

Soybean Supply Response to Price and Non-price Factors in Nigeria: Implications for Food Security

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Abstract

Productive growth exists side by side with food insecurity as planned supply does not equate actual soybean supply in Nigeria. Hence, the need to investigate the speed of response of planned supply of soybean to food security policy is imperative. Time series data spanning from 1960 to 2012 on unit domestic prices, output supply, export prices and volume, acreage and weather condition (rainfall) from CBN and NBS annual bulletins were used for the study. Analyses were done with descriptive statistics, simple ratios and econometric models such as Nerlove partial adjustment and Cob-Douglas models, cointegration test and error correction mechanism (ECM). The supply fluctuated in a downward trend between 186.9% in 1986-1990 to 4.6% before 2012. The ECM showed a short-run divergence for all the included series with 34.4% of the disequilibrium in the supply of one period, but corrected in the next period. There is an inelastic but positive domestic and export price in the short-run, which slightly improved in the long run, hence the reason for the extended growth in supply. Again, increased rainfall and acreage will increase actual supply, hence irrigation and expanded area of land for soybean cultivation is imperative. Adjustment co-efficient of 0.888 is less than unity and positive, hence the rise in actual supply is never instantaneous but strives to meet the planned supply. Increase in actual production, using cost-effective inputs like expanded land and irrigation facilities is important.

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

1.0 Introduction

Agriculture plays a pivotal role in the economic development of Nigeria, especially now where exists a dramatic transformation in food self-sufficiency and emerging food markets. Efforts toward diversifying economic base through agriculture, increased revenue through foreign exchange and contributions to the nation's gross domestic product must underscore a balanced food supply response behaviours through the price policy framework and other non-price factors of food production. Dependency of agricultural output supply on some policy and market behaviours as well as climatic conditions is not instantaneous, but follows a time lapse called *lag* (Gujarati, 1995). Such lags offer enough time for decisions that accentuate food accessibility and food security (Tripathi, 2008). Past food policy framework in Nigeria failed to tackle food insecurity because it mainly centered on food productivity growth as a sure means of food self-

sufficiency, employment generation, foreign exchange earnings and poverty reduction (Onyenweaku *et.al.*, 2010). No empirical study has linked productivity growth of soyabean to steady accessibility as adjustment of its actual output overtime hardly meets the planned supply.

Soybean (*Glycine max*) supply will assume a steady accessibility if and only if the planned (expected) supply, from a planned demand required for healthy living, meets the actual supply over a period of time. Incessant shortages or surpluses arising from reallocation of both price and non-price factors invoke supply instabilities and deviation from planned supply. Soybean supply in Nigeria is unstable. There is a domestic annual supply shortfall of about 100,000 tons for soybean meal and 300,000 tons for vegetable oil. The supply increased by only 2,600 tones/farmer in late 60's but dropped by 18.6% following farm resource reallocation during the oil boom era in the late 70's (RMRDC, 2004). It rose again by 9.11% annually from 1984 to 160,000 metric tons in 1995 and later to 550,000 metric tons in 2010, leaving a national demand gap of 200,000 metric tons that must be met through importation.

Nerlove and Bachman (1960) noted that farmers' response to variations in lagged commodity prices and prices of factors of production in local and national food markets both in short and long-runs results in a *food supply dynamics* and consequently food insecurity. Food is secured when there is adequate access to food at all times. At household level, adequate access to food occurs when food is not only available but affordable for healthy living at all times. Food security is thus defined as the actual output of soybean that meets a planned supply needed for healthy living. 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, changes in own-prices of food 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).

CBN (2003) observed that an anticipated rise or fall in the prices of food is responsible for the differences in actual and planned output supply of food in most economies. Reallocation in factors of production and prices may reduce the soybean output and revenue, following an anticipated fall in actual output from planned output. This may lead to choice of an alternative enterprise by small holder farmers during the next cropping season. The major issue of this study is, what level of adjustments is required by actual soybean supply to close up the planned supply needed for healthy living over time? Again, what speed of adjustment is needed to establish a

long-run equilibrium for a steady state food security? The issues have raised price oscillations and dynamism in equilibrium supply that initiated food shortages or surpluses and food insecurity (Ehirim, *et al.*, 2007). The study is aimed at determining the level and speed of adjustments needed for actual soybean supply to meet the planned supply and arrest food insecurity in Nigeria, given the present input and commodity price policies in a changing climatic condition.

2.0 Conceptual Framework and Review of Literature

The agricultural sector is dominated by the food crops sub-sector and its ability to strengthen food security, and economic growth is from a stable market. 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 (FAO, 1996). Tollens (1998) identified three dimensions of food security at household levels. They are; the availability of food, which ensures that food is enough for an active and healthy life. Food is available when there is enough production and supply is stable over time. Second is the access and utilization of foods, ingestion and digestion of enough and qualitative food for maintenance of good health. Accessibility of food is accounted for by its market unit prices and cost of the food and value addition to the food. Finally, food must be affordable, implying that there should be enough household income to ensure adequate procurement of food that will sustain body requirement for an active and healthy life.

At the national and international levels, 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 to “food security” is on its integration into the macro and micro economics level. Oktaviani and Asmarantaka (2010) noted that household food security is an integral part of macro economy and national food market growth despite the assumed influence by 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 at the community level. Agriculture and rural development is anchored on a market stability, which operates when 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 is on the upward regime but has continued to have a rapidly growing demand deficit and increasing market price since 2008. United States Development Agency (USDA, 2011) noted that such increased lagged prices have left no remedy than a rising import and unfavourable foreign exchange regime, which translates to intensified food insecurity issues.

Market stability and food security is always the targeted objective when the actual annual prices and supply of the soybean is adjusted to meet the planned or desired (expected) output supply. The gap between the planned food prices and supply with the actual food prices and supply raises errors of food insecurity in Nigeria. USAD (2011) opined that a gap of 36.3% in annual domestic supply is the reason for the gap between the planned and actual supply of soybean in Nigeria. The planned unit price of soybean galvanizes short run supply or a steady adjustment to meet with that of actual supply in the long-run. The change in planned or desired (expected) quantity supplied and the actual supply in year(t) approaches unity (1) when there is a full adjustment in factor prices, food policy changes and production constraints in the long-run. This gap between the planned and actual prices and output supply is what Nerlove supply model addresses (Olayemi, 1998) but the time effect on the available data is what the error correction methodology can address (Ehirim *et al.*, 2007).

The planned or 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:

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

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

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

EXP_{pt-1} is the expected export price of soybean based on previous expectations in naira

EXP_{vol} is the volume of export in tonnes

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

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

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

The Nerlovian framework in equation 1.0 has both price expectation 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 constraints, response to commodity price, farming and financial risk, weather changes and variations in land and edaphic factors. However, all these changes are accommodated in Nerlovian adaptive expectations because the changes in yield between a 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:

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

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

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

Expand and re-arrange equation 3.0

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

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

3.0 Methodology

3.1 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 on the East by the Republic of Cameroon, on the west by the Republic of Benin, on the north by the Republic of Niger and South by the Atlantic Ocean. Nigeria has a wide range of climatic distribution and six vegetation 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 the ecological and climatic requirements of the crop. Secondary data from CBN annual statistical bulletin, National Bureau of Statistics's (NBS) data base and Food and Agricultural Organization (FAO) 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 tonnes), annual rainfall (in millimeters) and acreage of soyabean cultivated (in hectares) from 1960 to 2012 and used for analysis.

3.2 Analytical Procedure and Model Specification

Trends in food supply follow agricultural gross domestic supply as a proxy. This is described using relative mean values and ratios. The ratio of a change in mean supply relative to the previous mean supply multiplied by 100 gives the percentage in mean supply. Again, the ratio of soybean supply to total aggregate food supply represents the soybean supply index. 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 gap between the planned and actual soybean supply in Nigeria created a time lapse that can be captured by Nerlove adjustment model (Nerlove, 1958; Ehirim *et al.*, 2007 and Molua, 2010).

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, generated supply elasticities because the parameter estimates of Cob-Dauglas model are themselves elasticities. Again, it is expected *a priori* that all the variables should have a direct effect on soybean output

supply response within the period the study reviewed. On this backdrop, the following parameters and their representatives were possible from equation 4.0:

$$\delta \beta_0 = A, \delta \beta_1 = B, \delta \beta_2 = C, \delta \beta_3 = D, \delta \beta_4 = E, \delta \beta_5 = F \text{ and } (1 - \delta) = G$$

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

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

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:

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

Generating a technical relationship with a time series data of this nature is rarely void of econometric problems such as spurious estimates (Greene, 2003; Ehirm *e.al.*, 2007 and Molua, 2010). Therefore, the validity of the series needed to be checked and the generated errors controlled. Once the stationarity properties of the individual series is 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 the most appropriate. This test, apart from stating the stationarity of each variable, chooses the lag length, which ensures that the residuals are empirical white noise while the series have constant variance and mean. Thus, there is 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 (i.e., $\alpha(1) > 0$). For this purpose the model is reparameterized by subtracting y_{t-1} from both sides and rearranging the terms.

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

Where: $\pi = -\alpha(1)$ and $\gamma_j = -(\alpha_{j+1} + \dots + \alpha_p)$. The ADF test as noted by Fuller (1976) and Dickey-Fuller (1979) is then performed on the pair of hypotheses $H_0: \pi = 0$ 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 is 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, assessing the quality of the model by adjusting the error mechanism for further investigation and or forecasting.

4.0 Results and Discussion

4.1 Structural Changes in Soybean Supply and Response to Food Security

Figure 1. presents the mean soybean supply in Nigeria. The mean output of soybean increased steadily in the early 1960's and declined slightly from 1981- 1985. Again, it rose rapidly to a 175.0 between 1986 to 1990. In the same way, the changes in mean soyabean supply responded positively to food policies of the government. It is evident from the analysis that 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 this period would be a good reason for food self-sufficiency programme of the government then. The result further showed a sharp drop of 5.94% and rise of 77.84% between 1991 to 1995 and 1996 to 2000 respectively.

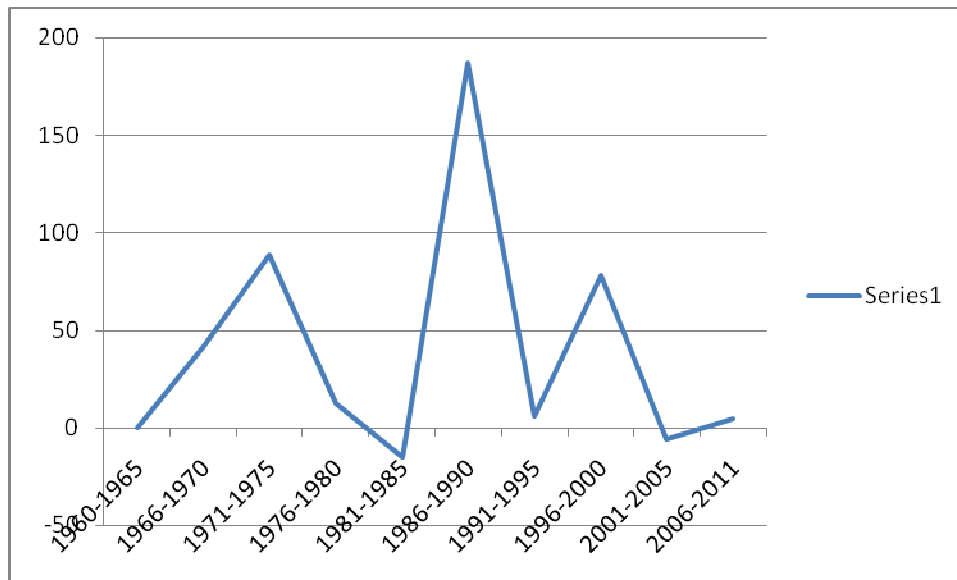


Figure 1. Percentage Change in Supply of Soybean in Nigeria

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 its status probably due the farmers' responsiveness to policies that favoured productivity growth and not food accessibility to the market. The increased supply was made when policy regime such as SAP 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 was a reason for scarcity at a period in time and excess supply at another time, hence, food insecurity dynamics was set up in the country.

4.2 The Relative Contribution of Soybean Supply to Aggregate Food Supply Dynamics

Figure 2. presents the contribution to agricultural GDP. The result shows that soybean supply contributes marginally to the agricultural GDP from the 60's till 2012. The contribution to 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 the 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).

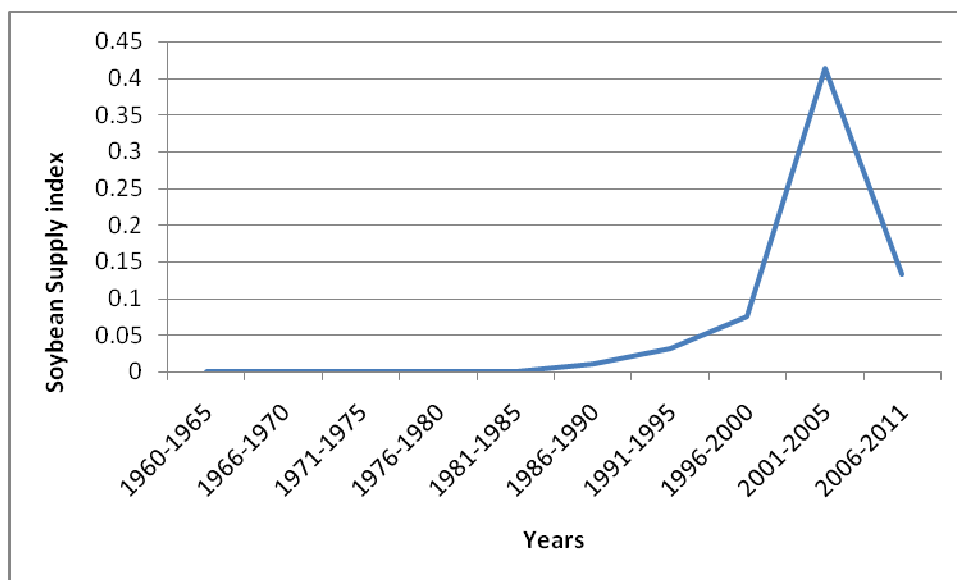


Figure 2. Trend in Soybean Contribution to Total Agricultural GDP from 1960 to 2011

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

4.3.1 The Unit Root Test on the Series

Table 1. is the unit root test of all the series included in the model. The Augmented Dickey-Fuller (unit root) test was performed on the series as shown in Table 3. The stationarity test on the series were done at their level $I(0)$ and at first difference $I(1)$ 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 $I(0)$ as shown in Table 3 as the ADF of all the series were lower than the critical value of $(p - 0.01) -3.558$ but were higher than the value when differenced by $I(1)$. This means that the alternative hypothesis is accepted that the series are stationary at first difference $I(1)$. The unit expected domestic prices, export price, volume of export, present mean rainfall and area under soybean cultivation each had a unit root at $I(1)$ see Table 1 below. It could be deduced from this finding that there could be a a short-run divergence and long-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 stochastic trend behaviour. Hence, a spurious estimation is eminent if technical relationship is carried out at their level $I(0)$ 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 imminent.

Table 1. Stationarity (Unit Root) Test

Variable	At level form		At 1st difference	
	ADF(lag length)	Remark	ADF(lag length)	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

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

4.3.2 Testing for Co-integrating Vectors

It could also be seen from the result that the Trace statistics performed better than the Max-Eigen statistics at ($\rho = 0.05$). There are evidences of non-stationarity of the series due to their random walk behaviour or unit root. A further test of co-integration with the Trace statistics is imperative. The cointegrating modelling brought the equations back to stationarity through a linear transformation (Ehirim *et al.*, 2007). The Max-Eigen value showed no cointegrating vector at ($\rho = 0.05$) but the Trace Statistics indicated 2 cointegrating vector (equation) at $\rho = 0.05$. The Trace statistics of 79.84 is greater than the critical value ($\rho = 0.05$) of 69.82 for at least two (2) cointegrating equations. The existence of at least one co-integrating equation/vector as shown by the Trace statistics indicated that there is an evidence of a long-run convergence or equilibrium despite the divergence of the series in the short-run (Engle and Granger, 1987; Johanson, 1988 and Ehirim *et. al.*, 2007)..

Table 2. Unrestricted Co-integration Rank Test (Trace and Maximum-Eigen Values)

Hypothesized (No. Of CE(s))	Eigenvalue	Trace Statistics	Critical value ($\rho = 0.05$)	Max-Eigen Statistics	Critical value ($\rho = 0.05$)
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

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

4.3.3 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 and other functional parameters. The log likelihood ratio, Co-efficient of Multiple Determinant (CMD) and Durbin-Watson statistic are 11.79, 0.229 and 1.846 respectively. 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-Watson value of 1.85. An error correction vector (ECM) of -0.344, which is negative and statistically significant at $p = 0.05$ was obtained. 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, converges to equilibrium in the long-run 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 volume of export, other variables showed consistent behaviour with *a priori* expectation. The result shows that the lagged value of yield has about 0.11% increase on the current output supply of soybean, implying that actual yield in the present year is sluggishly responding positively to last year's yield in the economy. Though the 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, it may drag too long to meet the planned supply. The issue of meeting the demand deficit of 36.3% as noted by USAD (2011) due to sluggish inelastic supply nature of this product can simply be averted by massive support in production by the small holder farmers in Nigeria. Similarly, an increase in lagged 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 responsiveness is on high domestic price expectation. 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)** (0.004)** (0.019) (0.011)** (0.013)** (0.022) (0.036)**

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

The study revealed a strong information about food price policies on productivity of soyabean in Nigeria. Soybean price policy regime in Nigeria has always favoured productivity growth without consideration to international market volatility (especially on external demand and prices) and domestic demand. The inverse relationship of export volume and inelastic nature soybean supply with the planned supply may be the reasons for the increased market prices. There may have been a lower than proportionate increase in expected output. Soybean farmers strived for increased food security with ignorance of inelastic supply nature and prices on their revenue. Policy regime that expanded farmers' inputs use must be done with caution so that output will expand massively at a lower input cost. Hence a look at input efficiency is suggested in this study. Another way to achieve a better performance must be through improved international market. Since the price attracts supply, efforts must be made at local production stage to meet the the targeted global demand and standard at a higher price. Again, the mean rainfall and expected area under soybean cultivation will increase actual supply of soybean in the country. Though this contrasts with Ehirim et al., (2007) finding, the wide growth of soybean in the savannah (with short rainfall duration) requires an alternative source of water such as irrigation to spread its production to other areas and facilitates off-season production.

4.3.4 Elasticity, Soybean Supply Response and Food Security Prediction in Nigeria

The adjustment coefficient is 0.888 which is greater than zero but less than unity (1) as shown in Table 3 below. The positive value in this case is an indication that short-run estimates of the expected output supply of soybean is positive. Therefore, the rise in actual supply is never instantaneous but rather, farmers are actually busy with short-run adjustments to bring an expected output supply to the actual supply level.

Table 3. 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	0.888	0.106
Acrage	0.018		0.020
Previous Output Supply	0.112		0.126

Source: computer print out, 2012.

In the very short-run, however, 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 corroborates USDA's (2011) assessment that Nigeria's domestic production of soybeans is continuing in upward trend but still does not meet the rapidly growing demand. This raised the food insecurity status as this demand 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 acreage with 0.093% and 0.018% increase in actual output respectively in the short-run. It 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). The short-run behaviours still persisted in the long-run and correction is expected with farmers mode of adjustment so that a more than proportional increase in actual supply will follow farmers' response to food price policy regime of the government.

5.0 Conclusion and Policy Recommendations

There is need to increase food security by closing the gap between planned supply and actual quantity supplied of soybean. There is evidence of short-run response with domestic and export price inelasticity that persisted in the long run. Hence, the self sufficiency framework of the present transformation agenda of the federal government should not target only productivity growth but also an elastic actual output in an efficient input use. This will give a more than proportionate increase in soybean supply required to boost food security in Nigeria.

The study therefore, recommends an elastic soybean output at reduced market prices. It is suggested that an efficient and cost-effective input use as well as expanded acreage with

irrigation (that will support short rainfall duration of the savannah region) be included in the policy framework of the transformation agenda of the federal government. It will initiate an output response that invigorates both domestic and export supply at a reduced domestic price. Increased domestic price is forcing down export and this requires immediate improvement. Such improvement comes when there is an inward investigation on resource use efficiency of the farmers. A close look at input efficiency will suggest the cost effective production system that can increase output at a reduced cost, hence reduced market prices. Again, the benefits of resource use efficiency will galvanize farmers' returns and output so that farmers will have more incentive to produce and 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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