# The Future Outlook of Nigerian Agricultural Sector Growth in the Light of Global Financial Developments-Discourse for Nigeria Green Alternative

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**Abstract:** *This empirical research investigated the future outlook of Nigerian Agricultural Sector Growth in the light of global financial developments using linear and symmetric price transmission mechanism model (ECM). The study made use of annual time series data covering GDP-Agriculture and its sub-sectors which spanned from 1990-2012. The findings showed that long-run association exit between agriculture and its sub-sectors with the mother sector establishing long-run equilibrium with its sub-sectors, though the convergence rate was moderate as indicated by the attractor coefficient. Furthermore, results showed that all the sub-sectors have positive influence on GDP-Agriculture with crop sub-sector having a lead influence when compared to other sub-sectors. Therefore, the study recommends that government should adopt adjustment strategies that hinges on shoring-up gross agriculture revenue to compensate for the dwindling oil revenues given that the prospect for the country economy depend on the policies articulated for the medium-to-long term and the seriousness with which they are implemented.*

**Key Words:** *Agriculture; Economy; Growth; ECM; ARIMA; Nigeria.*

## Introduction

The economic aspirations of Nigeria have remained that of altering the structure of production and consumption patterns, diversifying the economic base and reducing reliance on oil, with the aim of putting the economy on the part of sustainable, all-inclusive and non-inflationary growth. The implication is that while rapid growth in output, as measured by the real gross domestic product (GDP), is important, the transformation of the various sectors of the economy is even more critical. This is consistent with the growth aspirations of most developing countries, as the economy structure is expected to change as growth progresses.

Since 1999, the economic growth of Nigeria has risen substantially, with annual average of 7.4 percent in the last decade. But the growth has not been inclusive, broad-based and transformational. The implication of this trend is that economic growth in Nigeria has not resulted in the desired structural changes that would make agriculture the engine of growth, create employment, promote technological development and induce poverty alleviation. The economy has been import dependent with very little non-oil exports: it relies heavily on crude oil and gas exports with other sectors trailing far behind. The crude oil accounts for about 90 percent of foreign exchange earned by the country while non-oil exports account for the balance. In recent times, the economy has been susceptible to shocks in the oil industry which have been caused by either developments in the international crude oil market or the restiveness in the Niger Delta region of the country. However, Agriculture which was the major economy driver before the era of black gold or oil boom has been abandoned to the rural poor. Government expenditure outlays that are dependent on oil revenues have more or less dictated the pace of growth of the economy. Looking back, it is clear that the economy has not actually performed to its full potential, particularly in the face of its rising population.

## Research Methodology

The present study used deflated price annual time series data covering Agriculture sector, crop, livestock, fishery and forestry and sub-sectors spanning from 1990-2012, sourced from CBN database. The data were synthesized using simple regression model, ADF unit root, Elliot-Rothenberg-Stock (ERS) ADF-GLS test, and linear and symmetric price mechanism model (ECM). The empirical models used are given below:

### 1. Simple regression and Engel-Granger ECM model

Consider a multivariate co-integration model as follows:

$$GDP = ð_0 + ð_1 Agriculture + ð_2\ Industry + ð_3 Services + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ (1)$$

Where;

GDP = Gross Domestic Product

$\eth_0$ = Intercept

$\eth_{1-3}$ = Coefficient

$\varepsilon_t$ = Pure random walk

Co-integration of the multiple variables can be tested if all the variables display the same order of integration. The revenue adjustment mechanism between these variables, measured by Equation (1), was estimated through the Ordinary Least Squares (OLS) approach. ADF unit root test was applied to the residual of the estimation. These variables are said to be co-integrated if their residual is stationary, suggesting that there is a revenue adjustment mechanism between these multivariate series, which makes them converge to their long-term equilibrium relationship. In addition, short-term integration tests enable checking whether revenue responses on the variables are instantaneous. The short-term relationship is derived from the Granger (1981) representation theorem in the form of an Error-Correction Model (ECM) and is presented as follow:

$\Delta GDP = \acute{a}_0 + \acute{a}_1 \Delta Agriculture + \acute{a}_2 \Delta industry + \acute{a}_3 \Delta Services + \acute{a}_4 \varepsilon_{t-1} + V_t$ ............... (2)

Where;

$\Delta$ = First difference

$\acute{a}_0$ = Intercept

$\acute{a}_{1-4}$ = Coefficient of variable

$\varepsilon_{t-1}$ = Lagged value of the residual derived from Equation (1); and,

$V_t$ = White noise

**2. Augmented Dickey Fuller Test**

The Augmented Dickey-Fuller test (ADF) is the test for the unit root in a time series sample (Blay *et al.*, 2015; Singh, *et al.*, 2016; Sadiq *et al.*, 2016a). The autoregressive formulation of the ADF test with a trend term as cited by Beag and Singla (2014); Mahalle *et al.* (2015) is given below:

$$\Delta p_t = \alpha + p_{t-1} + \sum_{j=2}^{it} \beta i \Delta p_{it-j+t} + \mathcal{E} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, $p_{it}$ is the price in market $i$ at the time $t$, "$p_{it}$ $(p_{it} - p_{t-1})$ and $\acute{a}$ is the intercept or trend term.

### 3. ARIMA Model

A generalization of the ARIMA models which incorporates a wide class of non-stationary time-series is obtained by introducing the difference into the model. The simplest example of a non-stationary process which reduces to a stationary one after differencing is Random Walk. A process $\{y_t\}$ is said to follow an integrated ARMA model, denoted by ARIMA *(p, d, q)*, if $\nabla^d y_t = (1-\beta)^d \mathcal{E}_t$ is ARMA *(p, q)*, and the model is written below (Lama *et al.*, 2015; Sadiq *et al.*, 2016b):

$$\varphi(\beta)\,(1-\beta)^d y_t = \theta\,(\beta)\,\mathcal{E}_t \quad \text{.................................(22)}$$

Where, $\bullet t \sim WN(0, \sigma^2)$, and *WN* indicates white noise. The integration parameter *d* is a non-negative integer. When *d* = 0, ARIMA *(p, d, q)* = ARMA *(p, q)*.

#### *Forecasting Accuracy*

For measuring the accuracy in fitted time series model, mean absolute prediction error (MAPE), relative mean square prediction error (RMSPE), relative mean absolute prediction error (RMAPE) (Paul, 2014) and $R^2$ were computed using the following formulae:

$$\text{MAPE} = 1/T \sum \{A_t - F_t\} \quad \text{.................................... (23)}$$
$$\text{RMPSE} = 1/T \sum \{(A_t - F_t)^2 / A_t\} \quad \text{.............................. (24)}$$
$$\text{RMAPE} = 1/T \sum \{(A_t - F_t) / A_t\} \text{ X } 100 \quad \text{........................ (25)}$$
$$\mathbf{R^2} = 1 - \frac{\sum_{i=1}^{n} (A_{ti} - F_{ti})^2}{\sum_{i=1}^{n} A_{ti}^2} \quad \text{(Sadiq } et\ al.\text{, 2017) ....................... (26)}$$

Where, $\mathbf{R^2}$ = coefficient of multiple determination, $A_t$ = Actual value; $F_t$ = Future value, and T = time period(s)

### Results and Discussion

#### Estimates of Long-run Effects Using Simple Regression Model (Equation 1)

The regression of a non-stationary time series variables may cause a nonsense regression as evidenced by the coefficient of multiple determination $R^2$ (0.998) which is greater than Durbin-Watson statistic (0.794) as shown in Table 1a. A nonsense regression is not desireable given that it is not ideal for policy making and cannot be used for long-run prediction. However, the residuals of the simple regression (Equation 1) was found to be stationary at level as indicated by the ADF $\tau$-statistics which was greater than the Engel-Granger critical value at 5% significance level (Table 1b), indicating that the variables are co-integrated and the double logarithm OLS regression is not spurious, thus, a long-run model which can be used for policy making and also ideal for policy making. The stationarity of the residual variable implies that these variables have long-run association or they move together in the long-run: shared one stochastic trend. A further perusal of Table 1a indicates that all the stimulus variables or agricultural sub-sectors included in the model *viz.* crop, livestock, fishery and forestry sub-sectors have positive influence on the total agricultural revenue of the country in the long-run. For long-run prediction, it implies that 100 percent increase in the revenues that accrue to these agricultural sub-sectors *viz.* crop, livestock, fishery and forestry sub-sectors will increase the country total agricultural revenue by 88.3, 6.5, 4.1 and 1.1%, respectively. Therefore, it can be inferred that the crop sub-sector will have a dominant effect on the total agricultural revenue formulation, with the sub-sector being trailed from far by the livestock and fishery sub-sectors; while forestry trailed behind with a dismal performance.

**Table 1a: Results of Simple Regression Showing Long-run Effects**

| Variable | Coefficient | Standard error | t-value |
|---|---|---|---|
| **Intercept** | 0.21 | 0.031 | 6.774*** |
| **Crop** | 0.883 | 0.0052 | 169.91*** |
| **Livestocks** | 0.065 | 0.0061 | 10.73*** |
| **Fishery** | 0.041 | 0.0033 | 12.39*** |
| **Forestry** | 0.011 | 0.0031 | 34.68*** |
| **$R^2$** | 0.998 | | |
| **$R^2$-Adjusted** | 0.991 | | |
| **D-W stat** | 0.794 | | |
| **AIC** | -13.302 | | |
| **SIC** | -13.105 | | |
| **HIC** | -13.253 | | |

Note: ***, **, * significance at 1, 5 and 10% levels respectively

**Table 1b: ADF Unit Root Test on Residual**

| Variable | τ-statistic | Engel-Granger Critical Value | | Decision |
|---|---|---|---|---|
| | | 5% | 10% | |
| **Residual (U)** | -3.36 | -3.34 | -3.04 | Stationary at Level I(0) |

Note: * indicate that unit root at the level or at was rejected at 5% significant level

**Estimates of Short-run Effects Using Error Correction Model (ECM)**

The basic idea of co-integration was to identify the long-run relationship between variables. If there was a long-run relationship between the variables, then divergence from the long-run equilibrium path is bounded. If variables are found to be co-integrated we can specify an error correction model and estimate it using standard methods and diagnostic test. Also, since these variables were found to be integrated in the long-run i.e there is co-movement or long-run association between these variables, they are likely to establish long run equilibrium, thus, the need to develop a short-run model which capture both the long-run and short-run equilibriums. The results of the ERS (Elliot-Rothenberg-Stock) unit root test applied to the logarithm transformed variables at level shows that all the variables have unit root as indicated by the estimated t-statistics values in absolute term which were lower than their respective t-critical values at 5 percent confidence level, thus, accepting the null-hypothesis of non-stationarity and rejecting the alternative hypothesis of non-presence of unit root. Furthermore, the results of the ERS unit root test applied to all the variables, at first difference shows all the variables to be devoid of unit root as indicated by the estimated t-statistic values in absolute term which were higher that their respective t-critical value at 5% confidence level, thus, rejecting null hypothesis of non-stationarity in favour of the alternative hypothesis of non-presence of unit root (stationary) (Table 2a). Therefore, it implies that these variables were integrated of order one I(1), thus justifying the application of Error Correction Model (ECM). However, it is worth to mention that the reason for the application of the ERS (Elliot-Rothenberg-Stock) test also termed ADF-GLS test against the ADF test which is the most widely and commonly used unit root test was due to Type II error inherent in the estimated ADF test results (though not reported in the Table) which clearly showed that the ADF test had lost its power to test for stationarity due to the presence of structural points (SAP and post-SAP periods) in the captured data. It is because of the tendency of ADF to lose its power to test for stationarity, Maddalla and Kim (1998) as cited by Gujarati *et al.*(2012), Maddalla and Lahiri (2013) advocated that all the traditional unit root test models (DF, ADF and PP tests) should be discarded in order to avoid the problem of Type I and II errors. The results of the short-run model which capture both the long-run and short run equilibrium is shown in Table 2b. The attractor coefficient termed the error correction term (ECT) of the Agriculture revenue (Total) against the agricultural sub-sectors was found to be significant and negatively signed, implying that the GDP-Agriculture established a long-run equilibrium with all the agriculture sub-sectors. The attractor coefficient is above the long-run equilibrium and tends to move towards the level of the sub-sectors in order to re-establish equilibrium. The estimated attractor coefficient was -0.489, indicating that the GDP-Agriculture absorbed 48.9 percent of the shocks in order to maintain a long-run equilibrium annually. It can be inferred that the GDP-Agriculture corrects its previous error from the long-run equilibrium due to any short-run equilibrium at the speed of 48.9 percent per annum i.e it adjust at the speed of 48.9% from disequilibrium to equilibrium in the long-run, which will take approximately 6 months and 26 days to re-establish long-run equilibrium with its sub-sectors. Therefore, it can be inferred that there was long-run causality running from agricultural sub-sectors jointly to the GDP-Agriculture. The results showed that the speed of convergence of the GDP-Agriculture towards the long-run equilibrium with its sub-sectors was moderate, and this can be attributed to partial efficiency of the agricultural programmes in the country i.e policy inconsistency, bureaucratic delay, poor programme implementation, corruption etc. The results of the short-run equilibrium show that each of the sub-sectors *viz.* crop, livestock, fishery and forestry have short-run causal effect on the GDP-Agriculture. In other words, the crop, livestock, fishery and forestry sub-sectors positively influence the total revenue that accrues to agriculture sector (GDP-Agriculture) in the short-run. For policy implication, a 100% increase in the revenue that accrues to crop, livestock, fishery and forestry sub-sectors will increase the total GDP-Agriculture by 88.5, 6.4, 4.0 and 1.1%, respectively (Table 2b). An important observation from this study is that the long-run and short run elasticities were the same. Therefore, in the light of the recent macroeconomic challenges, government should adopt adjustment strategies that hinges on increasing non-oil revenues to compensate for the dwindling oil revenues because agricultural revenues can stand as the main driver of economic growth over the short-medium-long term.

**Table 2a: Unit Root Tests**

| Variables | t-statistics | t-critical value (5%) | |
|---|---|---|---|
| Ln(Agriculture) | -0.813 | -3.19 | Non-stationary I(0) |
| ΔLn(Agriculture) | -3.72 | | Stationary I(1) |
| Ln(Crop) | -0.80 | -3.19 | Non-stationary I(0) |
| ΔLn(Crop) | -3.74 | | Stationary I(1) |
| Ln(Livestocks) | -1.14 | -3.19 | Non-stationary I(0) |
| ΔLn(Livestocks) | -3.45 | | Stationary I(1) |
| Ln(Fishery) | -1.13 | -3.19 | Non-stationary I(0) |
| ΔLn(Fishery) | -3.81 | | Stationary I(1) |
| Ln(Forestry) | -0.56 | -1.96 | Non-stationary I(0) |
| ΔLn(Forestry) | -1.974 | | Stationary I(1) |

Note: * Indicate that Unit Root at the level or 1st difference was rejected at 5% significance

D : 1st difference

**Table 2b:**

| Variable | Coefficient | Standard error | t-value |
|---|---|---|---|
| Intercept | 0.124 | 0.111 | 1.117NS |
| ΔLn (Crop) | 0.885 | 0.0041 | 217.39*** |
| ΔLn(Livestocks) | 0.064 | 0.0051 | 12.51*** |
| ΔLn(Fishery) | 0.040 | 0.0029 | 13.92*** |
| ΔLn(Forestry) | 0.011 | 0.0006 | 18.85*** |
| $ECT_{t-1}$ | -0.489 | 0.2453 | -1.993* |
| $R^2$ | 0.9999 | | |
| $R^2$-Adjusted | 0.9993 | | |
| AIC | -13.64 | | |
| SIC | -13.39 | | |
| HIC | -13.58 | | |

Note: ***, **, * significance at 1, 5 and 10% levels respectively
NS: non-significant

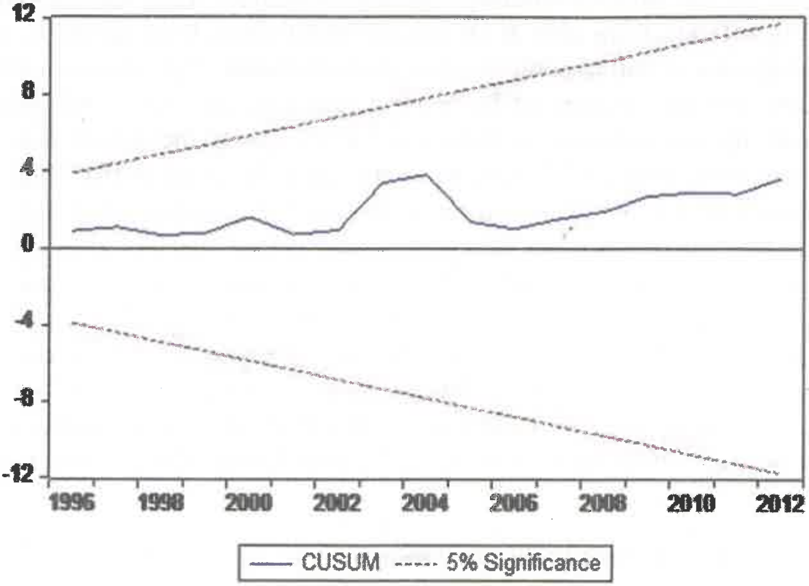
## Diagnostic Testing

Table 2c shows the diagnostic statistics results of the ECM model. The test of autocorrelation showed that the residuals were not serially correlated as indicated by the Breusch-Godfrey Lagrange Multiplier (LM) statistic which was not different from zero at 10 percent significance level ($p>0.10$), thus the acceptance of null hypothesis of no autocorrelation. The Arch test results revealed that the variance of the current residuals and that of the lagged residuals do not correlate as indicated by the Q-statistic which was not different from zero at 10 percent significance level ($p>0.10$), thus the acceptance of null hypothesis of no Arch effect. The stability test depicted in Figure 1 shows that the cusum line was within the boundary of 5% significance level, implying that there was no structural break in the equation: the models was not misspecified.  Furthermore, the result of the normality test showed that the residuals were normally distributed as indicated by Jarque-Bera statistic which was not different from zero at 10 percent significance level ($p<0.10$). Therefore, based on the outcome of the diagnostic statistics, it can be inferred that the ECM model used was the best fit and valid for prediction.

**Table 2c: ECM Diagnostic checking**

| Test | | Statistic | P-value |
|---|---|---|---|
| **Autocorrelation** | Breusch-Godfrey LM test (F-stat) | 1.0442 | 0.5197 |
| | Breusch-Godfrey LM test (Obs. $R^2$) | 15.726 | 0.2041 |
| **Arch Effect** | Q-stat | 2.664 | 0.103 |
| **Normality** | Jarque-Bera | 1.016 | 0.6018 |

## Figure 1 : Stability Test




### Forecasting Using ARIMA

Various combinations of the ARIMA models were tried after the first differencing of each variable series, and based on the smallest AIC value the best ARIMA model was selected. Of all the ARIMA models tested, ARIMA (1,1,0) model proved to be the best for almost all the variables except livestocks sub-sector which proved that ARIMA (0,1,1) to be the best given that it has the lowest AIC value (Table 3a).

**Table 3a: AIC and BIC Values of Different ARIMA Models**

| Variable | | 1,1,1 | 1,1,0 | 0,1,1 |
|---|---|---|---|---|
| **Agriculture** | AIC | 270.17 | 268.25** | 268.34 |
| | SBC | 273.44 | 270.43 | 270.52 |
| | Log likelihood | -132.08 | -132.12 | -132.17 |
| **Crop** | AIC | 271.54 | 269.60** | 269.67 |
| | SBC | 274.81 | 271.78 | 271.85 |
| | Log likelihood | -132.78 | -132.80 | -132.83 |
| **Livestock** | AIC | 265.36 | 264.18 | 263.49** |
| | SBC | 268.64 | 266.36 | 265.67 |
| | Log likelihood | -129.68 | -130.09 | -129.75 |
| **Fishery** | AIC | 267.01 | 265.01** | 265.24 |
| | SBC | 270.28 | 267.19 | 267.42 |
| | Log likelihood | -130.50 | -130.50 | -130.62 |
| **Forestry** | AIC | 252.85 | 251.91** | 253.49 |
| | SBC | 256.12 | 254.09 | 255.67 |
| | Log likelihood | -123.42 | -123.95 | -124.75 |

Note: ** indicates best ARIMA

Out of the total 22 data points (1990 to 2012), the first 17 data points (from 1990 to 2007) were used for model building, while the remaining 5 data points (from 2008 to 2012) were used for model validation. One-step ahead forecasts of the revenue for each variable along with their corresponding standard errors using naïve approach for the period 2008 to 2012 with respect to the fitted models were computed (Table 3b).

| Date | Agriculture | | Crop | | Livestock | | Fishery | |
|---|---|---|---|---|---|---|---|---|
| | Actual | Forecast | Actual | Forecast | Actual | Forecast | Actual | Forecast |
| 2008 | 2818.53 | 2697.14 | 2818.08 | 2696.99 | 2869.19 | 2735.02 | 2755.65 | 2609.47 |
| 2009 | 3063.90 | 3040.26 | 3069.44 | 3038.60 | 3065.84 | 3114.02 | 2963.09 | 2962.29 |
| 2010 | 3249.69 | 3269.07 | 3254.01 | 3276.29 | 3267.52 | 3206.97 | 3157.01 | 3143.70 |
| 2011 | 3458.87 | 3428.33 | 3459.50 | 3432.43 | 3515.29 | 3470.48 | 3391.73 | 3332.01 |
| 2012 | 3849.10 | 3647.93 | 3864.30 | 3646.83 | 3804.30 | 3709.30 | 3672.30 | 3583.68 |

| Date | Forestry | |
|---|---|---|
| | Actual | Forecast |
| 2008 | 2760.18 | 2643.03 |
| 2009 | 2924.85 | 3000.09 |
| 2010 | 3095.11 | 3083.29 |
| 2011 | 3302.65 | 3257.45 |
| 2012 | 3489.30 | 3490.99 |

The forecasting ability of the selected ARIMA models of revenue series for the economic variables were judged on the basis of $R^2$, the mean absolute prediction error (MAPE), root mean square error (RMSE) and relative mean absolute prediction error (RMAPE) values (Table 3c). A perusal of Table 3c shows that the RMAPE of each variable is less than 5 percent, indicating the accuracy of the models used.

**Table 3c: Validation of Models**

| Variables | ARIMA model | $R^2$ | MAPE | RMSPE | RMAPE(%) |
|---|---|---|---|---|---|
| Agriculture | 1,1,0 | 0.99 | 71.47 | 3.26 | 2.1 |
| Crop | 1,1,0 | 0.99 | 74.84 | 3.62 | 2.21 |
| Livestock | 0,1,1 | 0.99 | 57.27 | 2.22 | 1.75 |
| Fishery | 1,1,0 | 0.99 | 61.73 | 2.20 | 1.99 |
| Forestry | 1,1,0 | 0.99 | 10.75 | 1.39 | 0.41 |

Source: Authors computation, 2017

One step ahead out of sample forecast of the revenue for the economic variables selected during the period of the year 2013 to 2024 were computed. The absolute data points are shown in Table 3d and also were depicted in Figure 2a-2e to visualize the performance of the fitted model. A cursory review shows that the revenue of each variable would be marked by an increase, which is an indication of good prospect for the country economy. Under normal growth the forecasted trend will prevail; while under high and low growth the future trend of revenues for each variable will not exceed the upper and lower confidence limits, respectively. It can be observed from the forecasted results that crop sub-sector will have the highest contribution to the country GDP-Agriculture, while the remaining sub-sectors trailing behind. Under normal growth, the forecasted annual revenue growth rate for GDP-Agriculture, crop, livestock, fishery and forestry sub-sectors will be 3.6, 3.5, 3.5 and 3.4%, respectively. In the case of high growth, the annual revenue growth rate for GDP-Agriculture, crop, livestock, fishery and forestry sub-sectors are estimated to be 4.7, 4.4, 4.6 and 5.1%, respectively; and while under low growth, the estimated revenue growth rate for GDP-Agriculture, crop, livestock, fishery and forestry will be 2.1, 2.4, 2.1 and 1.1%, respectively. Therefore, since the country anticipated growth exceed the future outlook, onus lies on the stakeholders to implement sound policies to make agricultural sector the main driver of the economy due to the low oil prices which leads to decline in fiscal revenues, vulnerability to slow global economic recovery and global financial development.

| Date | Agriculture | | | Crop production | | | Livestock | | |
|---|---|---|---|---|---|---|---|---|---|
| | LCI | Forecast | UCI | LCI | Forecast | UCI | LCI | Forecast | UCI |
| 2013 | 3917.9934 | 4118.7760 | 4319.5585 | 3929.2912 | 4136.4551 | 4343.6191 | 3847.3379 | 4026.8586 | 4206.3793 |
| 2014 | 3981.8701 | 4334.7613 | 4687.6524 | 3991.3899 | 4352.1480 | 4712.9061 | 3861.4331 | 4195.3967 | 4529.3603 |
| 2015 | 4043.6660 | 4526.8345 | 5010.0030 | 4052.9330 | 4543.8069 | 5034.6808 | 3927.0873 | 4363.9347 | 4800.7822 |
| 2016 | 4112.9498 | 4708.2582 | 5303.5677 | 4123.0222 | 4725.2353 | 5327.4485 | 4012.7231 | 4532.4728 | 5052.2224 |
| 2017 | 4191.4752 | 4884.9389 | 5578.4025 | 4202.9123 | 4902.3091 | 5601.7058 | 4109.8732 | 4701.0108 | 5292.1485 |
| 2018 | 4278.5429 | 5059.5072 | 5840.4714 | 4291.5783 | 5077.5291 | 5863.4799 | 4214.7606 | 4869.5489 | 5524.3372 |
| 2019 | 4372.8752 | 5233.1347 | 6093.3943 | 4387.5721 | 5251.9602 | 6116.3482 | 4325.3095 | 5038.0869 | 5750.8644 |
| 2020 | 4473.2346 | 5406.3433 | 6339.4519 | 4489.5766 | 5426.0553 | 6362.5341 | 4440.2336 | 5206.6250 | 5973.0164 |
| 2021 | 4572.8752 | 5579.3652 | 6580.1458 | 4596.5240 | 5600.0075 | 6603.4911 | 4558.6707 | 5375.1631 | 6191.6554 |
| 2022 | 4688.0991 | 5752.3040 | 6816.5090 | 4707.5807 | 5773.8989 | 6840.2171 | 4680.0092 | 5543.7011 | 6407.3931 |
| 2023 | 4801.1298 | 5925.2059 | 7049.2819 | 4822.1006 | 5947.7643 | 7073.4281 | 4803.7967 | 5712.2392 | 6620.6817 |
| 2024 | 4917.1671 | 6098.0912 | 7279.0153 | 4939.5799 | 6121.6187 | 7303.6576 | 4929.6874 | 5880.7772 | 6831.8670 |
| **GR %** | **2.1** | **3.6** | **3.5** | **2.1** | **3.6** | **4.7** | **2.4** | **3.5** | **4.4** |

| Date | Fishery | | | Forestry | | |
|---|---|---|---|---|---|---|
| | LCI | Forecast | UCI | LCI | Forecast | UCI |
| 2013 | 3691.3391 | 3882.8504 | 4074.3617 | 3525.9392 | 3663.0421 | 3800.1450 |
| 2014 | 3730.7082 | 4063.3432 | 4395.9783 | 3557.6694 | 3827.7811 | 4097.8927 |
| 2015 | 3782.2709 | 4232.2369 | 4682.2029 | 3582.9825 | 3986.2407 | 4389.4988 |
| 2016 | 3847.3839 | 4396.6544 | 4945.9249 | 3609.0039 | 4140.3204 | 4671.6369 |
| 2017 | 3923.8437 | 4559.3446 | 5194.8455 | 3639.0569 | 4291.3453 | 4943.6338 |
| 2018 | 4009.2105 | 4721.3682 | 5433.5259 | 3674.5355 | 4440.2396 | 5205.9436 |
| 2019 | 4101.5215 | 4883.1345 | 5664.7475 | 3715.8481 | 4587.6477 | 5459.4473 |
| 2020 | 4199.3192 | 5044.8016 | 5890.2840 | 3762.9036 | 4734.0193 | 5705.1349 |
| 2021 | 4301.5391 | 5206.4304 | 6111.3216 | 3815.3718 | 4879.6679 | 5943.9640 |
| 2022 | 4407.3980 | 5368.0444 | 6328.6907 | 3872.8224 | 5024.8122 | 6176.8021 |
| 2023 | 4516.3095 | 5529.6526 | 6542.9958 | 3934.8002 | 5169.6049 | 6404.4096 |
| 2024 | 4627.8250 | 5691.2587 | 6754.6924 | 4000.8630 | 5314.1522 | 6627.4414 |
| **GR %** | **2.1** | **3.5** | **4.6** | **1.1** | **3.4** | **5.1** |

LCI: Lower Confidence Interval; UCL: Upper Confidence Interval

## ARIMA Diagnostic Checking

The model verification is concerned with checking the residuals of the model to see if they contained any systematic pattern which still could be removed to improve the chosen ARIMA. The results of the autocorrelation tests for each variable showed the residuals to be purely random as indicated by the Ljung-Box Q-statistics tests which were not significantly different from zero at 10 percent probability level. Also, the Arch effect tests showed no arch effects in the residuals as evidence by Arch-Lagrange multiplier (LM) test statistics which were not different from zero at 10 percent probability level. The normality tests for each variable showed that the residuals were normally distributed as evidence by Jarque-Bera test statistics which were not different from zero at 10 percent probability level (Table 3e). Therefore, these proved the selected model to be the best fit and appropriate model for forecasting.

**Table 3e: Diagnostic Checking for Best ARIMA Models**

| Variables | ARIMA model | Autocorrelation test (Ljung-Box Q) | Arch test (LM) | Jarque-Bera Normality test ($Chi^2$) |
|---|---|---|---|---|
| Agriculture | 1,1,0 | 0.254 (0.614)$^{NS}$ | 7.780 (0.455)$^{NS}$ | 1.641 (0.4402)$^{NS}$ |
| Crop | 1,1,0 | 0.2102 (0.647)$^{NS}$ | 4.413 (0.353)$^{NS}$ | 1.715 (0.424)$^{NS}$ |
| Livestock | 0,1,1 | 0.1468 (0.702)$^{NS}$ | 1.487 (0.829)$^{NS}$ | 1.674 (0.433)$^{NS}$ |
| Fishery | 1,1,0 | 0.0985 (0.754)$^{NS}$ | 1.987 (0.738)$^{NS}$ | 0.949 (0.622)$^{NS}$ |
| Forestry | 1,1,0 | 1.2556 (0.263)$^{NS}$ | 2.873 (0.579)$^{NS}$ | 3.484 (0.175)$^{NS}$ |

Note : ***, **, * significance at 1, 5 and 10% respectively
NS : non-significant
() : p-value

## Conclusion and Recommendation

This research investigated the future outlook of Nigerian agricultural sector growth in the light of global financial developments using linear and symmetric price transmission mechanism model. The results showed that the residual of the OLS regression was stationary at a level, indicating that GDP-Agriculture and its sub-sectors were co-integrated. Furthermore, it was observed that the GDP-Agriculture established a long-run equilibrium with its sub-sectors, and tends to correct any error from the equilibrium caused by any shock from the short-run equilibrium at a moderate rate annually. The agriculture sub-sectors were found to exert positive influence on the GDP-Agriculture revenue formation. Also, it was observed that the future outlook of the GDP-Agriculture and its sub-sectors will witness an increasing trend with the forecasted growth rate ranging from 3.4-3.6%. Therefore, in the light of the recent macroeconomic challenges, study recommends that government should adopt adjustment strategies that hinges on increasing GDP-agriculture revenue to compensate for the dwindling oil revenues given that its sub-sectors can stand as the main driver of the economy development over the medium term.

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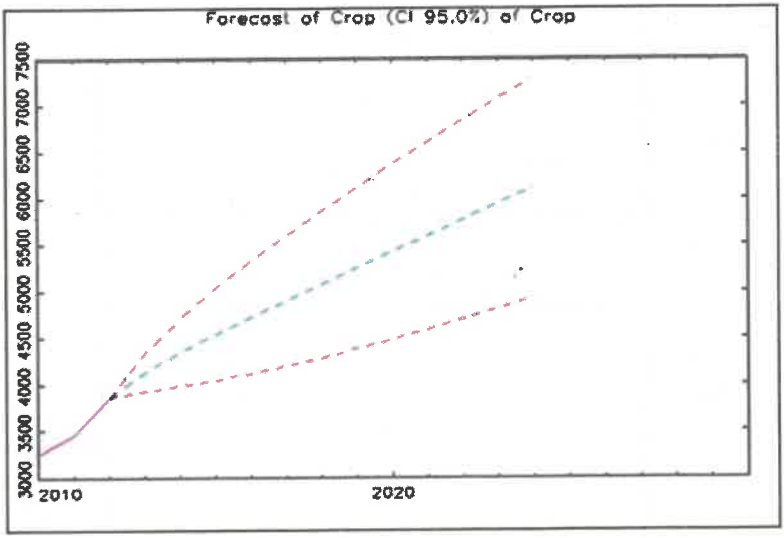
# APPENDIX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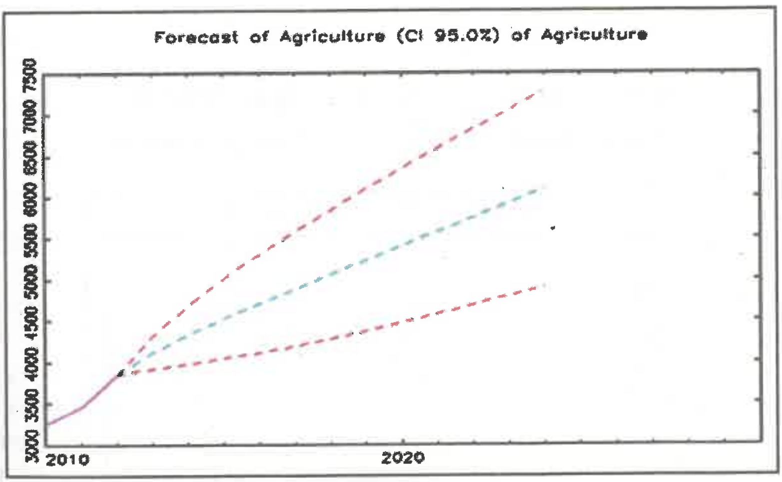
2010
2020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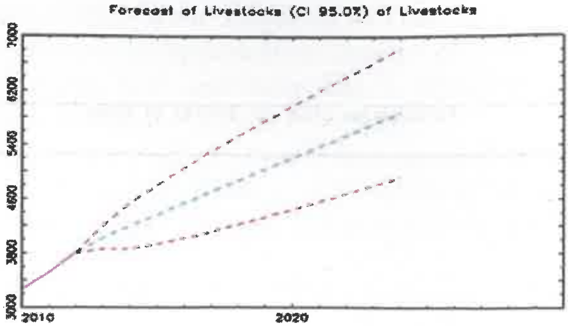
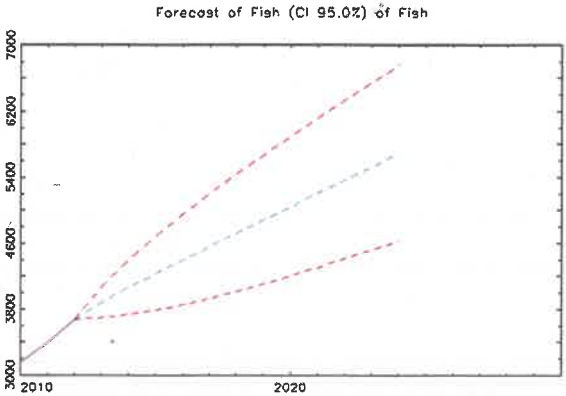
2010
2020




Row 1: Figure 2a: Agriculture; Figure 2b: Crop

Row 2: Figure 2c: Livestock; Figure 2d: Fishery

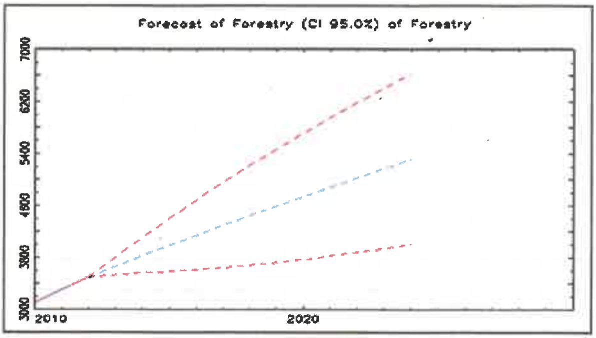



Figure 2e: Forestry