

Case Study

Soybean Supply Response for Food Security Dynamics in Nigeria: An ECM Approach

Abstract

Food insecurity is blamed on supply dynamics as low farmers responsive behaviours to food policy regime in Nigeria persist in the long-run. This study is aimed establishing farmers response to food security through soybean output response. Data were drawn from series of unit domestic and export prices, volume of export and output supply of soybean, its acreage and weather condition with rainfall as proxy from CBN and NBS annual bulletin from 1960 to 2012. Analysed were done with descriptive statistics, ratios and econometric models such as Nerlove partial adjustment and Cob-Daughlas models, cointegration test and error correction mechanism (ECM). There is a fluctuating changes in supply from 186.9% in 1986-1990 due to SAP policies to a drastically decline to 4.6% before 2012 reflecting a food insecurity dynamism. Though there is a short-run divergence of all the series, the ECM showed that about 34.4% proportion of the disequilibrium in the soybean supply in less than one period was corrected in the next period. Evidence of short-run inelastic and positive domestic and export price of actual supply persisted in the long run though with a slight improvement. Thus, making farmers supply responsiveness to food self sufficiency a short term event. The same with rainfall and acreage, thus making farmers to response to policies on irrigation and expanded area of land for soybean cultivation imperative. Adjustment coefficient is 0.888, which is positive and less than unity. Therefore, the slight rise in actual supply is never instantaneous but rather due to farmers effort in short-run adjustments to bring an expected output supply to the actual supply level. It is recommended that acreage distance and irrigation (to support short rainfall duration of the savannah region) be included in government policies to increase farmers supply responsiveness. Farmers should also look inward toward attaining efficiency since it is more cost-effective to galvanize improved returns and output, hence elastic soybean supply through efficiency than new technologies.

Keywords: Food, Supply, Response, Security, Soyabeans, Elasticities

Introduction

Agriculture plays a pivotal role in economic development of Nigeria especially now that there is a dramatic transformation in food self sufficiency and emerging food markets. Government concern in making agriculture a part of its economic diversification agenda, major foreign exchange earner and contributor to the nation's gross domestic product must underscore the adequacy of food supply response behaviours to its price policy framework and other factors of food production. The dependency of agricultural output supply on some market and policy behaviours as well as climatic conditions are really instantaneous because very often, agricultural output supply response to these variables with a lapse of time called *lags* (Gujarati, 1995). The behaviour of these lag variable is a source of concern for food security. Though it has attracted a

little attention in literature, food supply dynamic accentuates food accessibility and consequently food security dynamics of any society (Tripathi, 2008). Food policy framework in the last few years has only centered on food productivity growth as a sure means of food security, employment generation, foreign exchange earnings and poverty reduction (Onyenweaku *et.al.*, 2010) but it has not been made central to long term food accessibility. Productivity growth failed to explain the distortion in a long run food supply because of the effect of lapse of time on the expected full adjustment in input and production constraints like climate on actual output supply.

Agricultural output supply assumes a steady food security in the economy overtime when there is a stable economic development objective in the long-run. But changes in price and non-price factors overtime, sets up food insecurity dynamics as farmers response to variations in lagged commodity prices and prices of factors of production in local and national food market both in short and long-run influence (Nerlove and Bachman, 1960). Supply responsiveness is thus a veritable means for assessing the impact of food security and economic reforms. Policies with appropriate incentive like price or non-price incentives is likely to bring about high supply responsiveness, while those that act as disincentives are less likely to do so. Interestingly, own food price changes generate more revenue as farmers are likely to produce more of such product at better prices, thus ensuring long-term food security (Oguoma *et. al.*, 2010).

Soybean (*Glycine max*) production grew by an annual rate of 9.11% during 1984-2008 to an average of 620,396 tons annually between 2004 and 2008. The crop is not only considered as trade commodity but also a political commodity in the context of food security (CBN, 2003). Though Nigeria is the largest producer in Africa, the crop shows some irregular supply pattern due to farmers irregular response behaviour since 1962 (IITA, 2009). There is an increased output of 2,600 tones/farmer due to a favourable food pricing policy but the output supply dropped by about 18.6% during the crude oil era in late 70's due to reallocation in farm input resources following a near total neglect in food production policy (RMRDC, 2004). The various policy regime in the country translate to changes in consumer food prices and farm input prices hence the fluctuations in commodity prices and farmers response to soybean supply.

The insistent price fluctuations in soybean invoke inability on annual production of the product. Variations in output are largely due to reallocation in factors of production and expected prices rather than the actual prices and such problems often arouse fear among farmers as anticipated fall in actual output from expected output will reduce the gross revenue required for

the next cropping season. CBN (2003) observed that an anticipated rise or fall in price of food is responsible for the differences in actual and expected output supply of most soybean grains. An adjustment mechanism that brings the actual supply close to expected supply of soybean sets up an oscillatory price on the product in the marketing system with a dynamic movements in equilibrium price. This explained the shortage of the product at one time and surpluses at other times in the food market. The unstable price and supply movement of food supply account for increased food insecurity in the economy (Ehirim, *et al.*, 2007) thus, supply response for soybean is imperative for stable price policy and steady market of the product. Price adjustment, economic policies and natural factors that over time drift supply to a steady state economy and need for soybean supply to response to factors of its production in both short and long run formed the central idea of this study.

Conceptual Development

Agricultural sector is dominated by the food crops sub-sector, hence its market stability strengthens food security and fosters economic growth. Food security is achieved when all people, at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996). Tollens (1998) identified four dimensions of food security namely: the availability of food, that is enough food for an active and healthy life; the stability of supplies over time, that is, the guarantee that food is available at any given time; access to food, and utilization of foods, meaning procurement, ingestion and digestion of enough and qualitative food for maintenance of good health. The stability of soybean supply over time connotes adequate availability from all sources to meet the per capita protein requirement of the population over time. The volume, composition over time, and stability of soybean production are the most important determinants of aggregate its national supply and availability in Nigeria. Also important are the level of its import or the national capacity to import soybean.

At the international level, food security means adequate global food availability and adequate capacity by food-deficit countries to import or otherwise acquire food in required quantities from food surplus countries (Olayemi, 1998). An operational approach of “food security” is on its integration into the macro and micro economic level. Oktaviani and Asmarantaka (2010) noted that household food security is an integral part of macro economy and national food market growth despite its assumed influence by the international agricultural

commodity market volatility. This integrative view is based on both spatial and vertical food market integration, such that the national food market will be an aggregated micro markets in the community level. Agriculture and rural development is anchored on a market stability, which requires farmers response to adequate input and commodity price policies that draws a steady state food supply system, hence a steady food secured regime. On the contrary, Nigeria's domestic production of soybeans has shown a continued upward output regime, which does not meet the rapidly growing demand and the resultant deficit had doubled the price in 2008. United State Development Agency (USDA, 2008) noted that the such increased lagged prices have left no remedy than a rise import and unfavourable foreign exchange regime that intensified food insecurity issues in Nigeria.

Adjusting the desired (expected) output supply to meet the actual annual prices and supply of the soybean is a means to market stability. The expected unit price of soybean galvanize short run supply to a steady adjustment that equates to actual supply in the longrun. The desired (expected) quantity supplied and the actual supply in year(t) makes a change that approaches unity (1) when there is a full adjustment in factor prices, food policy changes and production constraints in the long-run. The desired (expected) output supply of soybean (Q_t^d) in year(t) is a distributed lagged model that is explicitly expressed in Nerlovian sense as:

$$Q_t^d = \beta_0 + \beta_1 P_{t-1} + \beta_2 Exp_{pt-1} + \beta_3 Exp_{vol} + \beta_4 R_t + \beta_5 A_t + \varepsilon_t - - - - 1.0$$

Where; Q_t^d is the desired (expected) quantity of soybean supplied in kifogramme in year(t)

P_{t-1} is expected unit domestic price in year(t) base on the previous expectation measured in naira

EXP_{pt-1} is the expected export price of soybeanbase on pervious expectation in naira

EXP_{vol} is the volume of export in tonns

A_t is average are of land with soybean cultivation in year(t) measured in hectares

R_t is the volume of rainfall in year(t) in millimeters

$\beta's$ are vectors to be estimated in the equation

The Nerlovian framework in equation 1.0 has both price expection and adjustment in other factors of output supply of soybean in the model. This study is interested in the change between actual and the desired (expected) level output supply. The change could be due to farmers response to farm input price variations, policy constarints, response to commodity price, farming and financial risk, weather changes and variation in land and edaphic factors. However, all these changes are accomodated in Nerlovian adaptive expectations because the changes in

yield between a time period occur in proportion to differences between actual output supply in the current period and the actual output supply in the previous period which is capable of generating food insecurity dynamic pending when a steady supply adjustment is achieved in the long-run. In this case the distributed lagged model becomes an autoregressive (dynamic) model (Gujarati, 1995). The Nerlove adjustment model for soybean supply is thus expressed as:

$$Q_t - Q_{t-1} = \delta\{Q_t^d - Q_{t-1}\} \quad \text{--- 2.0}$$

Where: Q_t is the actual supply in year(t), Q_{t-1} is the previous output supply, $Q_t - Q_{t-1}$ translate to the change in output supply of soybean and Q_t^d is already expressed in equation 1.0
Simple substitution will give the actual output supply in year(t) as

$$Q_t - Q_{t-1} = \delta\{\beta_0 + \beta_1 P_{t-1} + \beta_2 Exp_{pt-1} + \beta_3 Exp_{vol} + \beta_4 R_t + \beta_5 A_t + \varepsilon_t - Q_{t-1}\} \quad \text{--- 3.0}$$

Expand and re-arrange equation 3.0

$$Q_t = \delta\beta_0 + \delta\beta_1 P_{t-1} + \delta\beta_2 Exp_{pt-1} + \delta\beta_3 Exp_{vol} + \delta\beta_4 R_t + \delta\beta_5 A_t + (1 - \delta)Q_{t-1} + \delta\varepsilon_t \quad \text{--- 4.0}$$

The actual output supply of soyabean in Nerlovial sense include the farmers response to factors such as weather, area under soybean cultivation, previous supply of soybean and expected price from the previous experience.

Methodology

1. Study Area and Sample Selection

The study covered the entire Nigeria. Nigeria lies between longitudes 2°-15° east of the Greenwich Median and latitude 5°-15° north of the equator. The area is bounded to the East by Republic of Cameroon, to the west by Republic of Benin, to the north by Republic of Niger and South by Atlantic Ocean. Nigeria has a wide range of climatic distribution and six vegetative belts spread across savannah and forest zones. It has a rainfall and temperature range of 1500mm to 2500mm and 18 to 37°C respectively (NMA,2004) with an enormous population of over 140 million people (NPC,2006). Soybean is mostly grown in the savannah region of the countryside because of its ecological and climatic requirment of the crop. Secondary data from CBN annual statistical bulletin, National Bureau of Statistics (NBS) data base, Food and Agricultural

Organization (FAO) and journals were used for this study. Data collected from CBN annual and NBS statistical bulletin include aggregate annual prices (in naira) and quantities of soybean supplied (in tones), annual rainfall (in millimeters) and acreage of soyabean cultivated (in hectares) from 1960 to 2012 and used for analysis.

2. Analytical Procedure and Model Specification

Trend in food supply follows agricultural gross domestic supply as a proxy. A time series data spanning between 1960 to 2011 was used in this study. The issues raised against agricultural supply response were better tackled with either price expectation adjustment or partial output adjustment as shown between equation 2.0 to 4.0 above. The distinction between expected and actual supply of soybean in Nigeria within the time lapse is captured within Nerlove (1958), Ehirim *et.al.* (2007) and Molua (2010) frameworks.

Equation 4.0 is fitted into Cob-Dauglas Model to establish a technical relationship. The use of Cob-Dauglas model has in addition to establishing a relationship, generate supply elasticities because the parameter estimates of Cob-Dauglas model are themselves elasticities. Again, it is expected a priori that all the variable should have a direct effect on soybean output supply response within the period the study reviewed. On this backdrop, the following parameters and their representative were possible from equation 4.0:

$$\delta \beta_0 = A, \delta \beta_1 = B, \delta \beta_3 = C, \delta \beta_3 = D, \delta \beta_2 = E, \delta \beta_3 = F \text{ and } (1 - \delta) = G$$

If $(1 - \delta) = G$ then $\delta = 1 - G$. The final Nerlove estimation is:

$$\ln Q_t = \ln A + B \ln P_{t-1} + C \ln \text{Exp}_{t-1} + D \ln \text{Exp}_{vol} + E \ln R_t + F \ln A_t + G \ln Q_{t-1} + \delta \varepsilon_t - 5.0$$

The short supply elasticity could be generated directly from parameter (B) in equation 5.0, while the long-run adjustment in elasticity of supply as used by Omonona *et.al* (2004) and Ehiim *et al.* (2007) is expressed as:

$$\text{Longrun Supply Elasticity}\{LRE_\rho\} = \frac{\text{Short-run Supply Elasticity}}{\delta} = \frac{B}{1 - G} - 6.0$$

Generating a technical relationship with a time series data of this nature is rarely void of econometric problems such as spurious estimates (Greene, 2003; Ehirim *et.al*, 2007 and Molua, 2010). Therefore, the validity of the series need to be checked and the generated errors controlled. Once the stationarity properties of the individual series are established, linear combinations of the integrated series are tested for cointegration. The stationarity property is

commonly done using Engle-Granger approach before the cointegration test (Molua, 2010) and it ascertains whether individual series in the empirical analysis exhibit similar statistical characteristics before cointegration modelling. Following Engle-Granger approach Augmented Dickey-Fuller Test (ADF) is most appropriate. This test apart from stating the stationarity of each variable, chooses the lag length, which ensures that the residual is an empirical white noise and all the series have constant variance and mean thus, no random walk (Engel and Granger, 1987; Ehirm *et.al*, 2007 and Molua, 2010).

Problem arises if a process ($y_t = \alpha_1 y_{t-1} + \dots + \alpha_p y_{t-p} + v_t + u_t$), with deterministic term v_t , has a unit root and is hence integrated if $\alpha(1) = 1 - \alpha_1 - \dots - \alpha_p = 0$. This becomes the null. The objective is to test this null hypothesis against the alternative of stationary process (ie $\alpha(1) > 0$). For this purpose the model is reparameterized by subtracting y_{t-1} from both sides and rearranging the terms.

$$\Delta y_t = \pi y_{t-1} + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + v_t + u_t \text{----- 7.0}$$

Where: $\pi = -\alpha(1)$ and $\gamma_j = -(\alpha_{j+1} + \dots + \alpha_p)$. The ADF test as noted by Fuller (1970, 1976) Dickey-Fuller (1979) is then performed on the pair of hypothesis $H_0: \pi = 0$ as against $H_1: \pi < 0$ and it is based on the t-statistics of the coefficient π from an OLS estimation of equation 7.0 above. This followed by the cointegration modelling. Cointegration is a concept for modelling equilibrium or long-run relations of economic variables (Johanson, 1988). Establishing a long-run supply response of soybean is built around investigation of the number of cointegration relations, estimate their parameters and place appropriate restrictions. This is finally followed by designing the complete model, assess the quality of the model by adjusting the error mechanism for further investigation and or forecasting.

Results and Discussion

1. Structural Changes in Soybean Supply and Response to Food Security

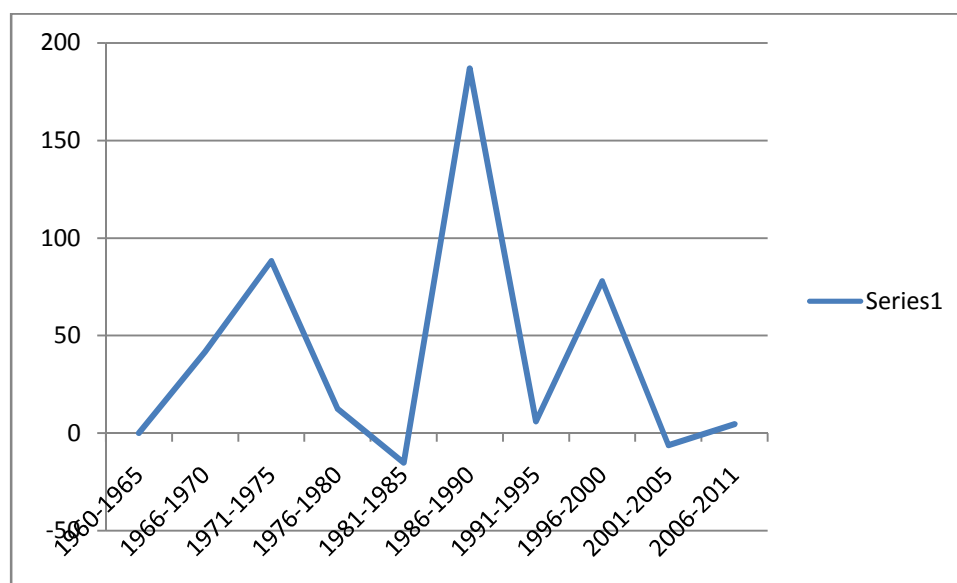
The mean output of soybean increased steadily in the early 1960's and decline slightly from 19681- 1985 but rose rapidly to a higher out level from 1986 – 1990. In the same way, the changes in mean soyabean supply as shown in Table 1. supported the fact that farmers output supply responded favourably to government policies. Evident from the result shows that about

88.24% change in soyabean supply between 1971 to 1975 and 1986 to 1990 indicated that food security dynamics followed the food policy framework of the country within the period as policies and programmes such as structural Adjustment Programme (SAP), deflationary policy, import control and guided deflations within the time period galvernized food self sufficiency. The result further showed a sharp drop of 5.94% and rise of 77.84% between 1991 to 1995 and 1996 to 2000 respectively.

Table 1. The Structure of Soybean Supply from 1960 to 2012

Years	Mean supply of soybean ('000)	Percentage (%) Change in Mean Supply
1960 – 1965	24.0	-
1966 – 1970	34.0	41.67
1971 – 1975	64.0	88.24
1976 – 1980	72.0	12.50
1981 – 1985	61.0	- 15.28
1986 – 1990	175.0	186.89
1991 – 1995	185.4	5.94
1996 – 2000	329.4	77.84
2001 – 2005	308.6	- 6.32
2006 – 2012	322.8	4.60

Source: Result print out from E-view software, 2012



Change in Supply of Soybean in Nigeria

Again, there was a negative growth in soybean supply from 2001 to 2005 and a marginal increase of 4.60% before 2012. This trend signified that the output supply of soybean has in recent years tried to gain it's status probably due farmers responsiveness to policies that favoured productivity growth and not food accesibility to the market. The increased supply were made

when policy regime such as SAP etc favoured food self sufficiency. It was followed by a long neglect of the programmes and finally the government food production initiative. The oscillatory supply behaviour is a reason for scarcity at a period in time and excess supply at another time, hence a set up of food insecurity dynamics in the country.

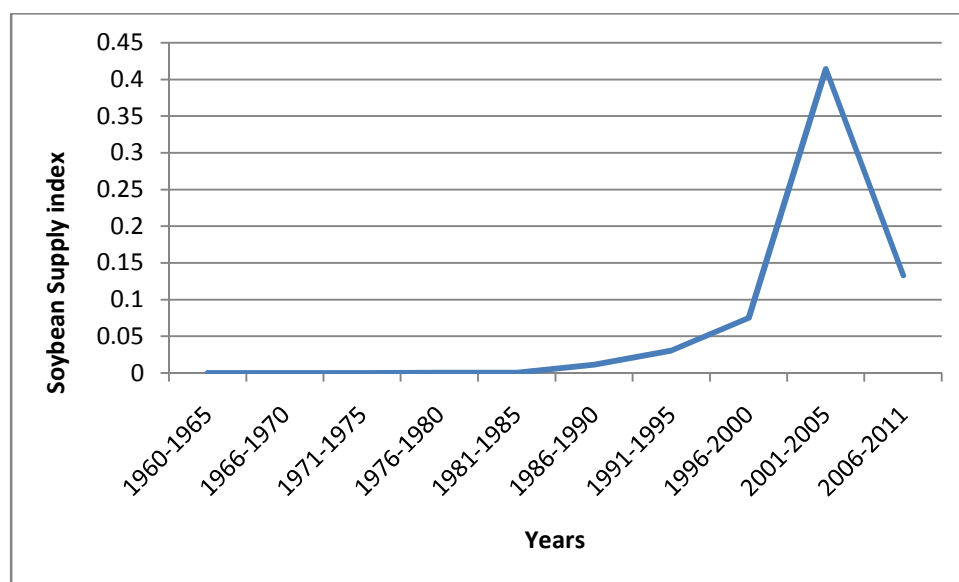
2. The Relative Contribution of Soybean Supply to Aggregate Food Supply Dynamics

The supply of soybean contributes marginally to the agricultural GDP from 60's till 2012. The contribution in food growth by soybean was as small as $7.1 \times 10^{-5} \%$ before 1970. However, the contribution of soybean to aggregate food supply increased marginally by 0.75% between 1996 to 2000 and dropped again to 0.16% before 2012. The insignificant increase in contributions of soybean to aggregate food supply in Nigeria could be a response to the presidential initiative on food self sufficiency programme of Nigeria (Anyanwu *et al.*, 1997 and CBN, 2003).

Table 2: Relative Contribution of Soybean Output Supply to Aggregate Food Supply

Years	Relativity index of soybean supply
1960 – 1965	0. 0000476
1966 – 1970	0. 0000711
1971 – 1975	0. 0000722
1976 – 1980	0. 000471
1981 – 1985	0. 000621
1986 – 1990	0. 0112
1991 – 1995	0. 0307
1996 – 2000	0. 0752
2001 – 2005	0.414
2006 – 2012	0.133

Source: Computed from CBN Annual Bulletin



Trend in Soybean Contribution to Total Agricultural GDP from 1960 to 2011

3. Determinants of Soybean Output Supply Response in Nigeria from 1960 to 2012

i. The Unit Root Test on the Series

The augmented dickey- further (unit root) rest was performed on the series as shown in Table 3. The stationarity test on the series where done at their level 1(0) and at first difference 1(1) with their corresponding lag lengths in paranthesis. The null hypothesis of no presence of unit root cannot be rejected for the series in their level 1(0) as shown in Table 3 as the ADF of all the series are lower than the critical value of $(\rho - 0.01) -3.558$ but were higher than the value when differenced by 1(1). This means that the alternative hypothesis is accepted that the series are stationary at first difference 1(1). The unit expected domestic prices, export price, volume of export, present mean rainfall and area under soybean cultivation each has a unit root at 1(1) see Table 3 below. It could be deduced from this finding that there could be a a short-run divergence and lon-run relationship with the series given the non-stationary properties at their levels and the lag length after differencing. The implication of non-stationarity or random-walk behaviour in the variables highlighted stocahstic trend behaviour hence a spurious estimation is eminent if technical relationship is carried out at their level 1(0) with the series. Such stochastic error generated in the series is invariant with time (Omotor, 2006). Therefore, error correction representation of the relationship is very eminent.

274 **Table 3. Stationarity (Unit Root) Test**

Variable	At level form		At 1 st difference	
	ADF(lag lenght)	Remark	ADF(lag lenght)	Remark
Domestic Price	-1.7622 (2)	Non Stationary	-7.1844(1)	Stationary
Export Price	-0.7475(3)	Non Stationary	-8.7927(2)	Stationary
Export Volume	-1.6476(1)	Non stationary	-9.8326(1)	Stationary
Mean Rainfall	-2.3012(2)	Non Stationary	-5.9564(2)	Stationary
Mean Acreage	-1.7444 (2)	Non Stationary	-6.3672(1)	Stationary
Previous Output	-0.5425(2)	Non Stationary	-5.2645(2)	Stationary

275 **Source: Result print out from E-view software, 2012.** ($\rho = 0.01$) are -3.558 and -3.592

276

277 **ii. Testing for Cointegrating Vectors**

278 The evidence of non stationarity of the series, which were purely due to their random walk
 279 behaviour or unit root lead to the test of cointegration in this study. The cointegrating modelling
 280 implies that the equation can be brought back to stationarity through a linear transformation
 281 (Ehirim *et al.*, 2007). It revealed the number of cointegrating equation of the technical
 282 relationship involving the series. At an evidence of at least one cointegrating vector, there must
 283 be a long-run convergence or equilibrium despite the divergence of the series in the short-run. It
 284 could be seen from the result that the Trace statistic performed better than the Max-Eigen
 285 statistics at ($\rho = 0.05$).

286 **Table 4. Unrestricted Co-integration Rank Test (Trace and Maximum-Eigen Values)**

Hypothesized (No. Of CE(s))	Eigenvalue	Trace Statistics	Criticalvalue ($\rho = 0.05$)	Max-Eigen Statistics	Criticalvalue ($\rho = 0.05$)
None*	0.5487	114.06**	95.75	34.22	40.08
At Most 1*	0.5273	79.84**	69.82	32.22	33.88
At Most 2*	0.5157	47.62	47.86	31.18	27.58
At Most 3	0.2155	16.65	29.80	10.43	21.13
At Most 4	0.1305	6.01	15.49	6.01	14.26
At Most 5	9.33X10 ⁻⁸	4.01X10 ⁻⁶	3.84	4.01X10 ⁻⁶	3.84

287 **Source: Result print out from E-view software, 2012:** Trace Statistics indicated 2
 288 cointegrating vector (equation) while the Max-Eigen value showed no cointegrating vector at
 289 ($\rho = 0.05$).

290 Trace statistics was thus adopted. Two cointegrating vectors emerged at $\rho = 0.05$ in Table 4
 291 below. The Trace statistics of 79.84 is greater than the critical value ($\rho = 0.05$) of 69.82 for at
 292 least two (2) cointegrating equations. This implies that there is a long-run equilibrium expectation
 293 despite the short-run divergence of the series in the relationship (Engle and Granger, 1987;
 294 Johanson, 1988 and Ehirim *et al.*, 2007).

295

iii. **Determinants of Soybean Supply and Error Correction mechanism (ECM)**

The maximum likelihood estimation of equation 5.0 revealed the determinant of soybean output supply in Nigeria. The result showed the effect of the included variables on soybean output supply. Loglikelihood ratio, Co-efficient of Multiple Determinants (CMD) and Durbin-Waston statistics of 11.79, 0.229 and 1.846. It could be deduced from this finding that 22.9% variations in soybean output supply could be explained by the variations in the included explanatory variables such as the expected domestic prices, export prices, volume of export etc. The model does not have autocorrelation with a Durbin-Waston value of 1.85. The result showed a moderate error correction vector (ECM) of -0.344, with an expected negative sign and statistically significant at $\rho = 0.05$ under two tailed test. The ECM of this model indicates that more than 34.4% adjustment towards long-run equilibrium for soybean output supplies is completed in one period. The speed of the short-run divergence converging to equilibrium in the long-run exist with about 34.4% proportion of the disequilibrium in the soybean supply in less than one period being corrected in the next period.

Furthermore, it is revealed in this result that all the variables have direct effect on farmers output supply response except lagged export volume. This implies that apart from expected lagged volume of export other variables showed consistent behaviour with a priori expectation. The model showed that lagged value of yield has about 0.11% increase on the current output supply of soybean. This implies that actual yield in the present year responds positively following the last year's yield in the economy thus food self sufficiency policy regime of the country has direct effect on supply responsiveness as farmers adjust with output supply to increase their supply following what happened in the previous supply. Similarly, an increase in lagged value of unit domestic price of soybean by 1.0% will lead to increased 0.01% response in output supplied in the country. This implies that supply responsiveness is strongly dependent on high domestic price expectation, hence food security with respect to soybean supply responds better to such high domestic price expectation in the country. A similar result was obtained with expected export prices. There is a possible high supply response of 0.028% with increased lagged export price than with a unit increase in export volume. An increase in lagged export volume will force down soybean supply response by 0.022%.

$$\ln Q_t = 0.042 + 0.010 \ln P_{t-1} + 0.028 \ln \text{Exp}_{t-1} - 0.022 \ln \text{Exp}_{\text{vol}} + 0.093 \ln R_t + 0.018 \ln A_t + 0.112 \ln Q_{t-1}$$

$$(0.018)^{**} \quad (0.004)^{**} \quad (0.019) \quad (0.011)^{**} \quad (0.013)^{***} \quad (0.022) \quad (0.036)^{***}$$

$$ECM = -0.344^{***}: \text{Log likelihood ratio} = -11.79: R^2 = 0.230: AdjR^2 = 0.201: \text{Durbin} - \text{Waston} = 1.846$$

326
327 This finding revealed a strong information about food price policies on productivity of soyabean
328 in Nigeria. Food price policy regime in Nigeria has always favoured productivity growth without
329 consideration to international market volatility (especially on external demand and prices) and
330 domestic demand. The inverse relationship between soybean supply and export volume shows
331 that domestic market of soybean suffers with increased export volume. Farmers strived for food
332 self sufficiency with ignorance of the benefits of export prices on their revenue with reference to
333 soybean in Nigeria and effort to meet up with export demand invariably affects output supply.
334 Policy regime that expanded inputs use by farmers must be cautious not only to expand farmers
335 input but also look toward its efficiency so that input intensification will galvanize their expected
336 return and this will favour farmers output responsiveness to actual output supply of soybean.
337 Another way to achieve a better performance must be through improved international market.
338 Since the price attracts supply, efforts must be made at local production stage to meet the global
339 demand and standard. Again, the mean rainfall and expected area under soybean cultivation will
340 increase actual supply of soybean in the country. Though this contrast with Ehirim et.al. (2007)
341 finding, the wide growth of soybean in the savannah (with short rainfall duration) requires an
342 alternative source of water such as irrigation to spread its production to other areas and facilitates
343 off season production.

344
345 **iv. Elasticity, Soybean Supply Response and Food Security Prediction in Nigeria**
346 The adjustment coefficient is 0.888 which is greater than zero but less than unity (1) as shown
347 in Table 5 below. The positive value in this case is an indication that short-run estimates of the
348 expected output supply of soybean is positive, therefore the rise in actual supply is never
349 instantaneous but rather farmers are actually busy with short-run adjustments to bring an expected
350 output supply to the actual supply level.

351 **Table 5. Short and Long-Run Elasticity of Soybean Supply in Nigeria**

Variables	Short-Run Elasticities	Co-efficient of Adjustment	Long-Run Elasticities
Expected Domestic price	0.010		0.011
Expected Export Price	0.028		0.032
Expected Vol Exported	-0.022		-0.025

Rainfall	0.093		0.106
Acrag	0.018	0.888	0.020
Previous Output Supply	0.112		0.126

Source: computer printout 2012.

In the very short-run however, it can be seen that it can be seen that expected domestic and export prices are all inelastic. An increase in expected domestic and export prices by 1.0% will give a less than proportionate increase in actual output of 0.01% and 0.028% respectively. This finding collaborate USDA (2008) assessment that Nigeria's domestic production of soybeans is continuing to trend upwards, but still does not meet the rapidly growing demand. This raised the food insecurity status as this deficit has caused the price of soybean meal to double in 2008. These high prices have severely impacted on rising import of the product. The same effect is observed on rainfall and acrag with 0.093% and 0.018% increase in actual output respectively in the short-run. Its is only export volume that is negative but still inelastic.

In the long-run, only slight improvement was observed with all the same parameters still inelastic. This finding is consistent with Ehirim *et.al.*, (2007), and this short-run behaviours still persisted in the long-run and correction is expected with farmers mode of adjustment so that a more than proportion increase in actual supply will follow farmers response to food price policy regime of the goverment.

Conclusion and Policy Recommendations

The need to increase food security following the actual quantity supplied of soybean requires farmers change in response behaviour towards food policy regime of the government. There is evidence of short-run response with domestic and export price inelastic food supply that persisted in the long run. Hence, the outlook of self sufficiency and productivity growth that is already experienced in Nigeria. This is not enough to give a more than proportionate increase in supply required to boost food security especially with soybean supply in Nigeria. The study therefore, recommends that cost-effectiveness and efficient use of input resources, intensify acreage distance and irrigated area (to support short rainfall duration of the savannah region) be included in the policy framework of the federal government. These will increase supply responsiveness of the farmers. Increased domestic prices is forcing down export and this can only improve when there is an inward investigation on resource use efficiency of the farmers. The effect could be that the benefits of resource use efficiency will galvanize farmers returns and

output so that supply for export will be abundant. Alternative use of soyabean and value addition to the product will give a higher unit price, which will translate to increased output, returns and consequently supply of the product for export.

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