THE EFFECTS OF OIL AND GAS EXTRACTION ON CASSAVA OUTPUT IN ELEME LOCAL GOVERNMENT AREA OF RIVERS STATE, NIGERIA (1986-2011)

Eche, Emmanuel*

Gisaor, Vincent Iorja*

Enganya Samaila*

Abstract

The research investigated the effects of oil and gas extraction on cassava output in Eleme Local Government Area of Rivers State between 1986 and 2011. An OLS regression equation was employed in conjunction with Augmented Dicker Fuller unit root test, Johansen Cointegration and Vector Autoregressive Model. The results show that in the long run, there is a negative relationship between land input, gas flaring and water pollution and cassava output in Eleme LGA. This result was consistent with our a priori expectation that, continued oil spillage and gas flaring have negative economic consequences on output. Based on such findings, recommendations were made for the operators to use modern technologies of extraction and regular monitoring of oil production activities and facilities to avoid vandalization.

Keywords: Cumulative Effects, Oil and Gas, Cassava output, Cointegration

* Department of Economics, Federal University Wukari - Nigeria

Introduction

According to the World Bank (2007), Nigeria is the world's eleventh largest oil producer. Her oil and gas resources are found in the densely populated Niger Delta wetlands. The region is therefore strategic to national aspirations. The consequences of environmental degradation are quite observed because of the efforts to maximally extract the natural resources especially oil and gas.

Environmental degradation which according to Douglasson (2006) is partly traceable to oil production has resulted into significant environmental challenges and has contributed to social conflict. Government effort to improve economic performance and achieve transition to the green economy may be truncated unless oil revenue required to prosecute reforms and programmes of economic diversification is assured. Since oil revenue remains the main source of national income, it behooves that a just and equitable resolution of the Niger delta conflict is at the heart of Nigeria's transition to the green economy.

Most importantly, the achievement of Vision 20:2020 and MDGs by 2015 may remain a mirage if the present status quo of negligence of other vital sectors of the Nigerian economy due to oil discovery is sustained. This forms the background for this research work whose benefits may not only be to the Eleme community but the entire nation and at the same sustaining efficient and effective oil and gas exploration and extraction activities in the Communities of the Niger Delta.

The specific objectives are to: **(i)** investigate the relationship between oil and gas extraction and agricultural output in Eleme local government area**; (ii)** examine the extent to which oil and gas extraction in Eleme local government has affected agricultural output. The scope will be the effects of oil and gas extraction on cassava output in Eleme Local Government Area of Rivers

State in Nigeria from 1986-2011. Cassava is one of the major staple food crops in this area and the IFAD Cassava Programme started in the region since 1987 with the objectives of replacing the traditional cassava varieties with improved ones and increase its productivity, promote mechanical cassava processing technologies and promote multiplication of yam seed using the yam minisette technique.

Theoretical and Empirical Review

Agriculture and the Nigerian Economy: In the words of Akande (1998), the role of agriculture in transforming both the social and economic framework of an economy cannot be over-emphasized. It is a source of food and raw materials, essential for expansion of employment for poverty reduction and improvement in income distribution, for speeding up industrialization and easing the pressure on balance of payments (Nwankwo, 1981). Nigeria is endowed with huge expanse of fertile agricultural land, rivers, streams, lakes, forests and grassland as well as a large active population that can sustain a highly productive and profitable agricultural sector. This monumental resource base if well harnessed could support a vibrant agricultural sector capable of ensuring self-sufficiency in food production, raw materials for the industrial sector gainful employment and balance of payments equilibrium.

In spite of the importance of agriculture as a whole, the methods of production remained highly primitive. This has resulted to diminishing productivity of the sector. The existence of these methods is attributable to the activities of the colonial masters who made no attempt to alter the production technology (Anyanwu, et al 1997). According to Anyanwu (1993), since independence, the role of agriculture in the economy has been on a downward trend especially its contribution to Gross Domestic Product (GDP). Its share to GDP fell from 61.50% in 1963/1964 to 14.63% in 1983. This situation has been partly due to the emergence of oil as an important commodity and partly to the poor performance of the agricultural sector.

During the period of 1970-1980, agricultural sector output remained on the decline before an upward swing of 41.2% was witnessed in 1986-1990 following the introduction of Structural Adjustment Programme (SAP) in 1986. Irregularities of SAP negatively pushed the sector to slump to 10% in 1998 (CBN, 2000). This declining situation contrast with Lewis' (1954) theory of development (the Rent-for-Surplus model) in which a limited highly skilled agriculture labour force sustains the sectors output while releasing the surplus to the industrial and service sectors. It further points to the failure of Nigeria to modernize her agricultural sector through skilled labour.

However, since the inception of democratic government in Nigeria in 1999, the contributions of agriculture to GDP has remained on the high side with a contribution of 41.8% to the GDP in 2009 and over 40% to the GDP in the 1st quarter report of 2010 of the National Bureau of Statistics (NBS, 2010). Thus, agriculture currently contributes more to the GDP of Nigeria but less in terms of foreign exchange and budgetary provisions. The oil sector contributes about 95% of Nigeria's foreign exchange earnings and 65% of budgetary earnings.

The impact of increased agricultural production established above is yet to be felt by the majority of Nigerians as there are still perennial food shortages across the country and indeed the globe. This calls for critical evaluation and re-evaluation of agricultural policies in Nigeria that remains the only key through which the country can achieve the much talked about economic diversification.

Oil and the Nigerian Economy: Right from the creation of Nigeria in 1914 until the end of colonialism in 1960, and until the end of the first decade after independence, Nigerian economy was agro-based. Agriculture was the mainstay of the economy. Robinson (1996) wrote that 'during the colonial period (1914-1959), Nigeria was exploited for its agricultural products. The main agricultural products were cocoa (produced in the West), groundnut and cotton (produced in the North) and palm oil (produced in the East, which includes the Niger Delta region). However, oil extraction began in Nigeria in 1956, but it did not play any significant role in the Nigerian economy until the early 1970s (Robinson, 1996).

According to Robinson, *"in the early 1960s, revenue from oil accounted for less than 10 percent of Nigeria's revenue base*". For example, in 1963 and 1964 oil revenue was only 4.1 per cent and 5.9 per cent respectively, of the total revenue of the country (Graf, 1988 and Robinson, 1996). So on the contrary, the bulk of the country's revenue during this period was from agriculture (Douglasson, 2006), and more than 70 per cent of the people employed in this sector (Robinson, 1996). However, from the early 1970s, the yield of oil began to increase and the dominance of agriculture in the country's economy began to decline. As a further demonstration of this importance, there is evidence to indicate that crude oil sales income as a percentage of foreign-exchange earnings escalated from 2.5 per cent of all such revenue to 58.1 per cent in 1970, to 93.6 percent in 1975, and to 98 per cent and more through the first half of the 1980s (Graf, 1988). This trend has continued ever since. For instance, in 1997 oil revenue constituted 88 percent of the federal government's foreign exchange earnings as shown in 1998 Budget, and 83.5 per cent of the total gross revenue for the year 2000, which shows that Nigeria earned N1.59 trillion from oil (The Guardian, 5 July 2001).

The question now is whether the federal government has plans to mitigate the huge environmental, ecological and social impacts caused by oil exploration and exploitation in the Niger Delta region, and whether this huge revenue accruing from oil is being utilized to better the living conditions of the inhabitants of this region particularly their food requirements.

GAPSIM Model: GAPSIM is an acronym for a Systemic Dynamic Simulation Model (GAPSIM) which derived its name from the Southeastern Anatolian Project (GAP). The Model was designed to address the potential long-term environmental problems of the Southeastern Anatolian Project (GAP) on agricultural output in Southeastern Turkey by Saysel et al (1999). It was designed to analyze issues related to water resources, land use, land degradation, agricultural production, pollution and demography as they affect the people's economy from a systems perspective. The analysis focuses on the totality of environmental, social and economic consequences on the economy of the people.

It belongs to the class of econometric input-output models and neoclassical approaches assuming bounded rationality. The models appear in the literature in two variants, empirically and theory based. Variables in the model can as well be adjusted to suite the purpose for which the model is applied. In this work therefore, the model will be adjusted to include both the environmental, climatic and human factors influencing agricultural output in Eleme.

Empirical Literature: Nwilo and Badejo (2005) wrote on oil spill problems and management in the Niger Delta using descriptive statistics. The study identified oil spill as one of the major environmental challenges in the region which has affected their livelihood in all ramifications. The study recommended the need to create serious awareness among the populace on the implications of oil spill incidents on the environment. Also, the need for the government to assist the host communities in claiming their right of compensation was buttressed.

Douglasson (2006) examined the effect of oil spillage on crop yield and farm income in Delta State using a multiple regression models to estimate both crop yields and profit and Test of Differences of Means. The study revealed that oil spillage has caused severe reduction in crop yield thereby, reducing farmers' income and profit. The study recommended the enactment and enforcement of stringent environmental laws to protect the area as well as implementation of policies to reduce the crushing level of poverty and guarantee a better livelihood for the people.

Opurika and Ibada (2008) wrote on oil induced environmental degradation and internal population displacement in the Niger Delta using descriptive statistics like tables and charts. They concluded that oil related environmental problems-oil spillages, gas flaring among others, have diminished the productivity of oil producing communities, resulting to occupational and income losses that set in both voluntary and involuntary migration. The paper draws attention to the urgent need to resolve environmental degradation issues in the Niger Delta.

Emoyan, Akpoborie and Akporhonor (2008) wrote on oil and gas industry and the Niger Delta: implications for the environment using only descriptive statistics. They contended that the negative impact of oil and gas industry on the region include; environmental pollution, biodiversity depletion, social and destabilization, underdevelopment of host communities, global warming and other associated elevated flood risk. They recommended for genuine stakeholders participation in environmental and developmental issues in the region.

Abii and Nwosu (2009) examined the effects of oil spillage on the soil of Eleme in Rivers State where ten soil samples were randomly collected at depth of 0-15cm and appropriate laboratory test conducted. The soil samples were excessively acidic which can be ascribed to the effect of oil spills. The study recommended regular monitoring of oil production activities and adequate compensation to the host communities.

Sekumade (2009) studied the effects of petroleum dependency on agricultural trade in Nigeria between 1970 and 2003 using the error correction modeling. The result shows that oil production has an inverse relationship with the output of agricultural exports crops in Nigeria. The major recommendation was for the government to address the overdependence of the Nigerian economy on oil at the expense of other sectors particularly agriculture.

Wokocha, Emeodu and Ihenko (2011) researched on the impact of crude oil spillage on soil and food production in Rivers State. The questionnaires were distributed to one hundred and twenty (120) respondents randomly selected from three communities in the area. The findings show that oil spillage has a negative effect on the physical, chemical and biological properties of the soil and also create a negative impact resulting in low food production as it reduces nutrients availability in the soil through increased soil acidity and toxicity of crude oil fraction which affects both crops and fishery resources.

From the foregoing, it is abundantly clear that no researcher has assessed the impact of oil and gas extraction on cassava or the totality of agricultural output of the people of Eleme. This work intends to fill this research and theoretical gap.

Methodology

The study used only secondary time series data on cassava input planted and output harvested by farmers in Eleme community. It also made use of data on oil spillage, water pollution and gas flaring as environmental factors while data on amount of rainfall in Eleme was used as an index of weather conditions. All these secondary sources of data were obtained from the State Ministries of Agriculture, Waters Resources and Environment in Rivers State.

Simple multiple regression analysis via e-views 7.0 statistical program was used to establish the relationship between oil and gas extraction and agricultural output. The overall effect of the relationship between dependent and independent variables in the model was captured by the coefficient of multiple determination (R^2) while the Durbin –Watson statistic tested for serial correlation.

Before then, the researcher employed the Augmented Dicker Fuller Unit Root Test for stationarity of the variables. The Johansen Cointegration test was used to ascertain the long run relationship amongst the variables in the model. The Vector Autoregression (VAR) estimate was used to capture both the short run and long run dynamic adjustments in the model.

Specification of the model: The explicit form of the model was given as:

$$\mathbf{A_Q = \beta_1 + \beta_2 O_s + \beta_3 W_p + \beta_4 G_F + \beta_5 C_s + \beta_6 R_c + \beta_7 A_L + E_{it}} \ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where: A_Q = Cassava Output in Eleme (measured in tones), O_S = Oil Spillage in Eleme (measured in quantity of barrels), W_P = Water Pollution (tones of water polluted from oil spillages), G_F = Gas flared (measured in billion cubic meters), C_s = Cassava Seed planted (measured in tones), Rc = Rainfall as an index of weather (measured in millimeters), A_L = Area of Cassava cultivation (hectares), while ε_{it} is the error term accounting for the effect of other variables not explicitly captured in the model.

On *a priori* expectation, cassava seed as input (C_s) and land cultivated in hectares (A_L) were expected to be positively related to the dependent variable cassava output. Rainfall (R_c) was expected to produce either positive or negative sign depending on how much rain was available during the farming season. Oil spillage (O_S), Water pollution (W_P,) and gas flaring (G_F) were expected to be negatively related to cassava output in Eleme. All the variables were used in their log form.

Data Analysis

Table 4.1: ADF Unit Root Test (1986-2011)

Variables	ADF Values at level	Mackinnon Critical value @ 5%	Order of Integration
DA_Q	-7.242500	-2.991878	1(0)
DO_s	-5.260568	-2.998064	1(1)
DW_P	-7.236955	-2.998064	1(1)
DG_F	-4.829484	-2.991878	1(0)
DC_s	-7.667892	-2.991878	1(0)
DR_c	-5.611112	-2.991878	1(0)
DA_L	-4.711196	-2.986225	1(0)

Source: Computed by the Author, 2013.

The result of the ADF shows that the log of gas flared, seed input, rainfall and land input are stationary at levels. The log of oil spillage and water pollution however shows evidence that they are integrated of order one (1). This clearly violated the stochastic assumptions of the OLS and hence more superior and dynamic model of analysis was employed. Since the ADF test for the period has shown that two of the series are integrated, there is the need to check for long run convergence to a unique equilibrium by all the integrated series.

The Johansen Cointegration test was conducted and the result is presented in both tables 4.2, 4.3 and 4.4 respectively.

Table 4.2: Johansen Cointegration Test (Trace Test)

Variable	Eigen Value	Trace statistics	5% critical value	Hypothesised no. of CE(s)	Prob**
A_Q	0.929327	161.8354	125.6145	None*	0.0001
A_L	0.835662	101.4188	95.75366	At most 1*	0.0192
C_S	0.617521	58.09351	69.81889	At most 2	0.2985
G_F	0.581961	35.02754	47.85613	At most 3	0.4466
O_S	0324393	14.09522	29.79707	At most 4	0.8352
R_C	0.177247	4.683782	15.49471	At most 5	0.8414
W_P	5.84E-05	0.001401	3.841466	At most 6	0.0.9687

*Trace test indicates 2 cointegrating equations at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level; ** Mackinnon-Hang-Michelis (1999) P-values*

Source: Computed by the Author, 2013

Looking at Table 4.2, the trace statistics as compared to the critical value at 5% level of significance, the in- built hypothesis of no cointegrating or the existence of at most one cointegrating vector is rejected. The result shows that there are two (2) cointegrating equations (vectors) in the set of normalized cointegrating vectors.

Table 4.3: Johansen Cointegration Test (Max- Eigen Value)

Variable	Eigen Value	Max- Eigen statistics	5% critical value	Hypothesised no. of CE(s)	Prob**
A_Q	0.919327	60.41658	46.23142	None*	0.0009
A_L	0.835662	43.32531	40.07757	At most 1*	0.0208
C_S	0.617521	23.06597	33.87687	At most 2	0.5254
G_F	0.581961	20.93232	17.58434	At most 3	0.2803
O_S	0324393	9.411435	21.13162	At most 4	0.7979
R_C	0.177247	4.682380	14.26460	At most 5	0.7813
W_P	5.84E-05	0.001401	3.841466	At most 6	0.9687

*Max- Eigen value test indicates 2 cointegrating equations at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level*
*** Mackinnon-Hang-Michelis (1999) P-values*
Source: Computed by the Author, 2013

The result of table 4.3 shows that Maximum Eigen test as compared to the critical value at 5% level of significance shows that there are two (2) cointegrating equations and the value is at par with the trace test. The test thus revealed the existence of equilibrium condition that keeps the variables in proportion to each other in the long run.

A normalization of the model has produced the results presented in table 4.4. This can be interpreted as the long run relationship between oil and gas extraction and cassava output in Eleme Local Government Area.

Table 4.4 Normalising the Model (*standard errors in parentheses*)

A_Q	A_L	C_S	G_F	O_S	R_C	W_P
1.0000	-0.383 (0.116)	5.462 (0.681)	-83.354 (29.646)	0.0058 (0.0008)	-7300.5 (550.45)	-626.94 (27.121)

Source: Computed by the Author, 2013.

Analysis of table 4.4 shows that even in the long run, there is a negative relationship between land input, gas flaring, and water pollution and cassava output in Eleme. Oil spillage was not negative but statistically significant hence the need to control both oil spillage and gas flaring in our economy to avert the consequences of a continued declining production. Since the ADF test violated the stochastic assumptions of the OLS, this necessitated the use of VAR estimate to capture both the short run and long run dynamic adjustments in the model.

Table 4.5: Vector Autoregression Estimates (1986-2011)

Variable	Coefficient	Std. Error	t-statistics
A_L (1)	-0.032254	0.23982	-0.13479
A_L (-2)	-0.543987	0.29909	-1.81879
C_S (-1)	-0.818369	1.54094	0.27002
C_S (-2)	0.493068	1.82601	2.04245
G_F (-1)	-0.000337	0.00219	-0.20470
G_F (-2)	-18.40411	89.9098	-0.70697
O_S (-1)	-25.04772	35.4296	-0.15396
O_S (-2)	0.002984	0.00355	0.84125
R_C (-1)	0.846314	0.37835	2.23683
R_C (-2)	-0.319176	0.53249	-0.59940
W_P (-1)	0.003252	0.00187	1.74255
W_P (-2)	-0.000985	0.00189	-0.52113
ECM	-54.86899	-54.3224	0.94079
R-squared	0.899223	Adj R-Squared	0.742459
F-statistic	5.736167		

Just like the Error Correction model, the overparameterised models are reparameterised through a process of continuous stepwise reduction of relatively insignificant parameters in the model. The extent to which any previous disequilibrium in the model is adjusted for in the current year is captured by the coefficient of the error correction.

The coefficient of error correction (ECM) in this model carries the correct sign and it also statistically significant at 5% level of confidence, with the speed of equilibrium of 55%. The value implies that 55% of any previous disequilibrium in the model is adjusted for in the following year. This means that the model has high adjustment potentials to endogenous policy variables.

The R^2 and adjusted R^2 are very high, 89% and 74% respectively. This is no doubt a good fit just like the case with the static model. The Vector Autoregression estimates does not indicate the Durbin-Watson statistic but from the table of significance using N-K and K-1 degrees of freedom (24-2) and (2-1) = 22 and 1, the Durbin Watson shows positive autocorrelation but too far from the normal bound of 1.73.

The result of the vector autoregression shows that the coefficient of the one-year lagged value of land input is negatively related to cassava output. A two-year lagged value of land input is also negatively related to cassava output in Eleme. By implication, the continued gas flared, pollution and oil spillage has affected the productive capacity of land in Eleme. This land requires special intervention for it to be suitable for agricultural activities.

A one-year lagged value of seed input is negatively related to cassava output while a two year lagged value of the seed input is positively related to cassava output. Both a one year and two year lagged values of gas flared is negatively related to the dependent variable. This is consistent with a priori expectation and the findings of Nwilo and Badejo (2005) and Abii and Nwosu (2009) that gas flared and oil spillage are the major causes of poor agricultural production in Eleme. The two year lagged value indicate that even in the long run, gas flared would negatively affect cassava output hence the need to regulate it now in the short run to avoid the anticipated consequences.

A one year lagged value of oil spillage is negatively related to the dependent variable and is also consistent to our a priori expectation. The two year lagged value is however positively related to the dependent variable but is not significant at 5% level of confidence. A one year lagged value of rainfall is positively related to the dependent variable but a two year lagged value is negative. The policy implication is, if other factors are not well regulated, rainfall alone would not change the fate of agricultural output in Eleme Local Government Area. A one-year lagged value of water pollution is positive while a two year lagged value is negative. It implies excessive oil spillage and gas flared would in the long run contaminate the water bodies, rendering them useless for agricultural activities.

Conclusion and Recommendations

It can be concluded that, in the long run, there is a negative relationship between land input, gas flaring, and water pollution and cassava output in Eleme. Oil spillage was not negative but statistically significant hence the need to control both oil spillage and gas flaring in our economy to avert the consequences of a continued declining production. Recommendations made include:

(a). the federal government as a matter of urgency, compel the oil multinationals to adhere to standard operational procedures for oil exploration and exploitation.

(b). modern technologies of extraction should be adopted by operating companies to reduce the negative impacts of their activities on the people and environment.

(c). communities should be properly informed and educated about any oil spills or any other ecological damage to avoid human disaster.

(e). adequate compensation should be paid to the host and affected communities.

(f). the entire Niger Delta should be declared an ecological disaster area that is desirous of special attention and special rehabilitation measures.

(g). the federal government should step up her campaign against pipelines vanderlization and also prosecute all people caught in this criminal act.

REFERENCES

Abii, T. A. and Nwosu, P. C. (2009) The Effects of Oil Spillage on Soil of Eleme in Rivers State; Journal of Environment and Science Vol 3 pp 316-320

Akande, E. (1998). "*Estimate of the Elasticities of Supply of Selected Agricultural Commodities";* Journal of Farm Economics Vol. 33 PP. 202-208.

Anyanwu, J. C. (1993). *Monetary Economics; Theory, Policy and Institutions*. Hybrid Publishers Limited Onitsha

Anyanwu, J. C. et al (1997). *The Structure of the Nigerian Economy* (1960-1997); Joanne Educational Publishers; Onitsha.

Asuquo, F. E. ed (1995) Trace Metals in Crude Oils and Beach Tar Balls From Nigerian Coastline; Indian Journal of Marine Sciences. 74 16-18

CBN (2000). "*The Changing Structure of the Nigerian Economy": Implications for Development.* A CBN Publication; Realm Communications Limited, Lagos.

Douglasson, G. O. (2006) The Effects of Oil Spillage on Crop Yield and Farm Income in Delta State, Nigeria; Journal Central European Agriculture. Vol 7 No 1 pp41-48

Graf, W, (1988). The Nigerian State: Political Economy, State, Class and Political System in Post-Colonial Era (London: James Curry).

Guardian, (2001). The Guardian Newspaper of 5 July 2001.

National Bureau of Statistics (2010) 2nd Quarter Report, 2010

Nwankwo, K. (1981) "Choice and Change in Indigenous Agricultural production" Journal of Farm Economics. Benin-City, PP. 107-128.

Nwilo, P.C. and Badejo, O. T. (2005): Oil Spill Problems and Management in the Niger Delta. International Oil Spill Conference; Miami, Florida, USA.

Opurika, C. O. and Ibaba S. I. (2008) Oil Induced Environmental Degradation and Internal Population Displacement in the Niger Delta: Journal of Sustainable Development in Africa Vol. 10 No 1 pp173-193

Omoyan, O. O., Akpoborie, I. A. and Akporhonor, E. E. (2008) The Oil and Gas Industry and the Niger Delta: Implication for the Environment; Journal of Applied Science, Environment and Management. Vol 12 No 3 pp 29-37

Robinson, D., (1996). Ogoni: The Struggle Continues Geneva: World Council of Churches, 1996.

Saysel, A. K. (1999). Dynamic Simulation Model for Long Term: Comprehensive Environmental Analysis of GAP. Ph.D. Thesis, Bogazici University, Istanbul, Turkey, 257 pp.

Sekumade, A. B. (2009) The Effects of Petroleum Dependency Economy on Agricultural Trade in Nigeria: An Error Correction Modeling Approach. Scientific Research and Essays. Vol 4(11) pp 1385-1391

Wokocha, G. A.; Emeodu, D.; Ihenko, S (2011). Impact of Crude Oil Spillage on Soil and Food Production in Rivers State, Nigeria. Journal of Money, Investment and Banking 19(1):29-34

World Bank (2007) The World Bank Development Report: World Bank, Washington DC.