea, yam, rice and maize in Ibadan. Following his correlation and regression analysis, the responsiveness of each crop yield to specific agro climatic variables (rainfall, temperature, sunshine and humidity) was determined. Adubi (1986) also adopted methods similar to those used by Akintola, found out that rainfall, rainy days and technology have positive effects on the yield of groundnut and cowpea and accounted for 56% and 52% variations in total yields respectively in Oyo State. Aniedu (1987) analysed the effects of agro climatic factors on food crops yield in the Eastern ecological agricultural zone of Nigeria (using cassasva, yam, maize and rice as study crops) found out that rainfall also had negative effect on cassava in Anambra and Rivers states but a positive effect in Cross Rivers state. Total rainfall, total number of rain days and technological trend were found to have accounted for 34% variation in cassava yield, 59% in yam yield in Rivers State.

These studies are relevant to the present study as the effect of agro climatic factors on the yields of crop was established and other factor such as technology was seen to have positive effect on the yield of crops. In the light of this, the present study also considers other variables (producer prices, exchange rate and Gross Domestic product) which also have effect on the crop yields.

The study examined the effects of agro climatic factors on the yield of cash crops in Nigeria and effect of other variables such as producer prices, exchange rate and level of national income (GDP) on output. This study therefore analyses the level of integration between variables and existence of equilibrium relationship. The remaining sections are divided as follow: section two presents the methodology. Section three deals with results and discussion while section four is concerned with conclusion and recommendations.

METHODOLOGY

This section presents the methodological framework adopted for the study. The subsequent subsections deal with nature and sources of data, the scope of data collected and analytical procedures

SCOPE AND SOURCES OF DATA

The empirical analysis covers the period between 1970 and 2003. Three main cash crops of Nigeria were selected; Cocoa, Palm kernel and Palm Oil. Secondary data used for the analysis were obtained from Federal Meteorological Services Publications, Central Bank of Nigeria (CBN) publications, such as Annual Reports and Statements of Accounts, and the Statistical Bulletin. Other sources were Federal Office Statistics (FOS) Annual Abstract of Statistics, International Financial Statistics Year Book (IFS) and Annual Reports of the Federal Ministry of Agriculture. Secondary data collected include the following average yield of each crop, average daily mean temperature, total rainfall, daily sunshine hours, radiation, relative humidity. Similarly data on exchange rate, produce prices and Gross Domestics Product (GDP) were also collected over the period.

ANALYTICAL TECHNIQUES

Several analytical tools were employed to analyze the data. These include time trend analysis, Dickey – Fuller (DF) test and Augmented Dickey –Fuller (ADF) statistics, Cointegration and Error Correction Models (ECM).

TEST FOR STATIONARITY

The first step in carrying out a time series analysis is to check for stationarity of the variables (price series in this case. A series is said to be stationary if the means and variances remain constant over time. It is referred as I(0), denoting integrated of order zero. Non stationary stochastic series have varying mean or time varying variance. Agro climatic variables series in this study were first tested for stationarity. The purpose was to overcome the problems of spurious regression. A stationary series tends to constantly return to its mean value and fluctuations around this mean value have broad amplitudes, hence, the effects of shocks is only transient. Other attributes of stationary and non-stationary data and their implications in econometric modeling are discussed by Adams (1992), Gujarati (1995) and Juselius (2006).

A variable that is non -stationary is said to be integrated of order *d*, written *I(d)*, if it must be differenced *d* times to be made stationary. In the same way, a variable that has to be differenced once to become stationary is said to be *I(1)* i.e., integrated of order 1. The augmented Dickey Fuller (ADF) was adopted to test for stationarity. This involves running a regression of the form:

$$\Delta P_{it} = \beta_1 + \beta_{2t} + \delta P_{it-1} + \alpha_1 \sum_{t=1}^{m} \beta_1 \Delta P_{it-1} + \ell_{it} \qquad (1)$$

Where:

Δ = first difference operator

P_{it} = food price series being investigated for stationarity

t = time or trend variable

The null hypothesis that $\delta = 0$ implies existence of a unit root in P_{it} or that the time series is non-stationary. The critical values which have been tabulated by Dickey and Fuller (1979), Engle and Yoo (1987) and Mackinnon (1990) are always negative and are called ADF statistics rather than t-statistics. If the value of the ADF statistics is less than (i.e more negative than) the critical values, it is concluded that P_{it} is stationary i.e $P_{it} \sim I(0)$.

When a series is found to be non-stationary, it is first-differenced (i.e the series $\Delta P_{it} = P_{it} - P_{it-1}$ is obtained and the ADF test is repeated on the first-differenced series. If the null hypothesis of the ADF test can be rejected for the first-differenced series, it is concluded that $P_{it} \sim I(1)$. The price series for all the markets included in this study were investigated for their order of integration.

CO-INTEGRATION TEST

Two or more variables are said to be co- integrated if each is individually non-stationary (i.e. has one or more unit roots) but there exists a linear combination of the variables that is stationary. Other attributes of co-integration are as shown in Engle and Yoo (1987) and Silvapulle and Jarasuriya (1994). After the stationarity test, the study proceeds by testing for co-integration between market price series that exhibited stationarity of same order.

The maximum likelihood procedure for co- integration propounded by Johansen (1988), Johansen and Juselius (1990, 1992) and Juselius (2006) was utilized. This is because the two-step Engle and Granger procedure suffers from the simultaneity problem and the results are sensitive to the choice of dependent variables (Baulch, 1995). Adopting a one-step vector auto-regression method avoids the simultaneity problem and allows hypothesis testing on the co-integration vector, r. The maximum likelihood procedure relies on the relationship between the rank of a matrix and its characteristic roots. The Johansen's maximal eigenvalue and trace tests detect the number of co-integrating vectors that exist between two or more time series that are econometrically integrated. The two variable systems were modeled as a vector auto-regression (VAR) as follows:

$$\Delta X_t = \mu_t + \sum_{t=1}^{k} \Gamma_i \, \Delta X_{t-1} + \pi X_{t-k} + \varepsilon_t \qquad (2)$$

Where:

X_t is a N x 1 vector containing the series of interest (staple foodstuffs spatial price series)

г and л are matrices of parameters

K = number of lags and should be adequately large enough to capture the short-run dynamics of the underlying VAR and produce normally distributed white noise residuals.

ε_t = vector of errors assumed to be white noise.

ERROR CORRECTION MODEL (ECM)

Error Correction Model (ECM) is an attempt to integrate economic theory useful in characterizing a long-term equilibrium with an observed disequilibrium by building a model that explicitly incorporates behaviour that would restore the equilibrium. The use of the ECM is facilitated when variable are first-differenced stationary and cointegrated. The reason for stationarity is to ascertain the order of integration and if not present the number of times a variable has to be differential to make it stationary. Since the estimation methods such as "least squares" can be applied to time series data only when all the data series are stationary, then the first difference forms should be used if non-stationary variables are to be included in a regression exercise. For example, for a random walk on non-stationary.

Variable Xt,

(4) $X_t = X_{t-1} + et \quad etN(0,s^2)$

the first difference of X_t can be written as

X_t = et, which is by definition a stationary process.

Cointegration or ECM is accepted when the residuals from the linear combination of the non-stationary series I (1) are themselves stationary. The acceptance of the ECM indicates that the model is best specified in the first difference of the variables. The ECM framework is essence guarantees the non-loss information from long term relationships in the first differences. The ECM is then used to analyze the impulse response of crop yield to a stimulus in the explanatory variables in a dynamic setting. The estimated equation for cocoa as an example is given as follows:

(5) $a(L)\Delta CYD_{t =} a_o + a_1(L)\Delta CEX_t +_{a2}(L)\Delta CHD_t + a_3(L)\Delta CRD_t + a_4(L)\Delta CRN_t$

$+a_5(L)\Delta CRP_t + a_6(L)\Delta CRP_{t-1} + a_7(L)\Delta CSN_t + a_8(L)\Delta CTP_t + a_9(L)\Delta GDP_t$

$+ a_{10}(L)\Delta GDP_{t-1} - a_{11}\, ECM_{t-1} + U_t$

Where:

CYD_t = Yield of Cocoa in time t (‘000) tonnes

CEX_t = Official exchange rate in time t.

CHD_t = Relative humidity in time t.

CRD_t = Radiation in time t.

CRN_t = Rainfall in time t.

CRP_t = Average producer price in time t.

CRP_{t-1} = Average producer price of the previous year.

CSN_t = Sunshine hours in time t.

CTP_t = Mean temperature in time t.

GDP_t = Gross Domestic Product in time t.

GDP_{t-1} = Gross Domestic Product of the previous year.

$ECM_{(-1)}$ = The error Correction Factor.

U_t = Stochastic Error term assumed to be independently and normally distributed with zero mean and constant variance.

RESULTS AND DISCUSSIONS

The results and discussion start with the presentation of stationarity test of the variables used for estimation. Following this is a sub-section on the co integration tests and Error Correction Model (ECM) analysis.

Table1: Test for Order of Integration using ADF Tests for Cocoa

Variable	Level without trend	Level with trend	First difference without trend	First difference with trend
LnCYD	-1.6385	-1.7794	-4.2979	-4.2395
LnCHD	-2.295	-3.1709	-3.0688	-5.1596
LnGDP	-.26338	-2.0385	-3.3259	-4.2232
LnCRN	-2.5414	-2.7484	-3.0980	-4.0706
LnCRP	-1.3219	-2.5350	-3.5287	-4.2279
LnCEX	.72460	1.9317	-3.1778	-4.2832
LnCRD	-2.1189	-2.4966	-3.7102	-3.6362
LnCTP	-2.5473	-2.6478	-3.2633	-3.9034
LnCSN	-1.3183	-1.7259	-3.5623	-4.9617
Critical values 95%	-2.9750	-3.5867	-2.9798	-3.5943

Source: Extracted from Regression results

Table2: Test for Order of Integration using ADF Tests for Palm Kernel

Variable	Level without trend	Level with trend	First difference without trend	First difference with trend
LnKYD	-1.0914	-1.2152	-3.4456	-3.8203
LnKHD	-2.2925	-2.4574	-3.0778	-5.1596
LnKRN	-2.5414	-2.7484	-3.0980	-4.0706
LnGDP	-0.54973	-2.0385	-3.3259	-4.2232
LnKRP	-1.6067	-2.4134	-3.0284	-4.5098
LnKEX	8.1720	8.5738	-3.1778	-4.7278
LnKTP	-2.5473	-3.3120	-3.2633	-3.9034
LnKRD	-2.1189	-2.4966	-3.7102	-3.6362
LnKSN	-1.2485	-1.6766	-3.5623	-4.9617
Critical values 95%	-2.9750	-3.5867	-2.9798	-3.5943

Source: Extracted from Regression results

Table3: Test for Order of Integration using ADF Tests for Palm Oil

Variable	Level without trend	Level with trend	First difference without trend	First difference with trend
LnPYD	-1.5403	-2.9951	-3.0232	-3.8617
LnPHD	-2.2925	-2.4574	-3.0688	-5.1596
LnPRN	-2.5414	-2.7484	-3.0980	-4.0706
LnGDP	-.26338	-2.0385	-3.3259	-4.2232
LnPEX	8.1720	-8.5738	-3.1778	-3.7278
LnPRP	-1.1365	-2.9447	-3.2511	-3.8723
LnPTP	-2.5473	-3.3120	-3.2633	-3.9034
LnPRD	-2.1189	-2.4966	-3.7102	-4.6998
LnPSN	-1.2485	-1.6766	-3.5623	-4.9617
Critical values 95%	-2.9750	-3.5867	-2.9798	-3.5943

Source**:** Extracted from Regression results

STATIONARY TESTS OF THE VARIABLES USED

The order of integration using ADF classes of unit root tests is presented in table 1, 2, and 3 for cocoa, palm kernel and palm oil respectively. In general, the tables reveal that all variables are not stationary at their level but become stationary at their level of first difference. For all the variables in level form, the ADF statistics are above the critical values of –2.9750 and –3.5867 for level without trend and level with trend respectively. Thus, the variables are non-stationary in their level form. In the first difference form, however, we can reject the null hypothesis for all variables and this indicates that the variables are I(1).

Table 4: Test for the number of co-integrating vectors for Cocoa.

H_o	H_a	Test Statistic	95% critical value
r=0	r =1	89.3513	61.2700
r ≤ 1	r = 2	83.7921	55.1400
r ≤2	r = 3	55.7109	49.3200
r ≤3	r = 4	44.1568	43.6100
r ≤4	r = 5	37.9295	37.8600
r≤ 5	r = 6	30.0136	31.7900
r ≤6	r = 7	14.7085	25.4200
r ≤7	r = 8	8.9784	19.2200
r≤ 8	r = 9	5.9289	12.3900

Source: Extracted from computer print out.

CO-INTEGRATION TESTS FOR COCOA

The null hypothesis is that the number of co-integrating vectors is less than or equal to r, where r is o, 1, 2, 3, 4, 5, 6, 7, 8 or 9. According to the results in Table 4, we can reject the null hypothesis of zero co-integrating vectors at the 95-pecent level. The trace test statistics for r = 4 is 37.9295 which is greater than the critical value. This means that there exist at most five co-integrating vectors.

Table 5: Test for the number of co-integrating vectors for Palm Kernel.

H_o	H_a	Test Statistic	95% Critical Value
r=0	r =1	99.1402	61.2700
r ≤ 1	r = 2	75.5203	55.1400
r ≤2	r = 3	62.4356	49.3200
r ≤3	r = 4	57.3737	43.6100
r ≤4	r = 5	49.5580	37.8600
r≤ 5	r = 6	31.0651	31.7900
r ≤6	r = 7	23.8831	25.4200
r ≤7	r = 8	22.3670	19.2200
r≤ 8	r = 9	15. 6398	12.3900

Source: Extracted from computer print out.

CO-INTEGRATION TESTS FOR PALM KERNEL

Table 5 indicates that there exist co-integrating vectors for all the nine variables used. The trace test statistic for r≤ 8 is 15.6398, which is greater than the critical value. Therefore, there is long-run equilibrium relationship between palm kernel and the variables.

Table 6: Test for the number of co-integrating vectors for palm oil

Ho	Ha	Test Statistic	95% critical value
r=0	r =1	92.3652	61.2700
r ≤ 1	r = 2	84.1905	55.1400
r ≤2	r = 3	56.0930	49.3200
r ≤3	r = 4	48.7923	43.6100
r ≤4	r = 5	40.1186	37.8600
r≤ 5	r = 6	31.7906	31.7900
r ≤6	r = 7	29.7651	25.4200
r ≤7	r = 8	21.6396	19.2200
r≤ 8	r = 9	16.6830	12.3900

Source**:** Extracted from computer print out.

CO-INTEGRATION TESTS FOR PALM OIL.

The result in Table 6 shows that all the variables used established co-integration. This means that there exist nine co-integrating vectors. Thus, all the vectors involve palm oil have a long-run equilibrium relationship.

For r ≤ 8, the test statistic is 16.6830, which is greater than the critical value.

Table 7: ECM Results of cocoa

Regressor	Dependent Variable Cocoa (∆LnCYD)		
	Coefficient	Std. Error	t-statistic
Constant	-0.028281	0.043283	-0.653402
∆Ln(CEX)	-0.115552	0.124320	-0.929471
∆ Ln(CHD)	0.265527	0.373756	0.710428
∆Ln(CRD)	-0.658211	0.506801	-1.298756
∆Ln(CRN)	0.159185	0.212257	0.749961
∆Ln(CRP)	0.212499	0.102447	2.074226
$\Delta Ln(CRP)^{-1}$	0.106311	0.096289	1.104087
∆Ln(CSN)	0.061009	0.361326	0.168847
∆Ln(CTP)	1.246567	0.703131	1.772879
∆Ln(GDP)	0.740497	0.580700	1.275180
$\Delta Ln(GDP)^{-1}$	0.674015	0.459533	1.466740
Ecm^{-1}	-0.662331	0.182375	-0.653402
R^2	0.693040	___	___
Adjusted R^2	0.499171	___	___
S.E of regression	0.187925	___	___
Sum of squared resid	0.671001	___	___
Log likelihood	16.42950	___	___
Durbin-Watson Stat	1.892262	___	___
Mean dependent var	-0.008788	___	___
S.D. dependent	0.265546	___	___

Var			
Akaike info criterion	-0.214344	___	___
Schwarz criterion	0.381112	___	___
F-Statistic	3.574778	___	___
Prob (F-Statistic)	0.006581	___	___

Source: Computer printout of ECM analysis for cocoa

Table 8: ECM Results of Palm Kernel

Regressor	Dependent Variable Palm Kernel (ΔLnKYD)		
	Coefficient	Std Error	t-statistic
Constant	-0.00444	0.021071	-0.210899
ΔLn(GDP)	0.359713	0.303231	1.186268
$\Delta Ln(GDP)^{-1}$	-0.201038	0.272250	-0.738429
ΔLn(KEX)	0.103879	0.061415	1.691420
ΔLn(KHD)	-0.115156	0.201705	-0.570912
ΔLn(KRD)	0.087413	0.259543	0.336794
ΔLn(KRN)	-0.048656	0.129467	0.375819
ΔLn(KRP)	0.029098	0.029197	0.996602
$\Delta Ln(KRP)^{-1}$	-0.019522	0.032227	-0.605776
ΔLn(KSN)	-0.037792	0.018054	-0.209318

ΔLn(KTP)	0.064273	0.410642	0.156519
ECM^{-1}	-0.681355	0.289780	-2.351279
R^2	0.440736	_____	_____
Adjusted R^2	0.087516	_____	_____
S.E of regression	0.097836	_____	_____
Sum squared resid	0.181867	_____	_____
Log likelihood	37.31744	_____	_____
Durbin-Watson stat	1.700413	_____	_____

Source**:** Computer printout of ECM analysis for palm kernel

Table 9: ECM Results of Palm Oil

Regressor	Dependent Variable (ΔLnPYD)		
	Coefficient	Std Error	t-statistic
Constant	-0.024706	0.057198	10.431935
ΔLn(GDP)	-0.341645	0.755614	0.452143
$\Delta Ln(GDP)^{-1}$	0.527357	0.614179	0.858636
ΔLn(PEX)	0.329310	0.172507	1.908960
ΔLn(PHD)	-0.051919	0.470161	-0.110428
ΔLn(PRD)	-0.142828	0.6468576	-0.220217
ΔLn(PRP)	0.086263	0.112659	0.765704
$\Delta Ln(PRP)^{-1}$	0.016742	0.089166	0.187765
ΔLn(PTP)	0.385025	0.953388	0.403850
ΔLn(RNP)	0.331141	0.305062	1.085487

ΔLn(SNP)	-0.790791	0.445210	-1.776220
ECM^{-1}	-0.648338	0.209184	-3.099362
R^2	0.482418	____	____
Adjusted R^2	0.155524	____	____
S.E of regression	0.253048	____	____
Sum squared resid	1.210632	____	____
Log likelihood	6.908362	____	____
Durbin-Watson stat	1.717838	____	____

Source: Computer printout of ECM analysis for palm oil

Table 10: Restricted parameter estimate for cocoa, palm kernel and palm oil

Crop	Constant term	X_2	X_6	X_7	$X_7(-1)$	X_8	ECM (-1)	R^2	F	DW	SC
Cocoa	-0.04 (-1.06)	1.39 (2.01)**	-	0.23 (2.89)*	0.16 (1.98)***	1.11 (2.03)**	-0.64 (-3.99)*	0.5634	6.71+	2.53	-0.0
Palm kernel	0.002 (0.164)	-	0.08 (1.79)***	-	-	-	-0.55 (-3.15)*	0.2598	5.26+	1.92	-1.7
Palm oil	-.009 (-0.217)	-	0.27 (2.31)**	-	-		-0.50 (-3.22)*	0.3263	7.26+	1.71	0.12

Source: Computed from computer print out

The value in parenthesis are t values

X_2 = Mean Temperature, X_6 = Exchange Rate, X_7 = Producer Price, X_8 = GDP, D.W. = Durbin – Watson statistic

* t values significant at 1%, ** t values significant at 5%, *** t values significant at 10%,

+F values significant at 1% D.W. = Durbin – Watson statistic

Sc = Schwartz information criterion

R^2 = R-squared

ERROR –CORRECTION MODEL

The results of the first step of the model are presented in table 7, 8 and 9. The coefficient of rainfall, sunshine, temperature, exchange rate, producer price and GDP are found to be positive for cocoa yield. It is expected that increased in the level of this variables would lead to an increase in the yield of cocoa. Humidity and radiation have inverse relationship with the yield of cocoa. Increased in the humidity and radiation would result in the yield reduction of cocoa. The results showed that there is direct relationship between exchange rate; humidity; radiation; rainfall; producer price and yield of palm kernel. Sunshine, temperature and GDP have negative effect on the yield of palm kernel.

The results also revealed that rainfall, radiation, producer price, humidity all have positive relationship with the yield of palm oil while radiation, temperature, sunshine and GDP have negative effects on the yield of palm oil. This reveals that higher level of rainfall; humidity, radiation and producer price would lead to increase in the yield of palm oil. However, in proceeding from the general error correction model to the parsimonious model, reparameterization of eight steps was done for the three crops in which variables that had low statistics and were not significant were eliminated. This was done in order to detect the most significant variables that mostly influenced the three crops. The final and parsimonious model is presented in table 10 for Cocoa, palm Kernel and Palm Oil.

In table 10 the coefficient of determination (R^2) of cocoa is 0.5634, thus the independent variables explain 56.3 % of the variations in the dependent variable. Also, the R^2 was 0.2598 for palm kernel and 0.3263 for palm oil and the coefficient estimates had expected sign. In the case of Cocoa, producer price X_7 was significant at 1% while lagged producer price $X_7(-1)$ was significant at 10%. Both mean temperature X_2 and Gross Domestic Product X_8 were all significant at 5%. For palm produce; only exchange rate X_6 was significant at 10% for palm kernel and at 5% for palm oil.

The Error Correction Term, ECM was significant at 1% for all the three cash crops. A feedback of 64% was achieved for cocoa, 55% for palm kernel and 50% for palm oil. This confirms that there is a relationship between the yield and producer price, lagged producer price, mean temperature, Gross Domestic Product and exchange rate. The results revealed that of all the dependent variables considered, only temperature, producer price and GDP were the most significant factors influencing the yield of cocoa. For palm kernel and palm oil it was only exchange rate which was most significant factor that mostly influences the yield.

CONCLUSION AND RECOMMENDATION

Based on the findings of the study; some important policies for increasing the yield of the crop studied emerged. For cocoa, producer prices, lagged producer prices, temperature and GDP were the most important factors that influence the yield of the cocoa. There is a known fact that temperatures really affect the yield of cocoa as tropical crops grow best in temperatures between 18^{o}c – 32^{o}c. Also, temperature serves as an important catalyst in almost all of the biochemical reactions that take place within the plant. Any slight deviation from the temperature range requirement of cocoa would lead to marked reduction in the yield. This problem could hardly addressed by any policy except environmental management that would address the global warming caused by greenhouse gas (ghg) emissions, which are products of technological development. Emerging from this is to formulate adequate global environmental management policy to address the problem of climate change due to global warming.

Equally there is a need to formulate a policy that would increase the producer prices of cocoa so as to encourage increased in cultivation of cocoa farms, as farmer would be motivated to develop new hectarage for cocoa cultivation and have more money to procure farm inputs such as chemicals. Emerging from the study is the fact that GDP was one of the key factors that influence the cocoa yield. GDP is partly an element of national income of country. Therefore, in order to boost the production of cocoa there is a need for government to formulate a broad policy that would create enabling environment to produce goods and increased the capacity building of industries especially agro-allied industry.

In the case of palm kernel and palm oil, only exchange rate was the significant factor that affects the yield of the palm produce. Government has to formulate the exchange rate policy that would encourage farmer to export the palm produce to foreign countries. This can only be done by devaluation of local currency in which the local currency will become weaker compare to the foreign currency like dollar and pound sterling. In the end, the farmer would be getting more naira from the sale of their palm produce to the foreign countries.

Therefore, government has to take the devaluation of local currency with caution. Another lasting solution is for government to formulate policy that would create enabling environment for development of small and medium scale enterprises that make use of palm produce, for example soap and vegetable oil industry. In order for these infant industries to grow government has to ban some imported commodities that compete with the local products in the Nigerian market. This can serve as a long-run solution so that farmers are favoured to dispose their palm produce in the local market with a rewarding producer price rather than solely depend on foreign market.

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