



Agriculture and Economic Growth in Nigeria (1990-2022)

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Abstract

The performance of agriculture in the economic growth of Nigeria between 1990 and 2022 was examined to assess its failures and successes to meet the Millennium Development Goals (MDGs) and currently the Sustainable Development Goals (SDGs). These international development policies as initiated by the United Nations stress combating extreme poverty in the world. Agriculture with its component parts of crop production (cp); livestock (li); forestry (fo) and fisheries (fi) and their response to the Gross Domestic Product (GDP) was reviewed using secondary data that were sourced from the National Bureau of Statistics (NBS) and the Central Bank of Nigeria statistical bulletin. Analysis was made using the Vector Auto Regression (VAR) model to the component parts of agriculture within the temporal space of 1990-2022. Other coefficients of the VAR that were used included the unit root test; lag length criteria; stability condition test; Engle and Granger test and the test of autocorrelation. The results of the fitted model are that the coefficients of lags 1,2 and 3 of GDP, lag 1 of cp, lags 2 and 3 of li, lags 1 and 3 of fo, and lags 1,2 and 3 of fi indirectly affected GDP. At lags 2 and 3 of cp, lag 1 of li, and lag 2 of fo affected GDP directly. Livestock, forestry and fisheries respectively affected other variables implying some relationship that can predict future values. Therefore, crop production-groundnuts, oil palm, rubber, cocoa etc. as it was until late 1980s is a major driver of the nation's economy hence contributing significantly to GDP. The paper therefore suggests that a return to agriculture with rich investments in the component parts will sustainably strengthen the economy and further improve GDP.

Key words: Agriculture, economy, GDP, farmers, market.

1. Introduction

Nigeria occupies a land area of about 923,768km² with an estimated population of 198 million persons (NBS, 2018). It lies astride the equator making it sit within the hot-humid tropics with the Gulf of Guinea on the western coast of Africa, the northern part is bounded by Niger republic; the north-east by Chad; the eastern part shares boundaries with Cameroon while the southern extremes lead to the Atlantic waterfronts. The wide range of products available in Nigeria is predicated principally on the numerous advantages its agricultural climate typifies (Adewumi and Omotosho, 2002). This in

effect makes the agricultural sector one of the most significant sectors of the economy especially in employment generation, contribution to Gross Domestic Product (GDP) and earnings from exports. Notwithstanding the enormous agricultural potentials in Nigeria, its growth has been at an extremely low rate. In 1960, before the oil boom, agriculture contributed over 64% to the total GDP but during the 1970s, the contribution of agriculture to the GDP declined to 48% (CBN, 2008). This decline continued in 1980-20% and 19% in 1985. It has also been observed that the agricultural sub sectors of crop production, fisheries, livestock and forestry have over the years declined in their contributions to the overall agricultural output. For example, Ojiako and Olayode (2008) noted that between 1983 and 1984, the share of livestock in agricultural GDP was about 19% but this has dropped to as low as 6% between 2004 and 2005. However, the contribution of agriculture to the GDP went up during the 1990s by some margin. In 2012 agricultural contributions to the GDP were 40% (CIA FACT, 2012). Obilor (2013) also noted that this might be attributed to the shift of emphasis to agricultural development even though the increment was insignificant. The oil boom of the 1980s greatly affected the economy but relegated the agricultural sector but there is a gradual government attention towards the development of agriculture in Nigeria today.

The contributions of the agricultural sector to the growth and development of any economy are categorized in four main ways; food for man, factor contribution, foreign exchange earnings and market contributions which are major factors that build an economy (Olajide, 2012). The decline of the contributions of the agricultural sector to the economy of Nigeria is traced to several reasons; -fifty percent (50%) and below of the country's cultivable agricultural land is under-cultivated and majority of the cultivated land is done by small holder and traditional farmers who use crude production techniques that result in low yields. Also, the small holder farmers are affected by certain issues such as poor access to modern inputs and credit, poor infrastructure, poor access to markets, land and environmental degradation, as well as poor research and extension services which further negatively affect agricultural output. These poor developments in the sector and their negative implications on economic growth have become a real issue of concern, knowing that the sector remains most critical to the economic growth and development of an emerging economy like Nigeria. With the failure to meet the Millennium Development Goals (MDGS), and the effort to achieve the Sustainable Development Goals (SDGs), it becomes imperative to examine the performance of this all important sector to the economic development of the country from time to time.

Despite these shortfalls, agriculture has remained the most viable source of sustenance for the people. Nigeria was once the world's largest exporter of groundnuts, the second largest exporter of cocoa and palm produce and an important exporter of rubber and cotton during the 1960s (Sekunmade, 2009). This was mainly achieved through the most effective application of regional competition. The sector has also continued to employ Nigeria's teeming population, providing jobs for up to two-thirds of the nation's labour force thus contributing its quota to the GDP yet presenting a large percentage of non-oil revenue (CIA, 2013; Sekunmade, 2009). However, Nigeria's agricultural sector still has great potentials for growth and development yet to be exploited such as in the areas of availability and accessibility of land, water, labour and its large domestic markets. According to FMARD (2012), about 84million hectares of Nigeria's total land area is estimated to have the potential for agriculture, while only about 40% of this is under cultivation. According to Chauvin, Mulangu and Porto (2012), Lipton (2012), Nigeria is rich in diverse rich plants that can support heavy livestock

population. It also has potentials for irrigation with a surface and underground water of about 267.7billion cubic meters and 57.9 billion cubic meters respectively. Besides, the large and ever growing population of Nigeria presents a vibrant domestic market with the potentials for increased productivity.

Conversely, the country is rather dependent on food importation. According to Nzeka (2013), in 2012 alone, importation of wheat was valued at \$1billion for Nigeria. The contribution of agriculture to GDP in 2017 was 20.85% (NBS, 2018). To reverse these negative trends in agricultural output is a thing of worry even as the records show that agricultural output in the recent times contributes less than expected in a country of over 200 million persons. A critical example of the contributions to economic growth from agriculture is presented in Table 1.

Table 1. Agricultural sector growth in Nigeria from the 1st quarter of 2019 to the 2nd quarter of 2022.

Characteristic		Growth rate
Q2	2022	1.2%
Q1	2022	3.16%
Q4	2021	3.58%
Q3	2021	1.22%
Q2	2021	1.3%
Q1	2021	2.28%
Q4	2020	3.42%
Q3	2020	1.39%
Q2	2020	1.58%
Q1	2020	2.2%
Q4	2019	2.31%
Q3	2019	2.28%
Q2	2019	1.79%

Source: *Statistical Research Development, 2023*

The table clearly shows the fluctuations in the growth of the sector within the period under review. In any case, agriculture as an enterprise provides man with various opportunities for food, employment, foreign exchange earnings and industrial raw materials. since obvious downturn now exists in the agricultural sector, reliance on existing secondary data will further explain the real quantitative extent of poor performance which has worsened its contributions to national economic growth. Against this backdrop, the following objectives are to guide this study; To examine records on the impact of agriculture on economic growth between 1990 and 2022, statistically analyse this growth trend within the period under review and project future implications of this trend of fluctuations all things being equal

2. Materials and Methods

The study used secondary data for agricultural output between 1990 and 2022 sourced from the National Bureau of Statistics (see appendix 1). The secondary data so presented were subjected to inferential statistics tests as shown below;

Model Specification

The Vector Auto Regression Model

Vector Auto Regression (VAR) is a statistical model used to measure and analyse the relationship between multiple variables over time. It is a stochastic process model, which means that it models randomness in the form of data points that can be observed at different moments in time. VAR fits perfectly where there are multiple variables to consider when making decisions or predictions. It generalizes univariate autoregressive data by allowing multivariate time series. A univariate regression is a one single equation model where its current values are explained by its lagged values. A VAR is an n-variables, n-equation model which expresses each variable as a linear function of its own past values; the past values of all other variables being considered and a serially uncorrelated error term. VAR model provides a coherent and credible approach to data description, forecasting, structural inference and policy analysis (Stock and Watson 2001).

The study sought to review how agriculture responds to GDP shock by the contributions of Crop production (Cp), Livestock (Li), Forestry (Fo) and Fisheries (Fi) as the component parts. It is therefore to see if as GDP increases, Crop production (Cp), Livestock (Li), Forestry (Fo) and Fisheries (Fi) will decrease the rate that will activate the economy. To do so, the multivariate VAR model is set as follows;

Variables: Crop production (Cp), Livestock (Li), Forestry (Fo) and Fisheries (Fi)

Frequency: yearly data 1990 – 2022

VAR Model Representation.

$$GDP_t = \alpha_1 + a_{11}Gd_{t-1} + a_{12}Cp_{t-1} + a_{13}Li_{t-1} + a_{14}Fo_{t-1} + a_{15}Fi_{t-1} + b_{11}Gd_{t-2} + b_{12}Cr_{t-2} + b_{13}Li_{t-2} + b_{14}Fo_{t-2} + b_{15}Fi_{t-2} + \dots + u_t \tag{1}$$

$$Cp_t = \alpha_2 + a_{21}Gd_{t-1} + a_{22}Cp_{t-1} + a_{23}Li_{t-1} + a_{24}Fo_{t-1} + a_{25}Fi_{t-1} + b_{21}Gd_{t-2} + b_{22}Cr_{t-2} + b_{23}Li_{t-2} + b_{24}Fo_{t-2} + b_{25}Fi_{t-2} + \dots + u_t \tag{2}$$

$$Li_t = \alpha_3 + a_{31}Gd_{t-1} + a_{32}Cp_{t-1} + a_{33}Li_{t-1} + a_{34}Fo_{t-1} + a_{35}Fi_{t-1} + b_{31}Gd_{t-2} + b_{32}Cr_{t-2} + b_{33}Li_{t-2} + b_{34}Fo_{t-2} + b_{35}Fi_{t-2} + \dots + u_t \tag{3}$$

$$Fo_t = \alpha_4 + a_{41}Gd_{t-1} + a_{42}Cp_{t-1} + a_{43}Li_{t-1} + a_{44}Fo_{t-1} + a_{45}Fi_{t-1} + b_{41}Gd_{t-2} + b_{42}Cr_{t-2} + b_{43}Li_{t-2} + b_{44}Fo_{t-2} + b_{45}Fi_{t-2} + \dots + u_t \tag{4}$$

$$Fi_t = \alpha_5 + a_{51}Gd_{t-1} + a_{52}Cp_{t-1} + a_{53}Li_{t-1} + a_{54}Fo_{t-1} + a_{55}Fi_{t-1} + b_{51}Gd_{t-2} + b_{52}Cr_{t-2} + b_{53}Li_{t-2} + b_{54}Fo_{t-2} + b_{55}Fi_{t-2} + \dots + u_t \tag{5}$$

Unit Root Test

Unit Root Test is a test of stationarity (or non-stationary) which has become widely popular over the past years. The unit root (stochastic) process is given as;

$$y_t = \rho y_{t-1} + u_t - 1 \leq \rho \leq 1 \tag{6}$$

where u_t is a white noise error term. If $\rho = 1$ equation (6) becomes a random walk model without drift which is a non-stationary stochastic process that would no longer be estimated using Ordinary Least Square method (OLS). By subtracting y_{t-1} from both sides of the equation (6) to obtain;

$$y_t - y_{t-1} = \rho y_{t-1} - y_{t-1} + u_t \tag{7}$$

$$= (\rho - 1) y_{t-1} + u_t \tag{8}$$

$$\Delta y_t = \delta y_{t-1} + u_t \tag{9}$$

where $\delta = (\rho - 1)$ and Δ is the first difference operation

A stochastic process is said to be stationary if its mean and variance are constant over time and the value of the covariance between the time periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed (Gujarati and Porter 2009; Stock and Watson 1990).

The hypotheses is:

H₀: the variables have unit roots (non-stationary)

Decision Rule: Reject H₀ if the p-val > 0.05 otherwise do not reject.

Difference – stationary process

If a time series data has a unit root, the first differences of such time series are stationary; therefore, the solution is to take the first differences of the time series. When a time series is $I(2)$, it will contain two unit roots, in which case we will have to difference it twice. If it is $I(d)$, it has to be difference d times where d is any integer.

Lag length criteria

Once a VAR model is estimated, it is important to check for the lag length criteria. The lag length defines the number of lags that will be included as explanatory variables in the model and has a substantial impact on its performance. The choice of an appropriate lag length is not always straightforward and requires careful consideration by the user. If the lag length is too small, the model is miss-specified and if the lag length is too large, then the degrees of freedom are wasted. The test uses Akaike, Schwartz and Hannan-Quinn criteria. The lower the values of these criteria, the more appropriate the lag length which ensures that there should be no autocorrelation at the selected lags.

Stability condition check

In literature, stability condition of the VAR model is also referred to as stationarity conditions. If all inverse roots of the characteristic Autoregressive polynomial have modulus less than one and lie inside the unit, the estimated VAR is stable that is, if $-1 < \rho < 1$. If the VAR is not stable, diverse test conducted on the VAR model may be invalid.

Engle and Granger Test

The Granger test shows the relationship between variables. If one variable causes the other one, it means that it helps to predict future values of the other variable (Granger 1969). The Granger causality test states thus;

$$GDP_t = \sum a_i Gd_{t-i} + \sum a_j Cp_{t-j} + \sum a_k Li_{t-k} + \sum a_l Fo_{t-l} + \sum a_m Fi_{t-m} + u_t \quad (10)$$

H₀: the independent variables (Cp, Li, Fo, and Fi) do not granger; cause GDP

Decision Rule: if p-value < 0.05 = the independent variables (Cp, Li, Fo, and Fi) granger cause GDP otherwise the independent variables (Cp, Li, Fo, and Fi) do not granger cause GDP at 5% significance level

4. Results and Discussion

Test of Unit Root

The results of tables 2– 6 above revealed that the p-values of 0.9892, 0.9915, 1.0000, 0.9943 and 0.9948 respectively were all greater than 0.05 that is, p-values > 0.05

which implied that the variables are non-stationary that is, they have unit roots and may not be used for VAR estimation. Hence, there is need for differences to ensure stationarity. The data used for these analyses are presented in appendix I.

Table 2: Dickey – Fuller Test on Crop Production

. dfuller Cp

Dickey-Fuller test for unit root Number of obs = 32

Test Statistic	Interpolated Dickey-Fuller			
	1% Critical Value	5% Critical Value	10% Critical Value	
Z(t)	0.667	-3.702	-2.980	-2.622

MacKinnon approximate p-value for Z(t) = 0.9892

Table 3: Dickey – Fuller Test on Livestock

. dfuller Li

Dickey-Fuller test for unit root Number of obs = 32

Test Statistic	Interpolated Dickey-Fuller			
	1% Critical Value	5% Critical Value	10% Critical Value	
Z(t)	0.794	-3.702	-2.980	-2.622

MacKinnon approximate p-value for Z(t) = 0.9915

. dfuller Cp

Dickey-Fuller test for unit root Number of obs = 32

Test Statistic	Interpolated Dickey-Fuller			
	1% Critical Value	5% Critical Value	10% Critical Value	
Z(t)	0.667	-3.702	-2.980	-2.622

MacKinnon approximate p-value for Z(t) = 0.9892

Table 4: Dickey – Fuller Test on Forestry

. dfuller Fo

Dickey-Fuller test for unit root Number of obs = 32

	Test Statistic	Interpolated Dickey-Fuller		
		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	2.916	-3.702	-2.980	-2.622

MacKinnon approximate p-value for Z(t) = 1.0000

Table 5: Dickey – Fuller Test on Fisheries

. dfuller Fi

Dickey-Fuller test for unit root Number of obs = 32

	Test Statistic	Interpolated Dickey-Fuller		
		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	1.000	-3.702	-2.980	-2.622

MacKinnon approximate p-value for Z(t) = 0.9943

Table 6: Dickey – Fuller Test on GDP

. dfuller GDP

Dickey-Fuller test for unit root Number of obs = 32

	Test Statistic	Interpolated Dickey-Fuller		
		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	1.055	-3.702	-2.980	-2.622

MacKinnon approximate p-value for Z(t) = 0.9948

Difference – Stationary

Since the data sets are not stationary, first order differences were conducted and discovered that some of the variables still have unit roots. Hence, in the time series $I(2)$, it will contain two unit roots, in which case it has to difference it twice. However, a stationarity test based on Dickey- Fuller was conducted on second order differences to determine if they are stationary as presented in Tables 7–10

Table 7: Dickey – Fuller Test on second difference order $L(2)$ of Crop Production

. dfuller dCP

Dickey-Fuller test for unit root Number of obs = 30

Test Statistic	Interpolated Dickey-Fuller		
	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-3.716	-2.986	-2.624

MacKinnon approximate p-value for Z(t) = 0.0000

Table 8: Dickey – Fuller Test on second difference order $L(2)$ of Livestock

. dfuller dLI

Dickey-Fuller test for unit root Number of obs = 30

Test Statistic	Interpolated Dickey-Fuller		
	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-3.716	-2.986	-2.624

MacKinnon approximate p-value for Z(t) = 0.0000

Table 9: Dickey – Fuller Test on second difference order $L(2)$ of Forestry

. dfuller dFO

Dickey-Fuller test for unit root Number of obs = 30

Test Statistic	Interpolated Dickey-Fuller		
	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-3.716	-2.986	-2.624

MacKinnon approximate p-value for Z(t) = 0.0000

Table 10: Dickey – Fuller Test on second difference order $L(2)$ of Fisheries

. dfuller dFI

Dickey-Fuller test for unit root Number of obs = 30

Test Statistic	Interpolated Dickey-Fuller		
	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-3.716	-2.986	-2.624

MacKinnon approximate p-value for Z(t) = 0.0000

Table 11: Dickey – Fuller Test on second difference order L(2) of GDP

. dfuller dGD

Dickey-Fuller test for unit root		Number of obs = 30		
		Interpolated Dickey-Fuller		
Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	
Z(t)	-7.204	-3.716	-2.986	-2.624

MacKinnon approximate p-value for Z(t) = 0.0000

The results in Tables 7 – 10 are that their p-values of 0.0000 respectively were all less than 0.05 that is, p-values < 0.05 which implied that the second order differences of the variables are stationary. In effect, they do not have unit roots and may be used for VAR estimation. The data obtained from the second order differences $L(2)$ used for these analysis are presented in appendix II.

The table below shows the result of the VAR model of GDP as explained by lags of GDP, crop production, livestock, forestry and fisheries. From the result of the table it shows that the coefficients of lags 1, 2 and 3 of GDP, lag 1 of crop production, lags 2 and 3 of livestock, lags 1 and 3 of forestry and lags 1, 2 and 3 of fisheries were all negatively explained by GDP. That is, they indirectly affect GDP. Hence any unit increase on these variables at those lags leads to decrease in GDP. However, lags 2 and 3 of crop production, lag 1 of livestock, lag 2 of forestry were all positively explained by GDP thus they affect GDP directly. Hence any unit increase on these variables at those lags leads to a corresponding unit increase in GDP as well. The result of the table also revealed that none of the coefficients of variables at the selected lags was statistically significant in explaining GDP.

Table 12: VAR Estimation

```
. var dgdp dcp dli dfo dfi, lag(1/3)
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Vector autoregression

Sample:	1995 - 2022	Number of obs	=	28
Log likelihood	= -642.4825	AIC	=	51.60589
FPE	= 3.89e+16	HQIC	=	52.76952
Det(Sigma_ml)	= 5.86e+13	SBIC	=	55.41219

Equation	Parms	RMSE	R-sq	chi2	P>chi2
dgdp	16	1742.36	0.4142	19.79982	0.1797
dcp	16	614.802	0.6422	50.24689	0.0000
dli	16	19.7978	0.6590	54.12134	0.0000
dfo	16	.959498	0.8424	149.6143	0.0000
dfi	16	7.25634	0.5212	30.47964	0.0103

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
dgdp					
dgdp					
L1.	-.4292576	.258501	-1.66	0.097	-.9359101 .077395
L2.	-.4434323	.2857859	-1.55	0.121	-1.003562 .1166977
L3.	-.3789941	.3207906	-1.18	0.237	-1.007732 .249744
dcp					
L1.	-.2056741	.6691904	-0.31	0.759	-1.517263 1.105915
L2.	.4176973	.7671242	0.54	0.586	-1.085838 1.921233
L3.	.5140905	.7640112	0.67	0.501	-.9833439 2.011525
dli					
L1.	12.70571	21.10269	0.60	0.547	-28.6548 54.06623
L2.	-14.19013	21.02576	-0.67	0.500	-55.39986 27.0196
L3.	-13.00847	18.03979	-0.72	0.471	-48.36582 22.34887
dfo					
L1.	-232.4575	376.0898	-0.62	0.537	-969.5801 504.665
L2.	37.29576	402.3608	0.09	0.926	-751.317 825.9085
L3.	-54.67966	259.3881	-0.21	0.833	-563.0711 453.7118
dfi					
L1.	-5.699539	36.4944	-0.16	0.876	-77.22724 65.82816
L2.	-5.032033	40.89961	-0.12	0.902	-85.1938 75.12973
L3.	-.204072	42.39637	-0.00	0.996	-83.29944 82.89129
_cons	155.8691	225.3376	0.69	0.489	-285.7845 597.5227

Lag Length Check

The appropriate lag length according to the selection criteria is lag 3. This is because the values of the selection criteria (Akaike and Hannan Quinn) at lag 3 were all less than the values of the selection criteria (Akaike) for other lag lengths. This implied that lag 3 is the appropriate lag length for the VAR model. Hence, there is no need for re-estimation of the VAR at other lags less or more than 3.

Table 13: Lag Length Selection Criteria

varsoc

Selection-order criteria

Sample: 1995 - 2022

Number of obs = 28

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-718.419				1.9e+16*	51.6728	51.7455*	51.9107*
1	-698.013	40.813	25	0.024	2.7e+16	52.0009	52.4373	53.4283
2	-673.682	48.661	25	0.003	3.5e+16	52.0487	52.8487	54.6656
3	-642.483	62.399*	25	0.000	3.9e+16	51.6059*	52.7695	55.4122

Endogenous: dgdg dcp dli dfo dfi

Exogenous: _cons

Table 14 shows the stability condition for the estimated model. From the result of the table, all the inverse roots of the characteristic (AR) Autoregressive polynomial have modulus all less than and lie inside the unit, hence the estimated VAR model is stable. This implied that the $I(2)$ is stationary and the diverse test conducted on the VAR model are valid and can be used for future predictions.

Table 14: VAR Stability Condition

. varstable

Eigenvalue stability condition

Eigenvalue	Modulus
-.8373531 + .3477954i	.906709
-.8373531 - .3477954i	.906709
-.05921934 + .9045082i	.906445
-.05921934 - .9045082i	.906445
.3746248 + .7426724i	.831809
.3746248 - .7426724i	.831809
.3707534 + .6335949i	.734098
.3707534 - .6335949i	.734098
-.6523481	.652348
.001505 + .6186974i	.618699
.001505 - .6186974i	.618699
.5855205 + .1913001i	.615979
.5855205 - .1913001i	.615979
-.4810431 + .3783436i	.612002
-.4810431 - .3783436i	.612002

All the eigenvalues lie inside the unit circle.

VAR satisfies stability condition.

The figure below shows the graph of the residual of the fitted model. From the graph, the residual fluctuates around the mean error which is 0 as indicated by the red horizontal line in the graph. This fluctuation around the mean shows a good behaviour of the VAR model fitted.

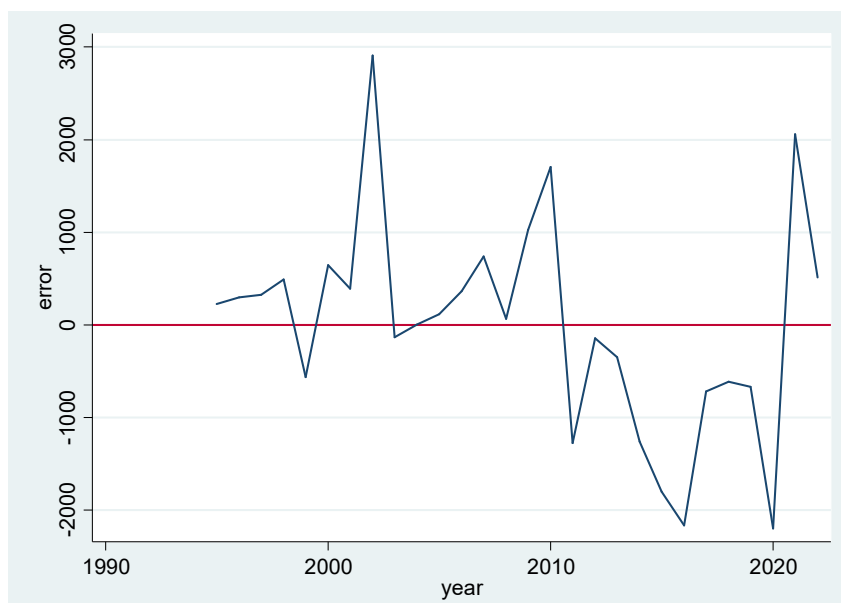


Figure 1: Graph of fitted VAR model

The Table 15 shows the test of autocorrelation or the lag range-multiplier test for estimated VAR model. The H_0 , there is no autocorrelation at lag order was not rejected. This is because the values $\text{prob} > \chi^2$ of 0.00247 and 0.01602 were all less 0.05. Therefore, there is no autocorrelation among the variables included in the model.

Table 16 shows the causality test using granger. The table showed that GDP does not cause the other variables which implied there is no relationship between GDP and the other variables (crop production, livestock, forestry, fisheries) and cannot be used in predicting the future values of the variables (crop production, livestock, forestry, fisheries) as the $\text{prob} > \chi^2$ of the coefficient for all $0.916 > 0.05$. However, crop production helps to cause other variables which implied that there is a relationship between crop production and the other variables (GDP, livestock, forestry, fisheries) and can be used in predicting their future values at 10% level of significance as the $\text{prob} > \chi^2$ of the coefficient for all $0.068 < 0.10$.

Furthermore, the result also showed that livestock, forestry and fisheries respectively help to cause other variables which implied that there are relationships between livestock, forestry and fisheries and the other variables and can be used in predicting their future values at 5% level of significance as the $\text{prob} > \chi^2$ value of 0.000, 0.000 and 0.042 for livestock, forestry and fishing respectively were less or equal to 0.05.

Table 15: Autocorrelation Test

. varlmar

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	49.4834	25	0.00247
2	42.4617	25	0.01602

H0: no autocorrelation at lag order

Table 16: Granger Causality test

. vargranger

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
dgd	dcp	.90441	3	0.824
dgd	dli	1.9515	3	0.583
dgd	dfo	.43534	3	0.933
dgd	dfo	.03632	3	0.998
dgd	ALL	6.0165	12	0.915
dcp	dgd	12.76	3	0.005
dcp	dli	1.1836	3	0.757
dcp	dfo	3.9767	3	0.264
dcp	dfo	12.761	3	0.005
dcp	ALL	19.934	12	0.068
dli	dgd	25.256	3	0.000
dli	dcp	25.161	3	0.000
dli	dfo	27.576	3	0.000
dli	dfo	5.3298	3	0.149
dli	ALL	42.584	12	0.000
dfo	dgd	70.537	3	0.000
dfo	dcp	103.21	3	0.000
dfo	dli	41.381	3	0.000
dfo	dfo	33.39	3	0.000
dfo	ALL	132.4	12	0.000
dfo	dgd	5.4469	3	0.142
dfo	dcp	9.2845	3	0.026
dfo	dli	2.7614	3	0.430
dfo	dfo	3.8773	3	0.275
dfo	ALL	21.63	12	0.042

6. Summary and Conclusion

Vector Auto Regression (VAR) as defined, is a statistical model used to measure and analyse the relationship between multiple variables over time. To measure and analyse the relationship between GDP, crop production, livestock, forestry and fisheries using VAR model, the variables were first tested for unit roots using Dickey-fuller Test. The results of the test are that the variables were not stationary as they contained unit roots. In order to make the data sets stationary, second order differencing $I(2)$ was conducted which made the series stationary using Dickey-fuller Test again. VAR model was then fitted. The result of the fitted model showed that the coefficients of lags 1, 2 and 3 of GDP, lag 1 of crop production, lags 2 and 3 of livestock, lags 1 and 3 of forestry and lags 1, 2 and 3 of fisheries were all negatively explained by GDP which is an indication that they are indirectly affecting GDP. This suggests that any unit increase in these variables at those lags leads to a decrease in GDP. At lags 2 and 3 of crop production, lag 1 of livestock, lag 2 of forestry there is a positive relationship with GDP. This implied that they affect GDP directly and any unit increase in these variables at those lags results to a corresponding unit increase in GDP as well. However, the result of the table also revealed that none of the coefficients of variables at the selected lags was statistically significant in explaining GDP. A check on the appropriate lag length was conducted so that the model should not be miss-specified if the lag length is too small, and if the lag length is too large, then the degrees of freedom are wasted. The result of the check showed that the appropriate lag length according to the selection criteria is lag 3. This is because the value 51.6069 of the selection criteria (Akaike) at lag 3 was less than the values of the selection criteria (Akaike and Hannan Quinn) for other lag lengths. This implied that lag 3 is the appropriate lag length for the VAR model.

However, a stability condition test for the estimated model was done. The result of the test revealed that all the inverse roots of the characteristic (AR) Autoregressive polynomial have modulus all less than and lie inside the unit. Hence the estimated VAR model was stable and may be used for future predictions. A graph was also plotted which showed the mean of the residual of the fitted model. However, the graph revealed that the residual fluctuated around the mean error which is approximately 0 as indicated by the red horizontal line in the graph. This fluctuation around the mean shows a good behaviour of the VAR model fitted. Furthermore, the test of autocorrelation or the lag range-multiplier test for estimated VAR model was examined. The H_0 that there is no autocorrelation at lag order was not rejected. This is because the values $\text{prob} > \chi^2$ of 0.00247 and 0.01602 were all less 0.05, which therefore implied that there is autocorrelation among the variables included in the model.

Finally, the causality test using granger was conducted. The results of the test are that GDP does not cause the other variables which implied there is no relationship that is between GDP and the other variables (crop production, livestock, forestry, fisheries) and cannot be used in predicting their future values as the $\text{prob} > \chi^2$ of the coefficient for all $0.916 > 0.05$ but crop production helps to cause GDP, livestock, forestry, fishing which implied there is a relationship between crop production and GDP, livestock, forestry, fisheries. Hence crop production can be used in predicting the future values GDP, livestock, forestry and fishing at 10% level of significant. Furthermore, the result also showed that livestock, forestry and fisheries respectively helped to affect other variables which implied a relationship between livestock, forestry and fisheries and can be used in predicting their future values at 5% level of significance as the $\text{prob} > \chi^2$ value of 0.000,

0.000 and 0.042 for livestock, forestry and fisheries respectively were less or equal to 0.05.

Accordingly, therefore, crop production in the areas of groundnuts, oil palm, rubber, cocoa etc. as it was until late 1980s was a major driver of the nation's economy hence contributing significantly to GDP. The country has now taken a downturn in agricultural production especially for crop production with heavy reliance on mineral oil and other solid mineral products. This paper therefore suggests strongly that a return to agriculture with rich investments in the component parts as shown in the results will strengthen the economy and further improve the GDP.

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Appendix I

Year	Cp	Li	Fo	Fi	GDP
1990	2828.59	462.22	72.61	101.29	21680.2
1991	2955.88	454.82	74.79	105.35	21757.9
1992	3044.55	458.92	76.51	94.81	22765.6
1993	3132.84	461.67	78.04	71.11	22302.2
1994	3226.83	466.29	80.07	66.49	21897.5
1995	3336.54	485.87	81.83	73.14	21881.6
1996	3463	499.96	82.24	88.35	22799.7
1997	3611.91	512.46	82.98	98.33	23469.3
1998	3752.77	526.3	83.98	112.2	24075.2
1999	3949.49	541.03	85.07	128.12	24215.8
2000	4067	553.48	86.35	133.25	25430.4
2001	4222.48	570.08	88.07	143.91	26935.3
2002	6977.88	597.5	88.69	153.02	31064.3
2003	7493.02	622.56	90.02	159.23	33346.6
2004	7956.66	663.03	95.87	173.02	36431.4
2005	8524.15	707.87	101.55	183.43	38777
2006	9162.65	756.73	107.66	195.43	41126.7
2007	9826.77	809.16	114.25	208.29	43837.4
2008	10438	864.19	121.22	221.97	46802.8
2009	11046.2	920.2	128.31	235.66	50564.3
2010	11683.9	979.56	135.72	249.71	55469.4
2011	12017.2	999.4	142.46	270.32	58180.4
2012	12919.5	972.76	146.09	291.31	60670.1
2013	13247.8	1030.94	154.31	317.47	63942.9
2014	13793.5	1086.85	161.34	338.75	67977.5
2015	14274.9	1151.32	167.64	358.7	69780.7
2016	14894.5	1185.12	171.64	356.13	68652.4
2017	15437	1204.21	177.33	360.91	69205.7
2018	15786.4	1208.13	182.75	366.83	70536.4
2019	16182	1210.06	187.47	379.06	72094.1
2020	16544.5	1233.11	190.51	380.03	70800.5
2021	16920.5	1240.22	193.22	384.45	73382.8
2022	17260.8	1247.72	196.36	386.24	75769

Appendix II

Year	Dcp	Dli	dfo	dfi	dgd
1990					
1991					
1992	-38.6196	11.5	-0.46	-14.6	929.9492
1993	-0.38013	-1.35001	-0.19	-13.16	-1470.96
1994	5.699951	1.869995	0.5	19.07999	58.54102
1995	15.71997	14.95999	-0.27	11.27	388.8594
1996	16.75	-5.48999	-1.35001	8.559998	934.0391
1997	22.44995	-1.58997	0.33001	-5.23	-248.479
1998	-8.04981	1.339935	0.259995	3.889992	-63.8398
1999	55.85986	0.890076	0.089996	2.050003	-465.182
2000	-79.21	-2.28009	0.190002	-10.79	1074.012
2001	37.96997	4.150085	0.440002	5.529999	290.2598
2002	2599.92	10.81995	-1.1	-1.55	2624.049
2003	-2240.26	-2.35999	0.709992	-2.90001	-1846.6
2004	-51.5	15.41003	4.520012	7.580017	802.3984
2005	103.8501	4.369934	-0.17001	-3.38002	-739.109
2006	71.00977	4.02002	0.43	1.590012	4.027344
2007	25.61914	3.570007	0.479996	0.860001	361.043
2008	-52.8984	2.600037	0.380005	0.820007	254.6602
2009	-3.05078	0.979981	0.119995	0.009995	796.1289
2010	29.57031	3.349976	0.320007	0.360001	1143.59
2011	-304.45	-39.52	-0.67	6.559998	-2194.09
2012	569.0596	-46.48	-3.11002	0.37999	-221.301
2013	-574.09	84.81995	4.590012	5.170013	783.1016
2014	217.3906	-2.2699	-1.19	-4.88001	761.8086
2015	-64.1602	8.559937	-0.73	-1.32999	-2231.38
2016	138.0195	-30.6699	-2.3	-22.52	-2931.48
2017	-76.9102	-14.7101	1.690002	7.350006	1681.516
2018	-193.209	-15.1699	-0.27	1.139984	777.4063
2019	46.15918	-1.98999	-0.7	6.310028	227.0781
2020	-33.0205	21.11987	-1.68001	-11.26	-2851.3
2021	13.4707	-15.9399	-0.32999	3.450012	3875.789
2022	-35.7695	0.390015	0.429993	-2.63004	-196.055