Determinants of output of agricultural commodities in Nigeria

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Abstract: Agriculture has been the backbone of the economy in Nigeria providing employment and source of livelihood for the increasing population and accounting for over half of the GDP of the economy at independence in 1960. However, the role it plays in the regional and economic development of the country has diminished over the years due to the dominant role of the crude oil sector in the economy. With the increasing food demand in Nigeria, the country has available input, natural resources and potential for increasing the volume of crop production towards meeting the food and nutritional requirement of the rapidly increasing population and guarantee food security in the country. This study was undertaken to analyse the effects of different factors and policies determining the volume of agricultural crop production in Nigeria between 1970 and 2008. This study estimated the production function and regress output of agricultural commodities on the independent variables. The results show that price of agricultural commodities, agricultural land and value of agricultural loan are positive and significantly related to output of agricultural commodities. While the relationship between average total rainfall and output of agricultural commodities was counter-intuitive, that is, a negative, significant relationship exists between average total rainfall and output of agricultural commodities. The study, therefore, recommends that there should be unlimited access to markets and sourcing of production inputs.

Keywords: Average total rainfall, output, agricultural commodity

INTRODUCTION

Agriculture has been the mainstay of the economy in Nigeria and many of the African countries, providing employment and source of livelihood for their increasing population. The history of agriculture in Nigeria is intertwined with the political history of the country and can be assessed from the pre-colonial, colonial and post-colonial periods. The pre-colonial society in the country strived on agriculture as the mainstay of the traditional economy and the period of the colonial administration brought a great impact on agricultural development with emphasis placed on research and extension services (Nwa, 2003). In the colonial era, agriculture was regarded as the backbone of the economy with most of the foreign exchanged earnings at the time derived from export of agricultural products. At independence in 1960, it accounted for over half of the GDP of the country’s economy and was the main source of export earnings and public revenue before the emergence of the oil sector and exploration of crude oil began in the country. However, studies on the linkage between agricultural commodities and its determinants are scanty in Nigeria. This present study therefore bridges this gap by examining the factors that determines agricultural output in Nigeria.

With agriculture as an occupation accounting for more than 60 percent of the total labour force of Nigeria’s working population providing both formal and informal employment in
which about 38 percent are females (Balogun, 2000); its role in the economic and regional development of the country is of significant importance. The total cultivable land in the country is estimated at 61 million hectares, which represent about 66 percent of the total area of the country (Aquasat, 2005), relating to adequate availability of land resources for agricultural production coupled with the availability of human labour resources.

However, the agricultural sector has suffered a relative decline in the preceding years after independence due to the dominance of oil sector in the economy and in the GDP aggregate share but the sector still accounts for about 33 percent of the GDP (Aigbokhan, 2001). While agriculture holds immense potential for enhancing and stabilizing the country’s foreign exchange earnings and guaranteeing food security in the country, the past three decades have witnessed a steady decline in this role. Nigeria, which was once a large net agricultural produce exporter now imports food and attempts to revive the agricultural sector as a dominant sector, have been unsuccessful. With the increasing human population in the country and increase in demand for food, there are challenges for the development of the sector by boosting and increasing the volume of food production towards meeting the increase in food demand and guarantee food security in the country without reliance on external food imports. This can come through the development of the water and land resources which are major inputs in the agricultural production process and annexing the surplus and under-utilised human labour resources from the increasing population growth, available in the country. However, these steps must be taken without compromising the sustainability of the industry and environmental resources including water and land resources which are vital inputs in the production process.

In the economic and national development of Nigeria, agriculture is expected to provide adequate supply of food to the people, produce a high level of agricultural raw materials for the industries and also generate employment for the people and a high level of returns to the farmers. However, despite evidence of availability of natural resource inputs including land and water and ample supply of human labour force which are the principal agricultural inputs, different problems have been confronting the sector over the years and one of such is the inconsistent government policies which have been described as a fatal perturbation that had rocked the boat of food security in Nigeria (Okuneye, 2002). Other problems identified include the socio-economic characteristics of the farmers, poor infrastructural facilities, credit facility problem, agricultural inputs and land tenure problems, all of which interact in a synergy, resulting in low production, high prices of food items, inflation, underdevelopment and concomitant poverty.

The aim of the study is to examine the factors that determine the output of agricultural commodities in Nigeria and the connections that exist between agricultural output and the independent variables.

The challenges of ensuring food security in Nigeria and meeting the millennium development goals (MDGs) and reduction in the poverty level in the country is hinged on the revitalization of the agricultural sector in the country based on the role the sector is playing through provision of jobs for majority of the labour force. However, while the sector has been adjudged to be performing very low in the preceding times after independence, there has been different studies to identify the problems confronting the sector as well as the effect of different policies on the sector Balogun, 2000; Aigbokan, 2001 and Akande, 2006).
Agricultural practices themselves have often added to the water shortage problem in Africa more than anywhere else due to differences in property rights. More precisely, because farmers are often not owners of the land they work on, the preservation of natural resources is generally viewed as a secondary objective. In addition, pressures represented by increasing populations and changing technology add to the problem of land deterioration related to agricultural practices, see for example Drechsel et al. (2001). Besides, problems associated with land use through, for example, deforestation, can translate into increased erosion. Another illustration of environment-damaging agricultural practices is the intense use of fertilizer in low-quality lands. As yields increase, so will water consumption, thus creating a vicious circle, see Gommes and Petrassi (1996).

Thus, it is expected of this study to contribute to an increased understanding of the development of agricultural commodities in relation to its determinants. It also adds to the existing literature on the increased knowledge of the potentials available for increased crop production and success in the agricultural sector in the country through their development.

This study therefore, focuses on the determinants of output of agricultural commodities in Nigeria. Quantitative techniques would be adopted, the study span through 1970 to 2008. The rest of the project is organized into four sections. The second section specifically reviews the relevant literature that is germane to the study. The methodology and data sources are devoted to section three. The interpretation of the empirical results will be the focus of section four. Section five articulates the summary, conclusion and policy implication of the study.

The literature is replete with varied categorization of agricultural productivity and factor inputs in terms of their definitions, measurement and linkages. Productivity measures the relationship between the quantity and quality of goods and services produced (agricultural output) and the quantity of resources needed to produce them (i.e. factor inputs such as labour, capital and technology). (Frisvold & Ingram, 1995; Okojie, 1995)

The relationship between the dependent variable (output of Agricultural commodities) and the independent variables (Price of Agricultural commodities, Average total Rainfall, Agricultural Land (cultivable) and Value of agricultural loan), is a one way relationship that was explained by the classical economists, that is, the classical growth theory, as reflected in aggregate production (mostly a variant of Cobb-Douglas function) derived essentially from the technical relations that make the level of output a function of production inputs (Shepherd, 1970). It is on this premise that classical model (Cobb-Douglas function) would be adopted as a framework in this study which will reflect better in the methodology.

Nigeria as a whole is well endowed with both natural and physical resources. The country is well drained with a reasonably close network of rivers and streams. Some of these rivers, particularly the smaller ones, are, however seasonal, especially in the northern parts of the country where the rainy season is only three or four months in duration. In addition, there are natural water bodies like lakes, ponds as well as lagoons, particularly in the coastal areas. Ayanwale et al., (2006) examined that the problems of water resources management in Nigeria arise from inadequate planning and management of the water resources and poor distribution of water in time and space in relation to man’s needs.

According to Balogun, (2000) high proportion of cash crop production takes place in...
the tropical rain forest located mostly in the western region of the country where the soils are very rich in humus with a high percentage of soil fertility. Mitsch and Gosselink, (1993) also discovered that 3.5 percent of the cultivable landmass are wetlands and this plays a vital role (in their function) to the human society and the ecology of the watershed through atmospheric maintenance as wetlands stores carbons within their plants communities and soil instead of releasing it to the atmosphere as carbon dioxide and thus helping to moderate global climatic conditions.

Mugera and Ojede (2011) also tests for efficiency catch-up in the agricultural productivity of 33 African countries from 1966 to 2001. They used recent advances in data envelopment analysis (DEA) to generate standard and bootstrap bias corrected technical efficiency scores. In general, they found no evidence of efficiency catching-up. Their results indicated that technical inefficiencies do exist in African agriculture. The overall average efficiency score is 0.745 and 0.526 for the standard and bias corrected scores and the mean 95 percent confidence band ranges from 0.537 to 0.734.

DATA SOURCES AND THE MODEL

Data Sources

Data covering the Sample period (1970-2008) were culled from secondary sources, mostly time series and aggregated data. The central Bank of Nigeria (CBN) Annual statistical Bulletin, World Development Indicator (WDI) of the World Bank, Food and Agricultural Organisation Statistics (FAOSTAT) of the United Nations and Federal Office of Statistics (FOS) and Industry Survey for various years were also used.

The link between agricultural development and economic growth has a significant role to play in the transformation and structuring of the economy of Nigeria and other economies where the majority of the labour force is primarily dependent on agriculture.

The Model

The Model in this study will follow the approach of production Analysis and estimate directly the production function of output of Agricultural commodities on the independent variables.

Output of Agricultural commodities is the dependent variable, while price of agricultural commodities, average total rainfall, agricultural land and value of agricultural loan are the independent variables. The independent variables will help in determining the output of agricultural commodities and its contribution to the Nigerian economy. The functional form of the model can then be written thus:

\[ QAC = f(PAC, ATR, AGL, VAL) \]  

In an econometric form;

\[ QAC = \alpha_0 + \alpha_1 PAC + \alpha_2 ATR + \alpha_3 AGL + \alpha_4 VAL + \mu \]  

1

\[ QAC = \alpha_0 PAC^{\alpha_1} ATR^{\alpha_2} AGL^{\alpha_3} VAL^{\alpha_4} \mu \]  

The equation is estimated by ordinary least square (OLS) technique by taking logarithm on both sides.

1The aggregations of the variables used in this study are obtained from Food and Agricultural Organization Statistics (FAOSTAT) of the United Nations on line data base.
\[ \ln Q = \alpha_0 + \alpha_1 \ln P + \alpha_2 \ln A + \alpha_3 \ln G + \alpha_4 \ln V + \mu + \epsilon \]  
(4)

Where Q, P, A, G, V and \( \mu \) are as define above. The advantage of Cobb-Douglas in functional form is that it is convenient to estimate, because it is linear in parameters.

All our agricultural data are taken from the FAO online database. For a measure of output of agricultural commodities and price of agricultural commodities we use the FAO net production index, where net production quantities of each commodity are weighted by the 1989-91 average international commodity prices and summed for each year, and the aggregate for a given year is divided by the average aggregate for the base period 1989-91. In order to proxy agricultural land input, in the production function, we use FAO’s measure of agricultural area, which includes arable land and the area used for permanent crops and permanent pastures, while value of agricultural loan and average total rainfall are obtained from the same source.

These data have been used in previous studies of agricultural productivity in SSA countries (Alene 2010, Fulginiti et al, 2004).

RESULTS PRESENTATION

This section deals with the presentation, interpretation and analysis of the results. Econometric theory requires all variables to be stationary if regressions are to be realistic (non-spurious). Null Hypothesis of non stationary is consistently rejected for all variables across years when variables are expressed in first differences. We shall consider the results on a priori criterion before attempting other statistical test results like the test for stationary, co integration and ordinary least square regression (OLS).

With the existence of a unit root in the log spot rates series, we test for the presence of a single unit root using the method of Dickey and Fuller (1981). This test is important since, as rooted by Diebold and Nerlove (1986), the Dickey-Fuller tests are robust to most Batteries of econometrics tests.

A time series approach will also be adopted in order to avoid potentially spurious results emanating from the non-stationarity of the data series and to analyse the short-run dynamic structure of the relationships. Engle and Granger (1987) suggest a two-step approach. First, the existence of a co integrating relationship among the variables in the equations is determined by standard co-integration techniques. If the variables are co-integrated, stable long-run relationships can be estimated using standard ordinary least squares (OLS) techniques. All these tests and estimations were carried out and interpreted accordingly.

Unit Root Test Result

For a guide to an appropriate specification of the regression equation, the characteristic of the time series data used for estimation of the model were examined to avoid spurious regression. We begin by determining the underlying properties of the process that generate our time series variables, that is, whether the variables in our model were stationary or non stationary. Macroeconomic data often appear to possess stochastic trends that can be removed by differentiating the variables. We therefore employ the Augmented Dickey-fuller (ADF) to test the order of integration of the variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>T-Statistic</th>
<th>1% Critical Value</th>
<th>5% Critical Value</th>
<th>Order of Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>LnQAC</td>
<td>-5.621093</td>
<td>-3.6394</td>
<td>-2.9511</td>
<td>I(1)</td>
</tr>
<tr>
<td>LnPAC</td>
<td>-5.216496</td>
<td>-3.6394</td>
<td>-2.9511</td>
<td>I(1)</td>
</tr>
<tr>
<td>LnATR</td>
<td>-7.255541</td>
<td>-3.6394</td>
<td>-2.9511</td>
<td>I(1)</td>
</tr>
<tr>
<td>LnAGL</td>
<td>-3.471790</td>
<td>-3.6394</td>
<td>-2.9511</td>
<td>I(1)</td>
</tr>
<tr>
<td>LnVAL</td>
<td>-4.546590</td>
<td>-3.6394</td>
<td>-2.9511</td>
<td>I(1)</td>
</tr>
</tbody>
</table>

Source: Authors’ computation using E-views 7.1
The result above in Table 1 shows that output of agricultural commodities, price of agricultural commodities, average total Rainfall, Agricultural land (cultivable) and Value of Agricultural loan are stationary at first difference, that is, the variables are integrated of order one (i.e. I(1) series). This is deducted from the fact that for the levels of variables; the absolute values of the Augmented Dickey-Fuller (ADF) are less than the critical values of the ADF at 5% level of significance.

**Table 2: Johansen Co integration Test Result**

<table>
<thead>
<tr>
<th>Trace Test K = 2</th>
<th>Maximum Eigen Value Test K = 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ho r ≤ 0 r &gt; 0</td>
<td>Ho r ≤ 0 r &gt; 0</td>
</tr>
<tr>
<td>A trace 72.95</td>
<td>A trace 39.8486</td>
</tr>
<tr>
<td>Critical Values</td>
<td>Critical Values</td>
</tr>
<tr>
<td>5% 68.52</td>
<td>1% 68.52</td>
</tr>
<tr>
<td>76.07</td>
<td>54.46</td>
</tr>
<tr>
<td>r ≤ 1 r &gt; 1</td>
<td>r ≤ 1 r &gt; 1</td>
</tr>
<tr>
<td>40.85</td>
<td>31.1068</td>
</tr>
<tr>
<td>47.21</td>
<td>33.46</td>
</tr>
<tr>
<td>54.46</td>
<td>38.77</td>
</tr>
<tr>
<td>r ≤ 2 r &gt; 2</td>
<td>r ≤ 2 r &gt; 2</td>
</tr>
<tr>
<td>20.06</td>
<td>26.5597</td>
</tr>
<tr>
<td>29.68</td>
<td>27.07</td>
</tr>
<tr>
<td>35.65</td>
<td>32.24</td>
</tr>
<tr>
<td>r ≤ 3 r &gt; 3</td>
<td>r ≤ 3 r &gt; 3</td>
</tr>
<tr>
<td>5.48</td>
<td>23.5065</td>
</tr>
<tr>
<td>15.41</td>
<td>20.97</td>
</tr>
<tr>
<td>20.04</td>
<td>25.52</td>
</tr>
<tr>
<td>r ≤ 4 r &gt; 4</td>
<td>r ≤ 4 r &gt; 4</td>
</tr>
<tr>
<td>0.62</td>
<td>17.3213</td>
</tr>
<tr>
<td>3.76</td>
<td>14.07</td>
</tr>
<tr>
<td>6.65</td>
<td>18.63</td>
</tr>
<tr>
<td>r ≤ 5 r &gt; 5</td>
<td>r ≤ 5 r &gt; 5</td>
</tr>
<tr>
<td>0.59</td>
<td>4.3587</td>
</tr>
<tr>
<td>3.58</td>
<td>3.76</td>
</tr>
<tr>
<td>5.79</td>
<td>6.65</td>
</tr>
</tbody>
</table>

**Source:** Authors’ computation using E-views 7.1

**Notes:** r represent number of co-integrating equation and k represent the number of lags in the unrestricted co-integration test. *r<sup>(x%)</sup>* denotes rejection of the hypothesis at the 5% (1%) level.

From the results obtained in Table 2, using the Johansen procedure, the null hypothesis of zero co integrating vectors is rejected by both the trace and max-eigen value statistics. The trace statistic shows six co integrating equations at the 5% level and five co integrating equation at the 1% level. While the maximal eigen value test suggest one co integrating equations at the 5% level and indicates no co integration at the 1% level. Hence, it can be concluded that there is a unique co integrating relationship between the variables at 5% significance level, which suggests that there is a long run relationship between the examined variables.

Table 2 above reveals that the null hypothesis of no co integration relationship among variables were rejected, and this shows that there is a long run equilibrium relationship between output of agricultural commodities and its explanatory variables.

**Table 3: Ordinary Least Square (OLS) Result**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>6.23589</td>
<td>1.96214</td>
<td>-3.178109</td>
<td>0.00033</td>
</tr>
<tr>
<td>PAL</td>
<td>0.53740</td>
<td>1.213445</td>
<td>8.683872</td>
<td>0.0000</td>
</tr>
<tr>
<td>ATR</td>
<td>-0.43943</td>
<td>13.27349</td>
<td>-2.519265</td>
<td>0.0171</td>
</tr>
<tr>
<td>AGL</td>
<td>0.953960</td>
<td>0.277703</td>
<td>3.435180</td>
<td>0.0017</td>
</tr>
<tr>
<td>VAL</td>
<td>0.004291</td>
<td>0.003793</td>
<td>1.131222</td>
<td>0.2666</td>
</tr>
</tbody>
</table>

**Source:** Authors’ computation using E-views 7.1

R<sup>2</sup>=0.834320 Adj. R<sup>2</sup>=0.812942 F-Statistics = 39.02703

Prob. (F-Statistic) =0.00000

Durbin Watson=2.134101

Table 3 above shows that price of agricultural commodities; Agricultural land (cultivable) and value of agricultural loan are positively related to output of agricultural commodities.
commodities. However, a negative but significant relationship exists between average total rainfall and output of agricultural commodities.

Our results indicate that a 1% increase in the price of agricultural commodities (PAC), agricultural land (AGL), and the value of agricultural loan (VAL) will result in 0.54%, 0.95%, and 0.004% increase in output of agricultural commodities (QAC) respectively while a 1% increase in average total rainfall (ATR) will result in a decline in output of agricultural commodities by 0.44%. The adjusted R-Squared is 0.81, meaning that the explanatory variables explain 81% of the variation in output of Agricultural commodities (QAC). There is no serial autocorrelation given that the Durbin Watson Statistic is within the acceptable bound.

**SUMMARY, CONCLUSION AND POLICY IMPLICATIONS OF THE RESULTS**

Our results show that Price of Agricultural Commodities (PAC) is positive and statistically significant related to Output of Agricultural Commodities (QAC). The implication of this is that, following the simple law of supply: the higher the price, the higher the quantity of the commodity supplied. Hence, price is one of the most important determinants of output, indicative that the price of agricultural commodities is a valid determinant of the quantity of agricultural produce in Nigeria.

The coefficient of Average Total Rainfall shows that it is negative, however, it is significant related to output of Agricultural commodities. The finding is counter-intuitive, that is, the more the amount of rainfall, the less the agricultural output in Nigeria. This may be as a result of the fact that aside rainfall, there are other artificial sources of water, like irrigation which boost agricultural production in Nigeria. Though our result shows that average total Rainfall is an important variable in determining the volume of agricultural output especially in the short term and medium term than in the long term. The implication of this is that Nigerian Government should embark on more technological method to conserve, preserve and manage the available water resources in order to increase the output of agricultural commodities.

This result conforms to the empirical findings of Olagunju, 2007, who studied water resource development and its effect on agricultural production in Nigeria. Furthermore, it is also observed that the agricultural land is positive and significantly related to output of Agricultural commodities. This implies that availability of land resources is one of the major factors determining the output of agricultural production in Nigeria. The result also indicates that cultivable land is required before any meaningful development can take place in the agricultural sector in Nigeria.

Value of Agricultural loan has a positive correlation with output of agricultural commodities and also significantly related to it. The coefficient of agricultural loan is very small (infinitesimal), the implication of this is that there is a shortage of loan (credit) available to farmers to expand or improve agricultural activities in Nigeria. Therefore, for any significant contribution of agricultural loan to output of agricultural commodities and economic growth, there is a need for conscious development in a new and innovative ways (Akande, 2006). Likewise, there is also a need for the implementation of good macroeconomic policies that will increase the availability of credit to farmers in Nigeria.

In view of these, a number of recommendations are further made based on the findings from the study. These include the following: unlimited accessibility to markets; accessibility and sourcing of production inputs; reduction in imported items and encouragement of
local production; creation of opportunities for increased agricultural productivity; unlimited accessibility to credit facilities; accessibility to land resources and continuity in agricultural and economic policies.

From a policy perspective, there should be development and implementation of a new framework for agricultural techniques that optimize agricultural output through increased and improved agricultural land systems via irrigation.

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