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The Effects of Petroleum Dependency on Food Crops Production in Nigeria

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Abstract

The discovery of oil in large quantities in Nigeria in the early 70s led to massive oil production and export which oil lured many youths away from the farms into the cities in search of white-collar jobs thereby neglecting agriculture and successive governments have immensely invested in food imports depleting the foreign reserve of the country. The study was conducted to examine the effects of petroleum dependency on food crops production, determine the trend, determinants of food crops production and establish the relationship between output of some food crops and oil exports. Secondary data were mainly used for the study and were obtained from Central Bank of Nigeria (annual statement of accounts (various issues) and statistical bulletins from 1970 to 2012 on output of selected food crops (maize, rice, millet, sorghum, wheat and Hungry rice Acha) as well as oil export were collected and analyzed. Augmented Dickey-Fuller (ADF) test showed that the seven variables were stationary after first differencing at 1% level of significance. Trend in food crops production revealed that maize, millet, sorghum, wheat and acha showed steady increase from 1985 – 1989 to 2004 – 2009 while rice production recorded downward slide from 1970 – 1984 but there was steady increase in production from 1985 – 2004. There was the existence of stationarity relationship between the selected food crops. Also, there was the existence of the same stochastic trend between selected food crops and oil exports as confirmed by error correction model (ECM). Sustained increase in the exchange rate of the naira and oil export had an inverse relationship with food crop production. Diversifying the economy was recommended to curtail food shortages in the country.

Keywords: *Dependency, Unit root, Co- integration, Food crops, Granger Causality*

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Background to the Study

The extractive sector in the Nigerian economy is large and extensive, with oil playing a dominant role. With nearly 37.2 billion barrels in reserves and 2.13% of global production, Nigeria has the world's tenth largest proven reserves (3.1% of global reserves), and is among the top 10 oil producers. Since the discovery and production of oil Nigeria in 1958, the subsector has continued to play a major and dominant role in the Nigerian economy. The expectation theory postulates that oil discovery, its exploration and production are expected to improve the living standards and qualities of life of the citizens of countries with oil deposits. The discovered natural resources and with its associated windfalls are expected to power the economy of these countries in terms of job creation, income, investment growth and development (Ariyeeteh and Asmali, 2011). The discovery of oil in large quantity since early 70s led to massive oil production and export. The discovery of the crude oil lured many youths away from the farms into the cities in search of white-collar jobs thereby neglecting agriculture. Many scholars have suggested significant relationship between economic growth vis- à-vis oil revenue income and agriculture but international evidences also suggested that resource-rich nations are characterized by slow or stagnating growth, de-industrialization, low savings, deteriorating capital accumulation and stagnating or declining productivity (Gushibet, 2012; Budina and Van Wijnbergen, 2013).

In the face of exportation of both agricultural and crude oil, Nigeria had also been importing huge amount of food from the international market although it has sufficient resources both human and economic to produce its own food. In 2010, Nigeria spent an enormous amount on food imports; about USD $635 billion on wheat imports and USD $356 billion on rice (National Planning Commission, NPC 2011). Wheat dominates Nigeria's agricultural imports and accounted for about 40.7% (N 390.6 billion) in 2019. Oji- Okoro (2014), reported that Over the years, Nigeria has immensely invested in its exports which have been seriously criticized by internal and external organizations who suggested that the federal government should stop depleting the foreign exchange resources of the country by using strategic initiatives. In four years (2016-2019), Nigeria's cumulative agricultural imports stood at N 3.3 trillion, four times more than the country's agricultural exports of N803 billion in the same period. The results of the government's policies to reposition the agricultural sector have been mixed. The Agricultural Promotion Policy (APP) introduced by the Federal Ministry of Agriculture and Rural Development (FMARD) with various intervention programmes by the Central Bank of Nigeria (CBN). The Anchor Borrowers Programme, have led to transformation in the sector especially in the area of rice production but the policies score recorded poor performance in the attainment of self-sufficiency for key agricultural products. For example, annual wheat production which stands at 0.06 million metric tonnes is barely able to cover local demand of over 5 million metrics tonnes despite the APP setting 2018 as the target year in which the nation would have attained self-sufficiency in wheat production. In view of this, the study was conducted to examine the effects of petroleum dependency on food crops production, its major determinants, determine the trend and establish the relationship between output of food crops and oil exports

Methodology

Secondary data were mainly used in the study and obtained from Central Bank of Nigeria (annual statement of accounts (various issues) and statistical bulletins. Time series data from 1970 to 2012 on output of selected food crops (maize, rice, millet, sorghum, wheat and Acha) as well as oil export were collected.

Method of Data Analysis

Both Descriptive statistics and inferential statistics were used in the analysis of the data collected. Arithmetic means (descriptive statistics) were used in the description of the variables of the study whereas Error correction model (inferential statistics) was used to determine the characteristics of time series data. The use of ECM is facilitated when variables are first differenced stationary and co integrated. Co-integration theory examines the time series characteristics of data with a view to overcoming the problems of spurious correlation usually associated with non-stationary time series data and simultaneously generate long run equilibrium relationships (Engle and Granger, 1987; Sekumade, 2009).

Test for Unit Root

The data were first subjected to test of stationary or order of integration of the data series conducted using the Augmented Dickey – Fuller (ADF) test. The test was carried out by applying a regression specified as:

$\Delta X_t = \alpha + \delta X_{t-1} + \sum_{t-1}^{k} \beta \Delta X_{t-1} 1 + e_t$ 1

The second test for co - integration – Johansen's approach was also carried out to determine the number of co integrating vectors using Johansen test which was based on maximum likelihood estimates of all the co - integrating vectors in a given set of variables and provides the likelihood ratio test for the number of co-integrating vectors. The model is given as:

$X_t = C_t + \lambda_1 X_{t-1} + \ldots + \beta_k X_{t-k-+} e_t$ 2

The first difference form is given as $\Delta X_t = C_t + \lambda_{k-1} X_{t-k} + \ldots + \beta_1 X_{t-1+} e_t$ 3

Where X_1 is vector of n variables e_t is error term

Error Correction model (ECM)

The ECM (OLS) is then applied to investigate the relationship between the dependent and independent variables. It is stated as:

$\Delta Y_{Maize} = X_0 + X_1 \Delta X_1 t_{-1} + X_2 \Delta X_2 t_{-1+} ecm\, t_{-1}$ 4

$\Delta Y_{Miillet} = X_0 + X_1 \Delta X_1 t_{-1} + X_2 \Delta X_2 t_{-1+} ecmt_{-1}$.....5

$\Delta Y_{Sorghum} = X_0 + X_1 \Delta X_1 t_{-1} + X_2 \Delta X_2 t_{-1+} ecm\, t_{-1}$..... 6

$\Delta Y_{Rice} = X_0 + X_1 \Delta X_1 t_{-1} + X_2 \Delta X_2 t_{-1+} ecm\, t_{-1}$.....7

$\Delta Y_{Wheat} = X_0 + X_1 \Delta X_1 t_{-1} + X_2 \Delta X_2 t_{-1+} ecm\, t_{-1}$.....8

$\Delta Y_{Acha} = X_0 + X_1 \Delta X_1 t_{-1} + X_2 \Delta X_2 t_{-1+} ecm\, t_{-1}$.....9

Where X_0, X_1 and $X_2$are coefficients ; $X_1\, t_{-1}$= Oil export (billion naira), $X_2\, t_{-1}$= exchange rate (naira) ; Δ = operator for change and ecm t_{-1} = regressor to capture short run relationship or dynamics

Results and Discussion

Trends in Food Crops Production

Food crops production in Table 1 revealed warping trends in some of the crops under investigation. These fluctuations may be attributed to various agricultural policies and initiatives put in place by successive governments in the country. The trend in maize production showed steady increase from 1985 – 1989 to a peak in 2004 – 2009. Maize is the fourth most consumed cereal during the past two decades, after sorghum, millet and rice in Nigeria. Nigeria is the 11th largest producer of maize in the world, and the 2nd largest maize producer in Africa after South Africa (Food and Agriculture Organization Statistics, FAO Statistics, 2014). As a versatile crop that is not just consumed domestically, maize is used industrially by flour millers, brewers, bakers of bread and confectionery and animal feed manufacturers. Similarly millet, sorghum, wheat and Hungry rice, Acha *(Digitaria exilis)* witnessed gradual and sustained increases from 1985– 1989 to 2004 – 2009. Rice production trend as revealed in Table 1 showed downward slide from 1970 – 1974 to 1980 – 1984 but there was steady increase in production from 1985 – 1989 to 2000 – 2004. The decrease in rice production was due to increase in the demand for rice in the diets of Nigerians with attendance consequence of huge imports for rice thereby depleting foreign reserve.

Nigeria has potentials for rice production but the resource has not been properly harnessed. One can deduce that favourable policies like SAP, commodity driven demand, agricultural value chain and the seven point agenda might be responsible for increase food crops production as indicated in these periods.

Table 1: Trends in Food Crops Production in Tonnes (1970 - 2012)

Year	Maize		Crops Millet		Sorghum		Rice		Wheat		Acha (hungry rice)	
	Total	Mean	Total	Mean	Total	Mean	Total	Mean	Total	Mean	Total	Mean
1970 – 74	4692	938.9	17679	3535.8	18008	3601.6	2018	403.6	92	18.4	67	13.4
1975 – 79	4196	839.2	12774	2554.8	14169	2833.8	1772	354.4	98	19.6	76	15.2
1980 – 84	4756	951.2	13834	2766.8	18356	3671.2	777	155.4	129	25.8	99	19.8
1985 – 89	17414	3482.8	21606	4321.2	28268	5653.6	6671	1334.2	1503	300.6	143	28.6
1990 – 94	36610	6122	23105	4621	27709	5541.8	14478	2895.6	1592	318.4	234	46.8
1995 – 99	32383	6476.6	30114	6022.8	39370	7874	16563	3312.6	244	48.8	332	64.4
2000 – 04	41396	8279.2	35188	7037.6	45357	9071.4	17410	3482.2	258	51.6	423	84.6
2004 – 09	47860	9572	37507	7501.4	48195	9639	20220	4044	286	57.4	1480	296
2010 – 12	26266	8755.33	1141	3813.66	20937	6979	13872	4624	196	65.33	311	103.7

Source: Authors own computation from secondary data 2020.

Unit Root Test

Time series data used for the study was subjected to Augmented Dickey-Fuller (ADF) test to see whether they have unit root or not. Result in Table 2 shows that the seven variables are stationary after first differencing at 1% level of significance. Therefore, the null hypothesis of the existence of unit root can now be rejected since they have no unit problem at first difference.

Table 2: Results of Unit Root Test

Variable	ADF - Statistics	Critical value	Significance Level	No of Lags
D(MAIZE)	-6.318306	-3.600987	1%	1
D(MILLET)	-9.428890	-3.600987	1%	1
D(SORGHUM)	-7.450231	-3.600987	1%	1
D(RICE)	-6.809396	-2.622585	1%	1
D(WHEAT)	-6.779318	-3.600987	1%	1
D(ACHA)	-5.154953	-3.600987	1%	1
D(CRUDE OIL EXPORT)	-7.278665	-3.600987	1%	1

Source: Data Analysis 2020

Co – integration Test

The test was carried out to establish the presence or absence of long run relationship among the series in the model. The likelihood ratio test statistics, the trace and maximal Eigenvalue test statistics were utilized in order to determine the number of co- integrating vectors. The variables considered are maize, millet, sorghum, rice, wheat, acha and crude oil export. Tables 3 and 4 contained both the Unrestricted Co – integration Rank Test (Trace) and Unrestricted Co – integration Rank Test (Maximum Eigen value). Table 3 indicated 2 co – integrating equation at 1% level of significance while Table 4 had only one co integrating equation at 1% level of significance and was not chosen thereby rejecting the null hypothesis.

Error Correction Mechanism

Error correction mechanism was carried out to address deviations in the short–run from the long – run relationship as confirmed by results in Table 3. As a consequence of the difference, the short – run interactions and the adjustments to the long – run equilibrium is necessary for policy implication for the production of food crops in the country. The error correction model (ECM) arises from the long – run relationship. The speed of adjustment of the model from short – run to long – run equilibrium necessitated the error correction term. Table 5 revealed that ECM coefficient of - 0.724647 and statistically significant at 1% and confirm to economic theory. The coefficient showed that 72.46 % distortion in food crops production in the country is yearly or annually being corrected. The implication is that when oil export falls, there is a corresponding reduction in food crops production with the possibility of food import to augment the short fall. The negative effect will linger on in the country for16 months before policy put in place will be felt.

Table 3: Unrestricted Co - integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob**
None *	0.791140	169.8610	125.6154	0.0000
At most 1 *	0.685062	105.6513	95.75366	0.0088
At most 2	0.475913	58.28075	69.81889	0.2919
At most 3	0.295314	31.79071	47.85613	0.6237
At most 4	0.250163	17.44058	29.79707	0.6075
At most 5	0.124012	5.636679	15.49471	0.7380
At most 6	0.005064	0.208163	3.841466	0.6482

Source: Data Analysis 2020Trace test indicates 2 cointegrating eqn (s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level**MacKinnon-Haug-Michelis (1999) p-values

Table 4: Unrestricted Co integration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob**
None *	0.791140	64.20964	46.23142	0.0003
At most 1	0.685062	37.37056	40.07757	0.0064
At most 2	0.475913	26.49004	33.87687	0.2917
At most 3	0.295314	14.35013	27.58434	0.7977
At most 4	0.250163	11.80390	21.13162	0.5671
At most 5	0.124012	5.428516	14.26460	0.6871
At most 6	0.005064	0.208163	3.841466	0.6482

Source: Data Analysis 2020 Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values

Table 5: ADF Test Result with ECM

Variable	Coefficient	Standard error	T statistic	Prob**
ECM(-1)	- 0.724647	0.15273	-4.74468	0.0000

Source: Data Analysis 2020

Granger Causality Tests

Table 6 indicates the direction of causality between output of selected crops and oil export. The result indicated that there existed interdependent and bidirectional causality between food crops and oil export and vice versa Co – integration between two series implies Granger Causality in at least one direction but the opposite may not be true. The result revealed that

seven cases of unidirectional relationship, two cases of bidirectional relationship and six cases of absence of integration between the pairs of crops. The case of unidirectional relationship indicates that the crop with significant value of probability causes output formation for the other crop with no response. Bidirectional relationship means both crops have influence on each other in terms of dependency on the increase of output. The case of lack of integration means that pair of crops in question has nothing to do with each other in terms of output formation.

Determinants of Food Crops Production

The ECM results for the determinants of food crops production is presented in Tables 7A and 7B and showed that the error correction variable (ECM) was significant for all the food crops considered in the study. This shows that there is the existence of long - run equilibrium relationship between output of each food crops and the variables. The coefficient for exchange rate in the long - run for all the crops was significant and has inverse relationship with food crops production. Conversely, sustained increase in the exchange rate of the naira would lead to resultant decrease in the quantity of output of maize, millet sorghum, rice, wheat and hungry rice (Acha) production. Sustained increase in the exchange rate of naira to the dollar will lead to soaring cost of inputs. Majority of farmers are poor and lack access to credit which is one of the major constraints stifling expansion of farms and the adoption of improved technologies in the country. Crude oil export in the long - run was statistically significant but has inverse relationship with rice and wheat production. Sustained increase in crude oil export has the attendant consequence on domestic production of rice and wheat leading to importation of the two commodities. Nigerian economy over the years was based on mono culture commodity (oil) thereby neglecting the agricultural sector which was the major foreign exchange earner for the country before oil discovery.

Conclusion and Policy Implication

There was the existence of long run relationship between petroleum dependency and food crops production in the country. A corresponding reduction in food crops production will be felt whenever there is a fall in oil export. Government should intensify policy on the diversification of the economy. Ban importation of food crops should be enforced to boost domestic food production.

Table 6: Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
MILLET does not Granger Cause MAIZE	41	0.42666	0.6559
MAIZE does not Granger Cause MILLET		5.37576	0.0091
SORGHUM does not Granger Cause MAIZE	41	0.34935	0.7075
MAIZE does not Granger Cause SORGHUM		6.63409	0.0035
RICE does not Granger Cause MAIZE	41	1.79365	0.1809
MAIZE does not Granger Cause RICE		8.42185	0.0010
WHEAT does not Granger Cause MAIZE	41	0.31226	0.7337
MAIZE does not Granger Cause WHEAT		3.19690	0.0527
ACHA does not Granger Cause MAIZE	41	10.1827	0.0003
MAIZE does not Granger Cause ACHA		3.49780	0.0409
SORGHUM does not Granger Cause MILLET	41	8.55121	0.0009
MILLET does not Granger Cause SORGHUM		0.30310	0.7404
RICE does not Granger Cause MILLET	41	0.72225	0.4926
MILLET does not Granger Cause RICE		0.65276	0.5267
WHEAT does not Granger Cause MILLET	41	0.00172	0.9983
MILLET does not Granger Cause WHEAT		0.05990	0.9420
ACHA does not Granger Cause MILLET	41	0.55031	0.5815
MILLET does not Granger Cause ACHA		0.25006	0.7801
RICE does not Granger Cause SORGHUM	41	0.41481	0.6636
SORGHUM does not Granger Cause RICE		1.55157	0.2258
WHEAT does not Granger Cause SORGHUM	41	0.53544	0.5900
SORGHUM does not Granger Cause WHEAT		0.05455	0.9470
ACHA does not Granger Cause SORGHUM	41	2.82791	0.0723
SORGHUM does not Granger Cause ACHA		0.44924	0.6416
WHEAT does not Granger Cause RICE	41	6.87358	0.0030
RICE does not Granger Cause WHEAT		2.90346	0.0678
ACHA does not Granger Cause RICE	41	1.05968	0.3571
RICE does not Granger Cause ACHA		2.56704	0.0907
ACHA does not Granger Cause WHEAT	41	0.24696	0.7825
WHEAT does not Granger Cause ACHA		1.27525	0.2917

Source: Data Analysis 2020

Table 7A: ECM results for the Determinants of Food Crops Production by OLS

Crop	Variable	Coefficient	Standard error	t. statistics
Maize	C	167.4752	319.398	0.52435
	Crude oil export (-1)	0.005653	0.00659	0.85836
	Crude oil export (-2)	0.011084	0.00650	1.70595
	Exchange Rate(-1)	16.05047	14.5890	1.10018
	Exchange Rate(-2)	-11.36446	5.5023	-2.06540**
	ECM			
		0.010480	0.00230	4.55652**
		R^2 =0.65(9.7) **		
Millet	C	0.923252	634.620	1.49327
	Crude oil export (-1)	31458998	0.00803	1.59594
	Crude oil export (-2)	976.3724	0.00854	0.32625
	Exchange Rate(-1)	69.74083	18.6918	1.74219
	Exchange Rate(-2)		16.9730	-
		-37.75998		2.22471**
	ECM		0.00378	
		0.008314		2.19947**
		R^2 = 0.71(11.2) **		
Sorghum	C	777.2170	533.610	1.45653
	Crude oil export (-1)	0.012639	0.00659	1.91735
	Crude oil export (-2)	0.008933	0.00691	1.29314
	Exchange Rate(-1)	42.26569	15.4623	2.73346**
	Exchange Rate(-2)	-45.22641	16.1887	-2.79369**
	ECM		0.00746	
		0.024596		3.29753***
		R^2 =0.87(7.6) **		

Source: Data Analysis 2020. ,**indicates significance@ 5% Figures in parenthesis are F. values

Table 7B: ECM results for the Determinants of Food Crops Production by OLS

Crop	Variable	Coefficient	Standard error	t.statistics
Rice	C	-31.55542	138.707	-0.22750
	Crude oil export (-1)	0.003987	0.00269	1.48116
	Crude oil export (-2)	-0.003248	0.00115	-2.82435**
	Exchange Rate(-1)	12.73238	6.71494	1.89613
	Exchange Rate(-2)	-13.22940	5.88028	-2.49791**
	ECM		0.00121	
		0.005623		4.64710**
		R^2 = 0.55(8.3)**		
Wheat	C	24.49492	35.0138	0.69958
	Crude oil export (-1)	0.000394	0.00067	0.59088
	Crude oil export (-2)			-
		-0.00066	0.000208	3.17308**
	Exchange Rate(-1)	0.578606	1.57802	-0.36667
	Exchange Rate(-2)	-0.326357	0.11466	-2.84630**
	ECM		0.000101	
		0.00079		7.82178**
		R^2 =0.63(9.6) **		
Acha(Hungry rice)	C		1.21958	0.48578
		0.592446		
	Crude oil export (-1)	2.92E-05	2.1E-05	1.42256
	Crude oil export (-2)	2.80E-05	2.0E-05	1.39534
	Exchange Rate(-1)	0.073149	0.04678	1.56354
	Exchange Rate(-2)	-0.073317	0.03559	-2.06005**
	ECM		2.2E-05	
		5.35E-05		2.45606**
		R^2 = 0.79(8.19) **	801.9228	

Source: Data Analysis 2020.,**indicates significance@ 5% Figures in parenthesis are F. values

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