Sources of agricultural growth in Nigeria: is it horizontal and or vertical expansion

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Abstract

Knowledge of source(s) of increase in agricultural production is necessary for policy decisions. Increase in agricultural production could be achieved by increasing cropped area and or productivity. This paper examined the existence of long run relationship between area cultivated (hectarage) and production on the one hand and between crop yield (productivity) and production on the other hand for selected food crops in Nigeria using cointegration analysis. It also determined the magnitude as well as the persistence of production response to hectarage (or productivity) shocks for long run relationships by calculating variance decomposition and impulse responses. The results showed that long run relationship existed between hectarage and production for rice, cassava, groundnut, melon, maize and guinea corn and between productivity and production for guinea corn only;) horizontal expansion accounted for most variation in production of rice, maize, melon and cassava; and production response to hectarage shock was essentially expansionary and persistent in most cases. For sustained increase in agricultural production in Nigeria, efforts should be directed at policies that ensure easy availability of cropped land while not neglecting research into the better use of improved technology for productivity rise.

Keywords: food crops, production, horizontal expansion, vertical expansion, Nigeria

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1. Introduction

There are compelling reasons to pay more attention to agriculture. This is because some three-quarters of the world's absolute poor live in rural areas, and their livelihood, are most often linked to agriculture (UN, 2001). At the same time, agriculture has a major impact on environment and is closely connected to water, health and nutrition, and education. The New partnership for Africa's Development (NEPAD) raised agriculture as a priority for Africa.

Agriculture is the mainstay of the Less Developed Countries (LDC) economies, underpinning their food security; export earnings and rural development. Significant progress in promoting economic growth, reducing poverty and enhancing food security cannot be achieved in most of these countries without drawing more fully upon the potential productive capacity of agriculture and its contribution to overall economic development. Despite its importance to the economy, agriculture in LDCs has remained largely underdeveloped in production both for the domestic market and for export.

The performance of the agricultural sector in Nigeria has not been stable. It improved in 2003 when aggregate index of agricultural production was estimated at 190.9 (1990 = 100), compared with 179.9 in the previous year. This showed an increase of 6.1 percent, compared with 4.0 percent recorded in 2002 and an average of 5.6 percent for the period 1999 to 2002 (Table 1).

Table 1: Index of Agricultural Production by the Activity

Sub-sector	**1999**	**2000**	**2001**	**2002**	**2003**
			1990 = 100		

Crops	165.5	171.0	177.1	184.1	196.2
Other crops	129.7	134.0	134.8	137.7	141.8
Livestock	153.0	157.2	163.7	170.5	179.0
Fishing	140.6	146.0	150.5	160.0	163.3
Forestry	116.3	118.1	120.4	121.3	124.2
Aggregate	161.7	167.0	173.0	179.9	190.9

Source: Central Bank of Nigeria (2003).

All the sub-sectors of agriculture contributed to the growth in output. Output of staples (in Table 2) grew by 7.1 percent, compared with 4.2 percent in 2002. All the major staple crops recorded increases in output during 1999 – 2003 period (CBN, 2003).

Table 2: Estimated output of Staples ('000 tonnes)

Crop	**1999**	**2000**	**2001**	**2002**	**2003**
Maize	6,515.0	6,491.0	6,592.0	6,698.0	7,019.5
Millet	6,391.0	6,765.0	7,088.0	7,231.0	7686.0
Sorghum	8,464.0	8,854.0	9,408.0	9,687.0	10229.5
Rice	3,522.0	3,865.0	3,989.0	4,085.0	4264.7
Beans	2,096.0	2,281.0	2,409.0	2,612.0	28,37.4
Cassava	35,980.0	36,795.0	37,949.0	39.410.0	41,853.4
Yam	25,950.0	26,451.0	27,589.0	28,979.0	31,471.2
Melon	340.0	352.0	356.0	384.0	423.2
Groundnut	2,307.0	2,390.0	2,361.0	2,375.0	2439.1

Source: Central Bank of Nigeria (2003)

These increases in agricultural production were either achieved through horizontal expansion (putting more land under cultivation) or vertical expansion (increasing production per unit of land through intensification). Productivity of land can be increased through the adoption of scientific methods of farming. These include the use of highyielding crop varieties, the application of fertilizers, the use of pesticides, farm mechanization and provision of irrigation facilities.

In most cases, where land is available for horizontal expansion, it is cheaper to increase agricultural production by opening up more land for crop production. Vertical expansion (intensification) may also be difficult to adopt by resource poor farmers because of high input requirement as well as high cost of agricultural inputs occasioned by the devaluation and liberation of markets. However, faster agricultural growth, particularly in countries with limited scope for land expansion will require continuing increases in land productivity. The most widely used indicator of crop productivity is production per unit of land (also referred to as crop yield).

Agricultural production function can be expressed as
$q=f(x_1,x_2)$ ………………………………………………………………… (1)
which states the quantity of output (q) as a function of the quantities of variable inputs x_1, and x_2.

Where x_1 - and x_2 are land area cropped and land productivity (crop yield), respectively.

The total product of x_1 in the production of Q is defined as the quantity of Q that can be secured from the input of $x_1$if x_2 is assigned the fixed value $x^0{}_2$:$q=f(x_1,x^0{}_2)$……………………………………………………………….. (2)

The input level $x^0{}_2$ is treated as a parameter, and q becomes a function of x_1 alone. The relation between q and x_1 may be altered by changing $x^0{}_2$. An improvement in crop yield (productivity) on the application of scientific methods can lead to the development of a new production function with a greater output coming from a given total input of farm resources. A typical distinctive example of output increasing technological change is that of hybrid corn.

This study intends to determine whether increases in food crops production in Nigeria owes a great deal to horizontal expansion or to advances in yield enhancing technologies. The specific objectives of this study are:

(a) to examine whether there is a long run relationship between area cultivated and food crop production on the one hand, and crop yield and food production on the other hand; and

(b) in case of long run relationship, to quantify and determine persistence of causality patterns.

The paper is divided into four sections. The next section discusses the methodology (concepts) which are required for the development of the test. Section 3 presents and discusses the results while the last concludes the study.

2. Materials and methods

Suppose the relationship between area planted (or crop yield) at period t (x_t) and agricultural output at period t (y_t) is presented in (3)

$y_t=\beta_0+\beta_1 x_t + u_t$……………… ………………………………………………...(3)

and the disequilibrium error is given by (4)

$u_t=y_t-\beta_0-\beta_1 x_t$ …………………………………………………………...(4)

If a long run relationship exists, then disequilibrium errors such as (4) should form a stationary time series and have a zero mean, that is, u_t

should be I (0) with E (u_t) = 0 (Engle and Granger, 1987). A unique long-run relationship between two time series x_t and y_t can be said to exist if (a) both the time series x_t and y_t are I(1), that is, become stationary on first differencing, and (b) there is some linear combination of x_t and y_t that is I(0), that is, stationary. When this is the case, we can be certain that any correlation over time between x_t and y_t is not spurious (Thomas, 1997).

When conditions (a) and (b) above hold, x_t and y_t are said to be co-integrated. Thus co –integration is the statistical equivalent of the existence of a long run economic relationship between I(1) variables. Both x_t and y_t must be I(1) if they are to be co-integrated.

In the bivariate context, co-integration requires that both variables under consideration are of the same order of integration. A series that is required to be differenced d times to become I(0), is called integrated of order d, denoted as I(d).

To determine the order of integration, we use two procedures (Engle-Granger tests):

(a) Dickey Fuller (DF) and
(b) Augmented Dickey – Fuller (ADF) tests. The DF procedure is based on the following regression:

$$\Delta y_t=\beta y_{t-1}+e_t \quad \text{.......}(5)$$

In (5), the null hypothesis is that:

$H_0 : \beta = 0$ (this implies that y is nonstationary)

The alternative is:
$H_a: \beta < 0$ (this implies stationarity)

where Δ denotes the difference operator and β is parameter to the estimated. A negative and significantly different from zero value of β indicates that y_t is I(0). Finally, ADF procedure accounts for the possibility that e_t is not white noise; It is based on the following regression:

$$\Delta y_t = \beta y_{t-1} + \sum \sigma_i \Delta y_{t-i} + e_t \quad \text{..(6)}$$

Again, a negative and significantly different from zero value of β indicates that y_t is I(0).

The hypothesis to be tested is H_0: y_t is not I(0) against H_a: y_t is I(0). If H_0 is not rejected, the same tests are repeated after taking first differences. In this case, the hypothesis becomes H_0: Δy_t is not I(0) against H_a: Δy_t is I(0).

These tests are very sensitive to the inclusion or otherwise of constant and trend terms. For instance, if one includes trend term when none is required, the test loses power (tendency to under reject the null when it is false). On the other hand, if one fails to include the trend term when one is present, the test loses power too. For this reason, different specifications were tried and the lead one chosen using statistical criteria.

To determine the appropriate lag length or the number of differenced terms to include in (6), we use Akaike information criterion (AIC). In this case, the criterion is to include an extra variable only if it decreases the AIC. The optimum lag length is the one with the least AIC value.

If the variables of interest are all I(1), to test for co-integration we regress one variable on the other and then test whether the estimated residual is I(0). In other words,

$$y_t=\beta_0+\beta_1 x_t+e_t \quad \text{...(7)}$$

is estimated and then test e_t in (8) for stationary using the DF an ADF tests.

$$e_t = y_t - \beta_0 - \beta_1 x_t \quad \text{……} \quad (8)$$

Where β_0 and β_1 are OLS estimates of the true β_0 and β_1. Stationary residuals imply that x_t and y_t are co-integrated. However, since OLS residuals have zero mean, and we do not expect them to have deterministic trend, both intercept and time trend are normally excluded from the DF regression. If the variables being considered are cointegrated, there exists Granger-causality in at least one direction. Furthermore, the bivariate system as defined by y_t and x_t can be represented by an error correction mechanism (ECM). The importance of such representation is that one can construct the vector autoregressive (VAR) representation in the sense of Sims (1980), by incorporating the long run relationship between y_t and x_t in the following way:

$$\Delta y_t = \mu_1 + \beta_1 e_{t-1} + \sum_{i=0}^{n} \gamma_{1i} \Delta y_{t-i} + \sum_{i=0}^{n} \delta_{1i} \Delta x_{t-i} + v_{1t}$$

$$\Delta x_t = \mu_2 + \beta_2 e_{t-1} + \sum_{i=1}^{n} \gamma_{2i} \Delta x_{t-i} + \sum_{ti=0}^{n} \delta_{2i} \Delta y_{t-i} + v_{2t} \quad \text{……} \quad (9)$$

e_{t-1} denotes the lagged level error term from cointegrating regression. μ_1, μ_2, β_1, β_2, γ_1, γ_2, δ_{1i}, δ_{2i} are parameters to be estimated and n denotes the number of lags. V_{1t} and v_{2t} are assumed to be mutually uncorrelated white noise processes. Equation (9) is sometimes called restricted VAR representation, where the restriction is the residual from the cointegration regression. The advantage of the ECM as opposed to unrestricted VAR is that by including the residual, both information in levels is retained and the stationary properties of the variables involved in the system are taken properly into consideration. Moreover, impulse responses and variance decompositions can be calculated from the estimated ECM system as means of quantification of the causality effects.

Variance Decomposition

Variance decomposition exhibits the contribution of each source of innovation to the variance of the k – year ahead forecast error for each of the variables included in the system. Stated otherwise, variance decomposition refers to the breakdown of the change in the value of the variable in a given period arising from changes in the same variable as well as other variables in previous periods.

Impulse Responses

Impulse responses give the dynamic response of each variable to innovations of this variable as well as other variables included in the VAR system. In other words, impulse responses describe whether a shock of one variable has a persistent or transitory effect on the other variable as well as on the variable itself (Baffes and Shah, 1994).

Data and their Sources

Annual time series data were collected on output, hectarage (area planted) and yield figures for maize, melon, rice, beans, millet, groundnut, cassava and rice for the period 1966 – 2001. These data were obtained from the Federal Office of Statistics, Lagos, Nigeria.

3. Results and Discussion

DF and ADF statistics for the level variables are shown in Table 3. The ADF statistics suggest non-stationarity in level for all variables except maize yield which is stationary in level while the DF statistics suggest stationary for melon (area and production) guinea corn (area), groundnut (yield), maize (yield) and rice (yield) and non-stationarity for others. Since DF is known to readily accept stationarity, we take it that it is only maize yield that is stationarity in level as both DF and ADF statistics suggest this.

DF and ADF statistics for the first differences are shown in Table 4. These statistics clearly suggest stationarity for all the variables. Non-stationarity is rejected at 5 percent level in all cases. Of the three basic data series, output and hectarage appear to be I(1) for all the selected crops, while yield is for all but maize. This means that we look for a possible long run relationship between hectarage and production across selected crops and between yield and production for all but maize. This is done by conducting test of co-integration between these variables.

Table 3: Stationary Tests for Logarithms of Variables

	DF	ADF (1)	ADF (2)	ADF (3)	ADF (4)
Melon +	-2.967*	-2.088	-1.816	-1.79	-1.544
Melon ++	-3.844*	-2.102	-1.686	-1.372	-1.123
Melon +++	-2.751	-2.031	-1.543	-1.772	-1.999
Guinea corn +	-3.114*	-2.085	-1.481	-1.399	-1.909
Guinea corn ++	-2.596	-1.99	-0.550	-0.963	-0.557
Guinea corn +++	-2.876	-2.084	-1.424	-1.355	-1.63
Groundnut +	-1.122	-1.100	-1.328	-1.488	-1.286
Groundnut ++	-2.111	-0.805	-0.430	-0.641	-1.177
Groundnut +++	-5.074*	-2.914	-2.631	-2.464	-2.397
Maize +	-0.385	0.045	-0.015	-0.601	0.762
Maize ++	-0.773	-0.211	-0.274	0.015	0.024
Maize +++	-6.055*	-4.656*	-3.820*	-2.251	-3.537*
Cassava +	-0.493	-0.358	-0.310	-0.680	-0.872
Cassava ++	-1.161	-0.828	-0.664	-0.609	0.603
Cassava +++	-2.142	-1.666	-1.593	-1.740	-1.996
Beans +	-1.221	-0.820	-0.663	-0.946	-1.252
Beans ++	-1.602	-1.461	-0.566	-0.446	0.751
Beans +++	-1.786	-1.894	-2.057	-1.735	-1.771
Rice +	-0.687	-0.606	-0.598	-0.601	-0.583

Rice ++	-2.376	-1.388	-0.613	-0.711	0.481
Rice +++	-5.215*	-2.884	-2.507	-2.186	-2.014

+ - area cultivated ++ - production +++ - yield * - significant at 5% level

Table 4: Stationary Tests for First Differences

Variable	DF	ADF (1)	ADF (2)	ADF (3)	ADF (4)
Melon +	-7.674**	-4.856**	-3.710**	-3.454**	-3.451**
Melon ++	-13.73**	-7.608**	-4.090**	-3.059**	-3.136*
Melon +++	-9.917**	-4.907**	-3.645*	-3.821**	-3.369*
Guinea corn +	-7.963**	-5.831**	-3.921**	-3.002*	-2.726
Guinea corn ++	-6.968**	-8.415**	-3.508*	-3.419*	-3.327*
Guinea corn +++	-8.246**	-6.627**	-5.335**	-4.930**	-4.031**
Groundnut +	-5.479**	-3.225*	-2.349	-2.341	-2.214
Groundnut ++	-9.861**	-5.595**	-3.366*	-2.169	-2.362
Groundnut +++	-11.08**	-6.681**	-4.653**	-3.482*	-4.812**
Maize +	-6.712**	-3.991**	-2.346	-1.998	-2.111
Maize ++	-7.737**	-4.230**	-3.729**	-2.925	-2.171
Maize +++	-9.664**	-6.291**	-5.417**	-3.392*	-3.322*
Cassava +	-5.732**	-3.743**	-2.524	-2.119	-2.054
Cassava ++	-6.440**	-4.317**	-3.390*	-2.811	-2.351
Cassava +++	-6.982**	-4.403**	-3.133*	-2.439	-2.397
Beans +	-6.543**	-4.639**	-2.912	-2.239	-2.244
Beans ++	-6.007**	-6.281**	-4.180**	-5.283**	-3.870**
Beans +++	-5.934**	-5.447**	-4.543**	-5.327**	-2.890
Rice +	-5.386**	-3.531*	-2.937	-2.555	-1.877
Rice ++	-6.650**	-3.719**	-3.363*	-3.462*	-2.740
Rice +++	-11.44**	-5.877**	-4.686**	-4.241**	-3.902**

x - significant at 5% level

xx - significant at 1% level.

Results of co-integration test (using Engle- Granger two- stage procedure) are presented in Tables 5 (a&b) below. The DF and ADF tests give evidence of co-integration between hectarage and production in respect of maize, melon, guinea corn, groundnut, cassava and rice. They also suggest co-integration between yield and production in respect of only guinea corn. This means that there is a long run relationship between area cultivated and production (as provided by economic theory) for all but beans. It is so between productivity and production for guinea corn only. The implication of this is that the growth in food crop production is Nigeria is determined mainly by horizontal expansion rather than vertical expansion (increasing productivity per unit of land through intensification). This finding is similar to that reported for LDCs where horizontal expansion accounted for about 77 percent of agricultural growth (UN, 2001). It is also consistent with the findings of Frisvold and Ingram (1995) who found the growth in the stock of traditional inputs (land, labour and livestock) as the dominant source of output growth in sub-Saharan Africa. In addition, Akpokoje et al (2001) and Nwanze et al (2006) attributed much of the expansion in rice production in Nigeria to vast increases in area under rice cultivation

Table 5a: Co-integration Tests for Production vs Area Cultivated

Variable	ADF (4)	ADF (3)	ADF (2)	ADF (1)	DF
Melon	-1.529	-1.562	-1.596	-1.879	-3.474**
Guinea corn	-1.152	-1.410	-1.580	-2.358*	-3.165**
Groundnut	-2.202*	-1.992*	-2.091*	-2.803**	-5.462**
Maize	-1.599	-1.862	-2.012*	-2.287*	-3.584**
Cassava	-2.878**	-2.984**	-3.142**	-3.551**	-5.812**
Beans	-1.229	-1.428	-1.573	-1.926	-2.016*
Rice	-2.179*	-3.031**	-3.233**	-2.972**	-5.214**

* - Significant 5% level
** - Significant at 1% level

Table 5b: Co-integration Tests for Production vs yield

Variable	ADF (4)	ADF (3)	ADF (2)	ADF (1)	DF
Melon	-1.589	-1.757	-1.595	-1.760	-2.998**
Guinea corn	-1.706	-1.468	-1.363	-2.164*	-2.950**
Groundnut	-1.451	-1.308	-0.924	-0.7738	-2.950**
Maize	-0.8297	-0.1607	-0.312	-0.2032	-0.7258
Cassava	-0.8297	-0.8647	-0.663	-0.5254	-1.329
Beans	-0.8165	-0.8051	-0.5996	(-0.9485	-1.250
Rice	-0.6868	-0.8744	-0.7037	-0.5915	-0.6955

* - Significant 5% level
** - Significant at 1% level

Variance Decomposition

Variance decompositions (and later impulse responses) are presented only for the cases in which there was co-integration. Variance decomposition results depict the magnitude of the effect of horizontal expansion on production for co-integrated relationships.Table 6 gives estimates of variance decomposition for rice, cassava, groundnut, maize, melon and guinea corn.

Table 6: Variance Decomposition of Production

Period/crop	Melon		Maize		Groundnut		Rice		Cassava		Guinea corn	
	H	P	H	P	H	P	H	P	H	P	H	P
1	79.84	20.16	72.94	27.06	46.19	53.81	75.20	24.80	30.40	69.60	64.73	35.26
2	78.49	21.51	67.86	32.14	42.64	57.36	74.47	25.53	30.79	69.21	67.15	32.85
3	73.45	26.55	68.33	31.67	46.42	53.58	76.99	23.01	36.09	63.91	66.50	33.50
4	73.34	26.66	66.99	33.01	46.21	53.79	78.77	21.23	44.90	55.10	68.46	31.54
5	71.77	28.23	65.99	34.01	45.33	54.67	80.56	19.44	47.08	52.92	69.35	30.65
6	74.06	25.94	67.17	32.83	45.09	54.91	82.08	17.92	50.14	49.86	69.64	30.36
7	74.05	25.95	69.16	30.84	45.12	54.88	83.08	16.92	53.88	46.12	71.20	28.80
8	74.39	25.61	69.64	30.36	45.14	54.86	84.01	15.99	56.48	43.52	72.02	27.98
9	74.89	25.11	71.30	28.70	45.13	54.87	84.81	15.19	58.87	41.13	72.59	27.41
10	74.82	25.18	72.27	27.73	45.11	54.89	85.50	14.50	61.19	38.81	73.61	26.39

H and P denote hectarage and production, respectively.

The results regarding cassava can be summarized as follows: innovations in area cultivated account for about 30% of the variation in future production in the near periods, but account for about 61% variation in future production overtime. Stating it differently, horizontal expansion is of increasing importance in explaining future variation in cassava production. On the contrary, past production declines in importance over time.

For groundnut, horizontal expansion and past production have an almost equal share in accounting for variations in production (45% and 55% respectively). This picture remains the same throughout the periods. Horizontal expansion accounts for most of the variation in future production (75% - 86%) for rice and it increases in importance over time. It increases from 75% in the first period to 86% in the last period. Past production declines in importance (in explaining future variation in production of rice) from 25% to 15%.

Horizontal expansion also accounts for most of the variation in future production (67% to 73%) for maize. It is slightly declining in importance over the first five periods (75% to 66%) and then becoming increasingly important for the last five periods (66% to 72%). While the contrary holds for past production. For melon, horizontal expansion also accounts for most of the variation in future production of melon. It accounts for between 72% and 80% while past production accounts for less than 30% of the variations in future production of melon. In the case of guinea corn, horizontal expansion accounts for most of the variation in future production of the crop. It increases in importance in explaining future variation in production from about 65% in the first period to 74% in the last period. The reverse is the case for variation in production.

Impulse Response

Impulse responses depict whether production response to hectarage shocks is temporary or permanent. Table 7 depicts impulse responses for cassava, melon, rice, groundnut, maize and guinea corn.

Table 7: Hectarage Shock/Production Response

Response Period	Melon	Rice	Cassava	Guinea corn	Maize	Groundnut	Guinea corn yield
1	0.682	0.45	0.34	0.23	0.30	0.28	0.10
2	-0.286	0.13	0.20	0.08	0.20	-0.011	-0.03
3	0.51	0.24	0.22	0.03	0.07	0.22	-0.03
4	0.15	0.20	0.30	0.19	0.09	0.11	0.08
5	0.14	0.24	0.18	0.10	0.09	0.06	0.02
6	0.37	0.21	0.25	0.05	0.09	0.13	0.03

7	0.07	0.22	0.25	0.15	0.11	0.10	0.05
8	0.31	0.22	0.23	0.11	0.06	0.09	0.03
9	0.19	0.22	0.23	0.06	0.11	0.11	0.01
10	0.20	0.22	0.24	0.12	0.09	0.10	0.03

As shown in Table 7 a one-standard deviation shock on hectarage induces more production of cassava for the ten periods. That is, area cultivated has a persistent effect on production of cassava.

The effect of hectarage shock on melon production is positive for all other periods except the second and last for the ten periods. This means that hectarage shock has persistent expansionary effect on production. A one-standard deviation shock on area cultivated induces more rice production over the ten periods. The largest effect on production is recorded in the first period. The effect of hectarage shock on production is however persistent.

In the case of groundnut, one-standard deviation shock on hectarage induces more production in the first six periods while after the sixth, the effect becomes negligible. In other words, the effect of hectarage shock lasts for only six periods, that is, the effect is temporary or transitory. In respect of maize, a one-standard deviation shock on hectarage induces more production for the ten periods. Here too, the effect of hectarage shock on production is persistent and expansionary. For guinea corn, hectarage shock exerts positive effect on production for the ten periods while that of productivity is oscillatory and negligible in some periods. The effect of the former is clearly expansionary and persistent and greater in magnitude than that of the latter.

4. Conclusions

In this paper an attempt was made to determine the existence of long run relationship (as postulated by economic theory) between hectarage and production on the one hand and between productivity (crop yield) and production for selected food crops on the other hand in Nigeria and determine the magnitude and persistence of production response to hectarage (or productivity) shocks for co-integrated relationships by calculating variance decomposition and impulse responses.

The results showed that long run relationship existed between hectarage and production for rice, cassava, groundnut, melon, maize and guinea corn and between productivity and production for only guinea corn for the period under review. Variance decomposition showed that horizontal expansion accounted for most of the variation in production of rice, maize, melon and cassava while it is moderate for groundnut: Productivity (crop yield) however, accounted for low percentage of the variation in guinea corn production. Impulse responses showed that production response to hectarage shock was generally expansionary and persistent for cassava, melon, rice and maize but temporary for groundnut. That is the effect is both immediate and long term. Finally, it can be said that the growth in food crop sub sector over 1966 – 2001 period owes more to horizontal expansion rather than enhanced land productivity through intensification practises.

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