

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

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Abstract

Productive growth exits side by side with food insecurity as planned supply does not equate ~~the~~ actual soybean supply in Nigeria. Hence, the need to invistigate the speed of ~~responses~~~~respond~~ 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, ~~acrage~~~~acreage~~ and weather condition (rainfall) from CBN and NBS annual ~~bulletine~~~~bulletins~~ were used for the study. Analyses were done with descriptive statistics, simple ratios and econometric models such as Nerlove partial adjustment and Cob-Dauglas models, cointegration test and error correction mechanism (ECM). The ~~result showed that~~ supply ~~fluctuates~~~~fluctuated in a downward trend~~ between 186.9% in 1986-1990 to 4.6% before 2012 ~~disperities in planned (expected supply) and actual supply.~~ 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 ~~persisted with a slight improvements~~~~slightly improved~~ in the long run, hence the reason for the extended growth in supply. Again, increased rainfall and acrage 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 ~~instantenous~~~~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

Introduction

Agriculture plays a pivotal role in ~~the~~ economic development of Nigeria, especially now that there is a dramatic transformation in food self ~~surficiency~~~~sufficiency~~ and emerging food markets. Efforts toward diversifying economic base through agriculture, ~~increasing~~~~increased~~ revenue through foreign exchange and ~~contributes~~~~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 accentuates food accessibility and food security (Tripathi, 2008). Past food policy

42 framework in Nigeria failed to tackle food insecurity because it mainly centered on food
43 productivity growth as a sure means of food self ~~surficiency, sufficiency,~~ employment
44 generation, foreign exchange earnings and poverty reduction (Onyenweaku *et.al.*, 2010). No
45 empirical study has linked productivity growth of soyabean to steady accessibility as
46 ~~adjusment~~adjustment of its actual output overtime hardly meets the planned supply.

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47 Soybean (*Glycine max*) supply ~~assumes~~will assume a steady accessibilty if and only if the
48 planned (expected) supply, ~~from a planned demand~~ required for a healthy living, meets the actual
49 supply over ~~a period of time~~. ~~Insisant~~Incessant shortages or surpluses arising from reallocation of
50 both price and non-price factors invoke supply instabilities, ~~and deviation from planned supply.~~
51 Soybean supply in Nigeria ~~has bee veryis~~ unstable ~~as it~~. ~~There is a domestic annual supply~~
52 ~~shortfall of about 100,000 tons for soybean meal and 300,000 tons for vegetable oil. The supply~~
53 increased by ~~only~~ 2,600 tones/farmer ~~due to a in late 60's~~ but dropped by 18.6% ~~because of~~
54 ~~following farm resource~~ reallocation ~~in farm input resources following during~~ the crude oil
55 ~~discovery boom era~~ in the late 70's (RMRDC, 2004). It rose again by 9.11% annually from 1984
56 to 160,000 metric tons in 1995 and later to 550,000 metric tons in 2010, leaving a national demand
57 gap of 200,000 metric tons ~~being that must be~~ met through importation.

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58 Nerlove and Bachman (1960) noted that farmers' response to variations in lagged
59 commodity prices and prices of factors of production in local and national food markets both in
60 short and long-runs results in a *food supply dynamics* and consequently food insecurity. Food is
61 secured when there is adequate access to food at all ~~time~~times. At household level, adequate
62 access to food occurs when food is not only available but affordable for healthy living at all times.
63 Food security is thus defined as the actual output of soybean that meets a planned supply needed
64 for healthy living. Policies with appropriate incentive like price or non-price incentives is likely
65 to bring about high supply responsiveness, while those that act as disincentives are less likely to
66 do so. Interestingly, ~~changes in own prices of~~ food ~~price changes~~ generate more revenue as
67 farmers are likely to produce more of such product at better prices, thus ensuring long-term food
68 security (Oguoma *et. al.*, 2010).

69 CBN (2003) observed that an anticipated rise or fall in ~~pricethe prices~~ of food is
70 responsible for the differences in actual and planned output supply of food in most economies.
71 Reallocation in factors of production and prices may reduce the soybean output and revenue;
72 following an anticipated fall in actual output from planned output. This may lead to a choice of an

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73 alternative enterprise by small holder farmers during the next cropping season. The major issue of
74 this study is, what level of adjustments is required by actual soybean supply to close up the
75 planned supply needed for healthy living over ~~time.time?~~ Again, what speed of adjustment is
76 needed to establish a long-run equilibrium for a steady state food ~~security.security?~~ The issues
77 have raised price oscillations and dynamism in equilibrium supply that initiated food shortages
78 or surpluses and food insecurity (Ehirim, *et al.*, 2007). The study is aimed ~~at~~-determining the
79 level and speed of adjustments needed to for actual soybean supply to meet the planned supply
80 and arrest food insecurity in Nigeria, given the present input and commodity price policies in a
81 changing climatic condition.

82 .

83 Conceptual Framework and Review of Literature

84 ~~Agricultural~~The agricultural sector is dominated by the food cops sub-sector and its
85 ability to strengthen food security, and economic growth is from a stable market. Food security is
86 achieved when all people, at all times have physical and economic access to sufficient, safe and
87 nutritious food to meet their dietary needs and food preferences for an active and healthy life
88 (FAO, 1996). Tollens (1998) identified three dimensions of food security at household levels.
89 They are; the availability of food, which ensures that food is enough for an active and healthy
90 life. Food is available when there is a enough production and supply ~~is~~ stable over time. Second
91 is the access and utilization of foods, meaning procurement, ingestion and digestion of enough
92 and qualitative food for maintenance of good health. ~~Accessibility~~Accessibility of food is
93 accounted for by its market, unit prices and cost of the food and value addition to the food.
94 ~~Finally~~Finally, food must be affordable, implying that there should be enough household income
95 to ensure adequate procurement of food that will sustain body requirement for an active and
96 healthy life.

97 At the ~~National~~national and international ~~level~~levels, food security means adequate
98 global food availability and adequate capacity by food-deficit countries to import or otherwise,
99 acquire food in required quantities from food surplus countries (Olayemi, 1998). An operational
100 approach to “food security” is on its integration into the macro and micro economics level.
101 Oktaviani and Asmarantaka (2010) noted that household food security is an integral part of
102 macro economy and national food market growth despite the assumed influence by international
103 agricultural commodity market volatility. This integrative view is based on both spatial and

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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 the such increased lagged prices have left no remedy than a rising import and unfavourable foreign exchange regime, which has translates to intensified food insecurity issues.

Adjusting the actual annual prices and supply of the soybean to meet the planned or desired (expected) output supply is a means to market stability and food security. 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 ~~sobean~~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 longrun. 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 sprices 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

131 | EXP_{pt-1} is the expected export price of soybean ~~base-based~~ on ~~perivious expectation~~ previous
 132 | expectations in naira
 133 | EXP_{vol} is the volume of export in ~~tonn~~ tonnes
 134 | A_t is average area of land with soybean cultivation in year(t), measured in hectares
 135 | R_t is the volume of rainfall in year(t) ~~measured~~ in millimeters
 136 | $\beta's$ are vectors to be estimated in the equation

137 | The Nerlovian framework in equation 1.0 has both price expection and adjustment in
 138 | other factors of output supply of soybean in the model. This study is interested in the change
 139 | between actual and the desired (expected) level output supply. The change could be due to
 140 | farmers response to farm input price variations, policy ~~constarints~~, constraints, response to
 141 | commodity price, farming and financial risk, weather changes and variations in land and edaphic
 142 | factors. However, all these changes are ~~accomodated~~ accommodated in Nerlovian adaptive
 143 | expectations because the changes in yield between a time period occur in proportion to
 144 | differences between actual output supply in the current period and the actual output supply in the
 145 | previous period which is capable of generating food insecurity dynamic pending when a steady
 146 | supply adjustment is achieved in the long-run. In this case, the distributed lagged model becomes
 147 | an autoregressive (dynamic) model (Gujarati, 1995). The Nerlove adjustment model for soybean
 148 | supply is thus expressed as:

$$149 \quad Q_t - Q_{t-1} = \delta \{Q_t^d - Q_{t-1}\} \text{-----} 2.0$$

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

$$156 \quad Q_t - Q_{t-1} = \delta \{ \beta_0 + \beta_1 P_{t-1} + \beta_2 Exp_{pt-1} + \beta_3 Exp_{vol} + \beta_4 R_t + \beta_5 A_t + \varepsilon_t -$$

$$157 \quad Q_{t-1} \} \text{---} 3.0$$

158 | Expand and re-arrange equation 3.0

$$160 \quad Q_t = \delta \beta_0 + \delta \beta_1 P_{t-1} + \delta \beta_2 Exp_{pt-1} + \delta \beta_3 Exp_{vol} + \delta \beta_4 R_t + \delta \beta_5 A_t + (1 - \delta) Q_{t-1} + \delta \varepsilon_t \text{---} 4.0$$

161

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

165

166 Methodology

167 1. Study Area and Sample Selection

168 The study covered the entire Nigeria. Nigeria lies between longitudes 2°-15° east of the
169 Greenwich Meridian and latitude 5°-15° north of the equator. The area is bounded to the
170 East by the Republic of Cameroon, to the west by the Republic of Benin, to the north by
171 the Republic of Niger and South by the Atlantic Ocean. Nigeria has a wide range of climatic
172 distribution and six vegetative belts spread across savannah and forest zones. It has a
173 rainfall and temperature range of 1500mm to 2500mm and 18 to 37°C respectively (NMA,2004)
174 with an enormous population of over 140 million people (NPC,2006). Soybean is mostly grown
175 in the savannah region of the countryside because of its ecological and climatic
176 requirements of the crop. Secondary data from CBN annual statistical bulletin,
177 National Bureau of Statistics's (NBS) data base, and Food and Agricultural Organization (FAO)
178 and world relevant journals were used for this study. Data collected from CBN annual and NBS
179 statistical bulletin include aggregate annual prices (in naira) and quantities of soybean supplied
180 (in tonnes), annual rainfall (in millimeters) and acreage of soyabean cultivated (in
181 hectares) from 1960 to 2012 and used for analysis.

182

183 2. Analytical Procedure and Model Specification

184 Trends in food supply follows agricultural gross domestic supply as a proxy. This is described
185 using relative mean values and ratios. The ratio of a change in mean supply relative to the
186 previous mean supply multiplied by 100 gives the percentage in mean supply. Again, the
187 ratio of soybean supply to total aggregate food supply represents the soybean supply
188 index. A time series data spanning between 1960 to 2011 was used in this study. The issues
189 raised against agricultural supply response were better tackled with either price expectation
190 adjustment or partial output adjustment as shown between equation 2.0 to 4.0 above. The gap

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191 between the planned and actual soybean supply in Nigeria created a time lapse that can be
192 captured by Nerlove adjustment model (Nerlove, 1958; Ehirim *et.al.* (2007) and Molua, 2010).

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

199 $\delta \beta_0 = A, \delta \beta_1 = B, \delta \beta_3 = C, \delta \beta_3 = D, \delta \beta_2 = E, \delta \beta_3 = F$ and $(1 - \delta) = G$

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

201
202 $\ln Q_t = \ln A + B \ln P_{t-1} + C \ln Exp_{t-1} + D \ln Exp_{vol} + E \ln R_t + F \ln A_t + G \ln Q_{t-1} + \delta \varepsilon_t - 5.0$

203 The short supply elasticity could be generated directly from parameter (B) in equation 5.0, while
204 the long-run adjustment in elasticity of supply as used by Omonona *et.al* (2004) and Ehiim *et al.*
205 (2007) is expressed as:

206
$$Longrun\ Supply\ Elasticity\{LRE_p\} = \frac{Short-run\ Supply\ Elasticity}{\delta} = \frac{B}{1 - G} - 6.0$$

207 Generating a technical relationship with a time series data of this nature is rarely void of
208 econometric problems such as spurious estimates (Greene, 2003; Ehirim *et.al.*, 2007 and
209 Molua, 2010). Therefore, the validity of the series needed to be checked and the generated errors
210 controlled. Once the ~~staionarity~~ stationarity properties of the individual series are established,
211 linear combinations of the integrated series are tested for cointegration. The stationarity property
212 is commonly done using Engle-Granger approach before the cointegration test (Molua, 2010)
213 and it ascertains whether individual series in the ~~empericale~~ empirical analysis exhibit similar
214 statistical characteristics before cointegration modelling. Following Engle-Granger approach,
215 Augmented Dickey-Fuller Test (ADF) is the most appropriate. This test, apart from stating the
216 stationarity of each variable, chooses the lag length, which ensures that the residual is an
217 ~~empericals are empirical~~ white noise and ~~all while~~ the series have constant variance and mean
218 ~~thus, Thus, there is~~ no random walk (Engel and Granger, 1987; Ehirim *et.al.*, 2007 and
219 Molua, 2010).

220 Problem arises if a process $(y_t = \alpha_1 y_{t-1} + \dots + \alpha_p y_{t-p} + v_t + u_t)$, with deterministic
221 term v_t , has a unit root and is hence integrated if $\alpha(1) = 1 - \alpha_1 - \dots - \alpha_p = 0$. This becomes

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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.

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

Where: $\pi = -\alpha(1)$ and $\gamma_j = -(\alpha_{j+1} + \dots + \alpha_p)$. The ADF test as noted by Fuller (1976) and Dickey-Fuller (1979) is then performed on the pair of hypothesis/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.

Results and Discussion

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.

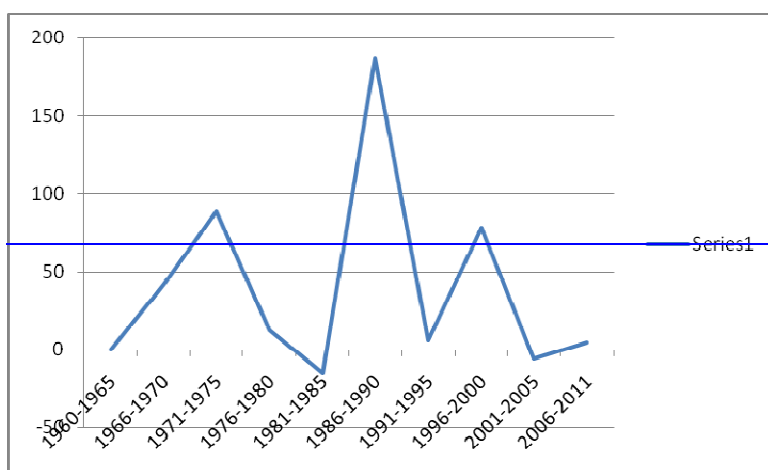
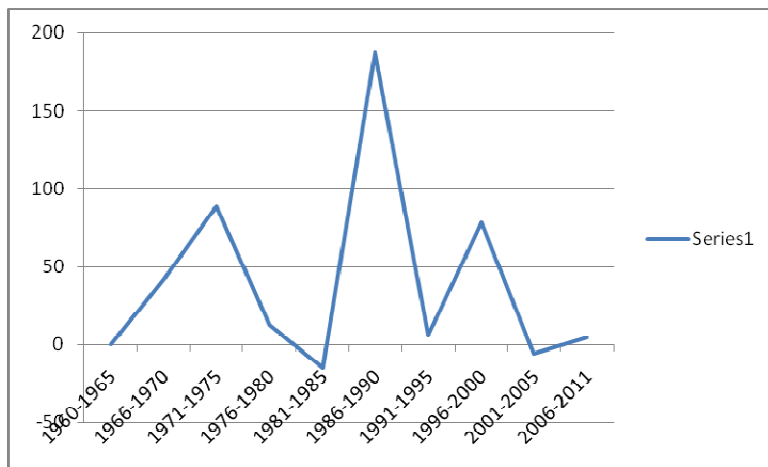


Figure 1. Percentage Change in Supply of Soybean in Nigeria

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 it's status probably due farmers~~the farmers'~~ responsiveness to policies that favoured productivity growth and not food accesibility to the market. The increased supply were was made when policy regime such as SAP etc favoured food self surfficiency~~surfficiency~~. It was followed by a long neglect of the programmes and finnaly~~finnaly~~ the government food production initiative. The oscillatory supply behaviour iswas a reason for

scacity at a period in time and excess supply at another time, [hence a set up of](#) food insecurity dynamics [was set up](#) in the country.

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 [into](#) 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 [sufficieny-sufficiency](#) programme of Nigeria (Anyanwu *et al.*, 1997 and CBN, 2003).

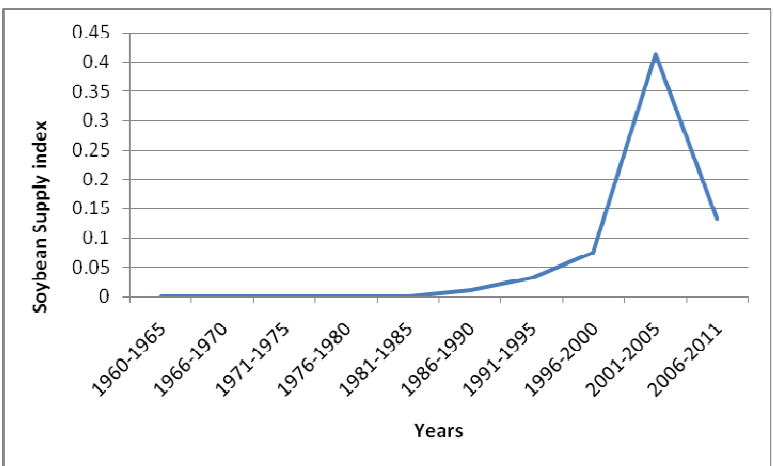


Figure 2. Trend in Soybean Contribution to Total Agricultural GDP from 1960 to 2011

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

i. 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-~~
~~furtherAugmented-Dickey-Fuller~~ (unit root) test was performed on the series as shown in Table
3. The stationarity test on the series ~~where~~~~were~~ 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~~~~were~~ 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~~~~had~~ a unit root at
1(1) see Table 1 below. It could be deduced from this finding that there could be a a short-run
divergence and ~~lon-run~~~~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~~~~stochastie~~ trend behaviour ~~hence-~~
~~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~~~~imminent~~.

Table 1. Stationarity (Unit Root) Test

Variable	At level form		At 1 st difference	
	ADF(lag ~~length~~ ~~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

ii. Testing for ~~Cointegrating~~~~Co-integrating~~ Vectors

~~The evidence~~~~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,
~~which were purely~~ due to their random walk behaviour or unit ~~rook lead to the~~~~root~~. A further test
of ~~cointegration in this study~~~~eo-integration with the Trace statistics is imperative~~. The
cointegrating modelling ~~implies that the equation can be~~ brought ~~the equations~~ back to

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stationarity through a linear transformation (Ehirim *et al.*, 2007). It revealed the number of 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 of the technical relationship involving the series. At/vector as shown by the Trace statistics indicated that there is an evidence of at least one cointegrating vector, there must be a long-run convergence or equilibrium despite the divergence of the series in the short-run. It could be seen from the result that the Trace statistic performed better than the Max-Eigen statistics at ($\rho = 0.05$), short run (Engle and Granger, 1987; Johanson, 1988 and Ehirim *et al.*, 2007).

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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

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Source: Result print out from E-view software, 2012: Trace Statistics indicated 2 cointegrating vector (equation) while the Max-Eigen value showed no cointegrating vector at ($\rho = 0.05$). Trace statistics was thus adopted. Two cointegrating vectors emerged at $\rho = 0.05$ in Table 4 below. 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. This implies that there is a long-run equilibrium expectation despite the short-run divergence of the series in the relationship (Engle and Granger, 1987; Johanson, 1988 and Ehirim *et al.*, 2007).

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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. ~~Log and other functional parameters. The log~~ likelihood ratio, Co-efficient of Multiple Determinant (CMD) and Dub-Waston statistic ~~of 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 explanatroy 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. An error correction vector (ECM) of -0.344, which is negative and ~~staitistically~~ statistically significant at $\rho = 0.05$ 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, coverges 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~~ is implies that apart from expected volume of export, other variables showed consistent behaviour with a piriori expectation. The result shows ~~es~~ that the lagged value of yield has about 0.11% increase on the current output supply of ~~soyabean. Implying soyabean, implying~~ that actual yield in the present year is sluggishly responding positively to ~~the~~ last year's yield in the economy. Though the food self ~~surfficiency-~~ ~~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 perivious 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 ~~acnean~~ 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%.

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

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(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 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.

iv. 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	0.888	-0.025
Rainfall	0.093		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](#) 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](#)~~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 [acrage](#)~~acrage~~ 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 proportionate increase in actual supply will follow farmers' response to food price policy regime of the government.

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 [an](#) 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 [agenderagenda](#) of the federal government should not [only](#) target [at](#) [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 [a](#) 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

424 policy framework of the transformation agender of the federal government. It will initiate an
 425 output response that invigorates both domestic and export supply at a reduced ~~deomestic~~
 426 ~~domestic~~ price. Increased domestic prices is forcing down export and this requires immediate
 427 improvement. Such improvement comes when there is an inward investigation on resource use
 428 efficiency of the farmers. A close look at input efficiency will suggest the cost effective
 429 production system that can increase output at a reduced cost, hence reduced market prices.
 430 Again, the benefits of resource use efficiency will galvanize farmers' returns and output so that
 431 farmers will have more incentive to produce and export will be ~~aboundant~~, ~~abundant~~. Alternative
 432 use of soyabean and value addition to the product will give a higher unit price, which will
 433 translate to increased output, returns and consequently supply of the product for export.

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 436
 437

Reference

439 Anyanwu, J.C., A. Oyefusi, H.A., Oaikhenan, A. and F.A. Dimowo (1997). ~~Nigeria, F. 1997.~~
 440 ~~The structure of the Nigerian Economy (1960 - 1997). Onitsha. Department of~~
 441 ~~Economics and Structure. Statistics University of Benin, Joancee Educational Publishers~~
 442 ~~Ltd. 203-209~~

444 Central Bank of Nigeria (2003). Central Bank of Nigeria Annual Report and Statement of
 445 Account 2003. Part 3. www.centbank.org/2003/CBN-ISSN-1597-2976 ISSN 1597-2976-
 446 May 2006

448 Central Bank of Nigeria (2004). The Changing Structure of Nigerian Economy and Implications
 449 for Development. Lagos Realm communications ~~Victoria Island Lagos.~~

451 Dickey D.H. and W.H Fuller (1981). likelihood Ratio Statistics for Autoregressive Time Series
 452 with Unit Root. *Econometrics*, Vol 49, No. 4 pp. 1057-1072.

454 Ehirim NC, M.A.Y. Rahji and P.M. Deustop-Nguezet (2007). Determinants of Groundnuts
 455 Supply in Nigeria 1960-2003, An Error Correction Model Approach. *International*
 456 *journal of Agriculture and Rural Development*, Vol 10, No.1, pp. 46-52.

458 Engle, R.F. and C.W.J. Granger (1987). Co-integration and Error Correction Representation,
 459 Estimating and Testing. *Econometrics*, Vol. 55, pp. 251-276.

461 Food and Agricultural Organization. 1996. Production Year Book. FAO, Rome, Italy.

463 Fuller, W. A (1976). *Introduction to Statistical Time series* Willey, New York. (USA).

464

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- Formatted: Font: Not Italic
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465 Greene, W. (2003). *Econometric Analysis* Prentice Hall New Jersey, (USA)
 466
 467 Gujarati, D.N. (1995). *Basic Econometrics International Edition* (3rd Edition) McGraw-Hill
 468 New York, International Editions Economic Series:- Singapore
 469
 470 | Intitute of Tropical Agriculture (2009). Soyabean www.iita.orgsoybean June 2009
 471
 472 | Johanson, S. (1988). Statistical Analysis of [Cointegration](#) ~~Co-integration~~ Vectors. *Journal of*
 473 *Economic Dynamics and Control*, (12) pp. 231-234
 474
 475 Molua, L. E. (2010). Response of Rice Yields in Cameroon: Some Implications for Agricultural
 476 Price Policy Department of Economics and Management, University of Buea, Cameroon,
 477 P.O. Box 63 Buea, Cameroon. *Libyan Agriculture Research Center Journal International*
 478 1 (3): ISSN 2219-4304, pp. 182-194, IDOSI Publications.
 479
 480 Nerlove M. (1958). Dynamic of Supply: Estimation of Farm Supply Response to Price. Johns
 481 Hopkins University Press, Baltimore.
 482
 483 | NMA (2004)- National Metrological Centre Annual [reports for several years](#) ~~Reports~~.
 484
 485 National Population Commission (2006). National Population Cencius Figures and Aanalysis.
 486 National Population Commission Abuja, Nigeria.
 487
 488 | Oguoma, N. ~~N.~~ O., N. ~~C.~~ Ehirim, G. ~~N.~~ Benchendo, I. ~~Nnadi~~ and E. ~~N.~~ Okoronkwo (2010).
 489 Determinants of aggregate household demand for edible oils in Imo State. *African*
 490 *Journal of Agricultural Research* Vol. 5(15), pp. 1932-1936, Available online at
 491 <http://www.academicjournals.org/AJAR> DOI: 10.5897/AJAR09.081 ISSN 1991-637X
 492 Academic Journals
 493
 494 | Oktaviani, R and R. ~~W.~~ Asmarantaka (2010). The Rise in International Food Prices: The Impact
 495 on and Policy Implications for Indonesian Food Security. Department of Economics and
 496 Agribusiness, Faculty of Economics and Management, Bogor Agricultural University,
 497 Indonesia. Contributed Paper at the Thirteen Annual Conference on Global Economic
 498 Analysis United Nations Conference Centre, Bangkok, Thailand.
 499
 500 | Olayemi, J. ~~K.~~ (1998). Food Security in Nigeria. Research Reports No. 2. Development Policy
 501 Centre, Ibadan, Nigeria.
 502
 503 | Omonona ~~BT.B.T., S.H.~~ BT.B.T., S.H., Yusuf ~~SH., E.J.~~ SH., E.J. Udoh ~~EJ~~ and ~~O.C.~~ Ohmourra ~~OC~~ (2004) Determinants
 504 of output supply Response of selected cereals in Nigeria. *Nigerian Journal of Agricultural*
 505 food And ~~environment vol~~ Environment Vol. 1, ~~n0~~ No. 1 ~~PPpp.~~ PPpp. 52-62.
 506
 507 | Omotor D- (2006) causally test of the Relationship between savings And economic growth
 508 Evidence From Nigeria. *Oceanic bank and Business journal* Vol 1 issue 1.
 509

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510 | Onyenweaku ~~CE, C.E.~~ Nwachukwu ~~in~~ and ~~T.C.~~ Opara ~~TC~~ (2010): Productivity growth in food
 511 | crop production. African Crop Science Journal, Vol. 18, NO. 3, pp. 119
 512 |
 513 | RMRDC (2004). Raw Material and Research Development Annual Survey Report. Raw Material
 514 | Reaserch and Development Council of Nigeria.
 515 |
 516 | Tripath, A. (2008): Estimation of Agricultural Supply Response by ~~Cointegartion~~~~Co-integartion~~
 517 | Approach Indian ~~crauh institute~~~~Crauh Institute~~ of ~~development~~~~Development~~ Research.
 518 |
 519 | Tollens E. ~~1998.(1998).~~ Food security: Incidence and causes of insecurity among vulnerable
 520 | groups and coping strategies. In: Food security in ACP countries, Proceedings of a CTA seminar,
 521 | Leuven, Belgium. 26-30th October. pp. 27-50.
 522 |
 523 | United State~~s~~ Development Agency (2011). USDA Attache: Nigerian Soyabean Output
 524 | Growing. Trade Intelligence Alibaba.com, America
 525 |

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