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Aggregate Agricultural Output Supply Response in Akwa Ibom State of Nigeria: An Application of the Nerlovian Adjustment Model

Ime Okon Utuk
Department of Economics Faculty of Social and Management Sciences Akwa Ibom State University Obio Akpa Campus Nigeria.

Abstract: *A large number of economists have concentrated their efforts on the study of the supply response of the crop sub-sector and individual crops to price and non-price incentives, but studies on aggregate supply response are few. This study is necessary in that it would assist policy makers to identify and evaluate the key variables which are important in determining aggregate agricultural output supply. The Nerlovian adjustment model was used for the estimation. The estimated coefficient were very low, indicating weak or minimal contributions of the variables to output growth in Akwa Ibom State. Moreover, the estimated short-run and long-run elasticities were fairly inelastic. However, the adjustment coefficient which measures the speed and magnitude of changes in planned output in response to anticipated output was above average. What this portrays is that farmers in Akwa Ibom State were more responsive to policy incentives. More of these factors should be committed to agricultural production, so as to improve productivity.*
Key Words: *Akwa Ibom state of Nigeria, aggregate agricultural output, Nerlovian adjustment model, supply response, supply elasticities.*

I. Introduction

A large number of economists have concentrated their efforts on the study of the supply response of the crop sub-sector and individual crops to price and non-price incentives, but studies on aggregate supply response are few. Infact, empirical estimates of supply response of individual crops are numerous. There are a few studies on the impact of price on aggregate agricultural output. Elbadawi [1] have elaborated on this issue.

Information on the agricultural sector's supply response to changes in prices and non-price incentives may help policy-makers to advance the process of poverty reduction and modernization. If agriculture is highly responsive to policies, policy-induced changes in farmer's response could be effective in increasing production, which in turn could assist in ensuring long-term food security in Akwa Ibom State of Nigeria. In fact, robust estimates of the coefficients of supply elasticities can serve as a solid basis in determining effective policy relevant interventions for promoting production, equity, efficiency and finally increase income distribution in the farm sector of the economy [2]. Therefore there is need to know the exact responses of agricultural supply if an effective overall agricultural policy is to be implemented in the state. Thus, this study is necessary in that it would assist policy makers to identify and evaluate the key variables which are important in determining aggregate agricultural output supply.

The paper is organized as follows. Following this introduction is the statement of the problem. Section three deals with data collection and analysis. Section four presents the review of past studies on aggregate agricultural output supply. Section five describes the methodological framework and empirical model. Section six reports empirical results. The final section summarizes conclusions and makes recommendations for policy and future research.

II. Statement of the Problem

Akwa Ibom State is a state in Nigeria. The state was created on September 23rd, 1987 from the former Cross River State. The state is made up of a homogenous group of people believed to originate from a single ancestral stock of the Bantus that migrated from the Eastern part of Africa during the historic expeditions of the thirteenth century [3]. The people have a common linguistic heritage, Ibibio which is spoken and understood by every group in the state.

The state with an estimated total population of 3,920,208 [4], covered with an estimated land area of 7,081 square kilometers lies between latitude $4^0 32^1$ and $5^0 33^1$ North and Longitude $7^0 25^1$ East of equator. Largely, Akwa Ibom State falls within the humid rain forest zone and most of the land is gentle undulating. Over seventy (70) percent of the people of Akwa Ibom State earn their livelihood through agricultural production.

The state is located in the populated forest area of the South-East Coast of Nigeria. It is well bathed by five major rivers – Cross River, Qua Iboe River, Imo River, Ikpa and Swamps of the Bight of Bony. Some of these rivers present attractive possibilities for small-scale irrigation development. The topography is more or less flat or slightly undulating in certain areas and lies below 300 metre above see level.

The climate is tropical, marked by two distinct seasons, the dry (November - March) and the wet (April - October) seasons. The wet season is sometimes interrupted by a short dry period in August. The mean annual rainfall is 2,220mm to the North of the state and up to 3,000mm to the South. Sunshine is between 1,400 to 1,500 hours per year. Daily mean temperature ranges from 23^0c to 30^0c. There are five distinct terrains, namely, the alluvial plains, coastal ridge sands, rolling sandy plains, dissected upland and the Obotme isolated hills, a collection of hills that rise to about 250 metres above sea level, the highest in the state. There are three easily distinguishable vegetation types: the saline water swamp forest, the fresh water swamp forest and the rainforest.

The people of Akwa Ibom are serious minded farmers. They grow crops, keep stocks of small ruminants, and fish in the abundant revirine and coastal waters. In the face of limited employment opportunities, agriculture is developed to accommodate both the food supply and jobs needs of the people. From the saline water swamp forest in the South to the rain forest in the North, the land is suitable for large scale agriculture. A number of cash crops, which can be processed into primary and secondary products, are grown all over the state.

Furthermore, the Akwa Ibom State government has made provisions for agricultural activities in its annual budget on a yearly basis. Table 1 shows that the expenditure for agricultural programme is on the increasing trend. In 1988, the expenditure for agricultural activities was over twelve million naira and in 1989, it was over twenty seven million naira. In the year 2011, it was over four billion naira and in 2012, it was over thirteen billion naira.

Despite all the attractive scenery for agricultural activities and government expenditure on agricultural programme which is on the increasing trend over the period, the sector is not producing the expected results. The sector is still characterized by poor performance. For instance, the state still experiences

i. Increasing food supply shortfalls;
ii. Rising food prices;
iii. Food insecurity;
iv. Food self-insufficiency
v. Poverty among the rural farmers and;
vi. Importations of food items to augment domestic demand.

Therefore, any meaningful attempt to ensure a rapid growth and development of the sector in the state would require a detailed knowledge of the supply response parameters of aggregate agricultural output growth. The provision of these supply response estimates in order to create a basis for further policy reforms is the main motive of this study.

TABLE 1: Government Expenditure on Agriculture (Akwa Ibom State)

Year	Expenditure on Agriculture
1988	12,377,000
1989	27,278,000
1990	62,175,800
1991	75,946,090
1992	93,179,780
1993	109,243,210
1994	129,662,000
1995	162,270,000
1996	93,186,000
1997	138,602,520
1998	129,355,480
1999	217,012,850
2000	516,000,000
2001	1,302,874,460
2002	1,170,000,000
2003	382,103,830
2004	801,000,000
2005	1,060,000,000
2006	1,409,000,000
2007	1,513,000,000
2008	2,471,000,000
2009	3,297,000,000
2010	4,835,000,000
2011	4,368,000,000
2012	13,047,000,000

Source: [5]

III. Data Collection and Analysis

Agricultural supply response can be analyzed from the point of view of aggregate output or supply, sub-sectoral output, that is, crop output or livestock output and individual crop [6]. The level of aggregation depends on the objective of the study as well as the availability of data. This study will concentrate on aggregate output. The reason is to investigate the entire performance of the agricultural sector in the state.

Time – series data covering the period between 1988 to 2012 (25 years) are used. The following secondary data are required for the study. They are data on aggregate output, farm gate prices, index of rural, wage rate, public sector expenditure on agriculture, average rainfall index population growth and education (adult literacy) and rural infrastructure measured by government expenditure for upgrading rural roads.

3.1 Sources of Data

The data used in the study were collected from secondary sources. Data were obtained from the Akwa Ibom State Ministry of Agriculture, Akwa Ibom State. Agricultural Development Project (AKADEP), Akwa Ibom budget and Planning Department, National Bureau of Statistics (NBS), Akwa Ibom State Ministry of Rural Development Akwa Ibom State Agency for Adult and Non-Formal Education and from Akwa Ibom State Agricultural Handbook. The reduced form of the Nerlovian model which incorporate price and non-price incentives to assess the impact of Agricultural supply response to policies aim at increasing agricultural productivity in the state is used.

3.2 The Measure of Output

There is a great deal of disagreement in the literature on what the correct measure of output should be. The three choices for measuring output are the acreage under cultivation, production or yield per unit area, and total production in terms of weight or tonnage produced [7].

Askari and Cummings [8] assert that farmer's expectation of increase in output is best expressed in terms of the acreage planted because this is how farmers translate their output expectations into action. However, by using acreage planted, the inherent assumption is that farmers can only increase their output in response to public policies by utilizing more land. This is incorrect, since farmers could also increase output by farming their land more intensively [9]. A further reason why acreage planted may not be the correct measure of output is that farmers may have a limited area of land available for the cultivation of crops. In this situation, since the area of land is given, the farmers cannot increase the areas of cultivated land in response to policy incentives.

The use of production per unit area as a measure of output is flawed in that it assumes that farmers will only respond to policy incentives by producing more intensively, thereby causing production per hectare to increase. This measure overlooks the possibility that policy incentives to increase output may instead cause a decline in the average yield per hectare as a result of marginal land of an inferior quality being cultivated.

Secondly, land itself is often far from a homogenous factor of production. If land is sufficiently heterogeneous in quality, and if other inputs constrain production, a situation is conceivable in which a farmer might decide to increase the planned output of a specific crop by devoting less, but better land to that crop, [10].

The third problem is associated with absolute and relative scarcity of cultivated land. That is, the supply of cultivated area is not indefinitely elastic. This is particularly important where the size of cultivated land per household is very small on the one hand, and where food crops predominate it on the other. In other words, whether or not there exists an excess capacity with which to sufficiently expand area under a crop or group of crops in response to changes in public policies is too important an aspect to ignore. Scarcity of land constraints peasants from increasing cultivated area in response to policy incentives.

The best measure of output appears to be the use of the actual produce weight because it acknowledges that farmers may response to policy incentives by using either more intensive or more extensive farming techniques. An additional factor in favour of the use of this particular measure is that data on tonnage produced is readily available. This study will therefore use the actual out produce based on its advantages. Aggregate output will be calculated as a weighted average of the production index of individual crops, the weights being the share of each crop in the total value of agricultural output.

3.3 Output Price Specification

One of the most important factors relating to the output price specification is in choosing the relevant deflator. Askari and Cummings, elaborate very well on this. The real output price can be either one of these.

a. the price of the crop actually received by farmers
b. the ratio of the price of the crop received by farmers to rural consumer price index;
c. the ratio of the price of the crop received by farmers to some price index of the farmers inputs;

d. the ratio of the price of the crop received by farmers to some index of the price of competitive crops (or the price of the most competitive crops)

The use of the nominal output price does not make economic sense if inflation is high, since farmers will be interested in the actual purchasing power of their money and as a result will respond to changes in real output prices rather than changes in nominal prices. The output price and deflator that are eventually chosen must be relevant to the farmer's decisions and policy incentives that are being examined. However, when analyzing the supply response to policy measures in a developing country such as Nigeria, the choice of the deflator may be limited by lack of reliable data. Hence, as a result of data limitation, this study will use the ratio of the price of the crop received by farmers to rural consumer price index. Price changes are positively related to agricultural output.

IV. The Review of Past Studies

The response of aggregate agricultural output is an issue that has recently attracted greater attention. While studies on individual crop response abound, studies on aggregate supply response are few. Despite the paucity in the number of studies, there was a general belief in the low aggregate supply response. This belief constituted one of the main arguments for discouraging agricultural policies in favour of industrial policies in developing countries which turned the domestic terms of trade against agriculture [11].

Olomola [12], examined the response of aggregate agricultural output supply in Nigeria between 1970 and 1996. A simple regression analysis was used for the estimation. Using the elasticity coefficient, the contribution of each explanatory variable to the growth of output was analyzed. The emerging results indicated a high expenditure variability and a lopsided pattern of government commitment to agricultural activities over the years and the became worse under structural adjustment programme (SAP). There was a positive correlation between agricultural output and government policy measures like rural infrastructure and public sector expenditure on agriculture, but their effects on output were not substantial over the years. In relative terms, what this means was minimal or weak contributions of these variables to the growth in output.

Most of the empirical estimates of aggregate agricultural supply response have been largely based on Nerlove's [13] formulation. The studies include those carried out by (Reca, [14], Bapna, [15], Chhibber, [16], Bond, [17]). These studies produced broadly similar results with short-run aggregate supply elasticities around 0.2 and long-run elasticities of about 0.4 [18].

According to the author, supply response studies have been plagued with numerous methodological problems and data limitations that limit the reliability of supply elasticity estimates. As noted by Binswanger [19], the common problems related to the aggregate agricultural supply response model are the neglect of non-price factors, simultaneity and other problems associated with econometric estimation. This study improves data and econometric tests and incorporates some important non-price variables into the model in its examination of the supply response of aggregate agricultural output in Akwa Ibom State of Nigeria.

V. Methodological Framework and Empirical Model

According to Turner, [20], "a research method is a means or a mechanism for explaining a social fact or reality". Moreover, Pu, [21] has observed that the choice of a research method by a scholar or researcher is a function of a number of factors or consideration. The choice of a research method according to him will depend on whether the study is a one-sector analysis, partial or general equilibrium analysis.

Secondly, the choice will also depend on the ability of the model to capture dynamic growth process in the economy. The study is basically an attempt to appraise the supply response of the crop sub-sector of Akwa Ibom State Agriculture. The study makes use of the Nerlovian adjustment model for the estimation. The model was developed by Nerlove [22]. Hence, following Nerlovian [23] tradition, the general supply response model can be presented as:

$$Q_t^e = bo + b_1P_t^e + b_2W_t + U_t \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where Q_t^e is desired level of output, P_t^e is a vector of expected level of prices, W_t represents the set on non-price factors, bi's are parameters and U_t accounts for unobserved random factors with zero expected value. What this model is saying is that the desired level of output depends on the expected price level and other non-price factors. This model assumes a linear relationship. The Nerlovian model is constructed to handle two dynamic processes: adaptive expectations and partial adjustments. Since the desired level of output cannot be obtained by farmers due to policy constraint, Nerlove postulate the following hypothesis, known as partial adjustment:

$$Q_t - Q_{t-1} = \gamma\,(Q_t^e - Q_{t-1}),\ O< \gamma <1 \ldots\ldots\ldots\ldots(2)$$

γ is known as the coefficient of adjustment, $Q_t - Q_{t-1}$ is the actual change in output and $(Q_t^e - Q_{t-1})$ is the desired change in output.

Equation two is saying that the actual change in output in any given time period t is some fraction γ of the desired change for the period. If $\gamma = 1$, it means that the actual output is equal to the desired output, that is, actual output adjusts to the desired output instantaneously in the same time period. However, if $\gamma = 0$, it means that there is no change since actual output at time t is the same as that observed in the pervious time period. Typically, γ is expected to lie between these extremes since adjustment to the desired output is likely to be constrained by policy lags.

Specification of a model that explains how price expectations are formed based on differences between actual and past prices assumes:

$P_t^e - P_{t-1} = \partial (P_{t-1} - P_{t-1}), O < \partial < 1$ ……………………………….(3)

Where ∂ is adaptive expectations coefficient. Specifically, equation three states that expectations are revised each period by a fraction ∂ of the gap between the current value of prices and its previous expected value. This means that expectations about the price level are revised by farmers by a fraction ∂ due to policy inconsistency that affect the price level observed in the current period and what its anticipated value had been in the previous period. If $\partial = 1$, it means that expectations are realized immediately and fully, that is, in the same time period. If, on the other hand, $\partial = 0$, it means that expectations are static, that is, conditions prevailing today will be maintained in all subsequent periods. However, expectations are seldom fully realized, there is usually a gap between actual and expected level of prices because of constraint in public policies and non-policy variables.

In order to use the Nerlovian model for estimation, it is necessary to transform the three equations into the reduced form. In the reduced form, the partial adjustment variable Q_t^e which is associated with the desired output and the adaptive expectation variable P_t^e which is associated with price expectation are transformed into distributed lag structures in the form of past level of output and the previous expected price level. This is consistent with the Nerlovian model which is based on price expectation and output adjustment. The entire process necessary to arrive at the reduced from equation is shown below. There are two constants in the equation, γ and ∂. γ is referred to as the Nerlovian coefficient of adjustment. By imposing a restriction that $\partial = 1$ and substituting equations (2) and (3) into equation (1), a reduced form equation is derived as follows:

$Q_t^e = bo + b_1 P_t^e + b_2 W_t + U_t$ ……………...………….(1)

$Q_t = Q_{t-1} + \gamma(Q_t^e - Q_{t-1})\ 0 < \gamma < 1$. ……………………….(2)

$P_t^e = P_{t-1} + \partial (P_{t-1} - P_{t-1})\ 0 < \partial < 1$ …………………… (3)

$Q_t = Q_{t-1} + \gamma Q_t^e - \gamma Q_{t-1}$..$(2^1)$

$P_t = P_{t-1} + \partial P_{t-1} - \partial P_{t-1}$…............……………………..$(3^1)$

Substitute equation (3^1) into equation (1) where $\partial = 1$:

$Q_t^e = bo + \cancel{b_1 P^e_{t-1}} + b_1 P_{t-1} - \cancel{b_1 P^e_{t-1}} + b_2 W_t + U_t$

$Q_t^e = bo + b_1 P_{t-1} + b_2 W_t + U_t$ …………………………(4)

$Q_t = Q_{t-1} + \gamma Q_t^e - \gamma Q_{t-1}$ ………………………………(2^1)

Substitute equation (4) into equation (2^1):

$Q_t = Q_{t-1} + \gamma (bo + b_1 P_{t-1} + b_2 W_t + U_t) - \gamma Q_{t-1}$……….(5)
Remove the bracket

$Q_t = Q_{t-1} + \gamma bo + \gamma b_1 P_{t-1} + \gamma b_2 W_t + \gamma U_t - \gamma Q_{t-1}$………..(6)

Collect like terms:

$Q_t = \gamma bo + \gamma b_1 P_{t-1} + \gamma b_2 W_t + (1 - \gamma)\ Q_{t-1} + \gamma U_t$

The equation becomes:

$Q_t = a_o + a_1 P_{t-1} + a_2\ W_t + a_3\ Q_{t-1} + U_t$…………………(7)

Where:

$a_o \quad = \gamma bo$

$a_1 \quad = \gamma b_1$

$a_2 \quad = \gamma b_2$

$a_3 \quad = 1 - \gamma$

$U_t \quad = \gamma U_t$

Hence,

$a_3 \quad = 1 - \gamma$

$\therefore\ y = 1 - a_3$

$a_0 \quad = \gamma\ b_o$

$a_o \quad = (1 - a_3)\ b_o$

$$\therefore\ b_o = \frac{a_o}{1 - a_3}$$

$a_1 \quad = \gamma b_1$

$a_1 \quad = (1 - a_3) b_1$

$$\therefore\ b_1 = \frac{a_1}{1 - a_3}$$

$a_2 \quad = \gamma b_2$

$a_2 \quad = (1 - a_3)\ b_2$

$$\therefore b_2 = \frac{a_2}{1 - a_3}$$

The 'a' parameters are the short-run elasticities while b is the long-run elasticities. 1-a_3 is the coefficient of adjustment.

Equation seven is the reduced form of the Nerlovian model. It says that the current level of agricultural output Q_t is determine by the autonomous output a_o, the previous expected level of prices, P_{t-1}, a set of non-price variables Wt, the past level of output Q_{t-1} and on the disturbance term U_t.

While equation (7) depicts the theoretical description of the Nerlovian model, its final form for empirical estimation must capture the relevant factors underlying agricultural supply.

Agricultural supply represents the response of farmers to changes in farm profits. Changes in farm profits, however, are the result of the interplay of changes in prices and non-price factors. Available empirical findings tend to suggest that the association between real farm prices and agricultural output is weak, which implies the importance of non-price factors in determining farm output, [24]; [25].

The specification of the agricultural supply response should therefore consider these non-price variables. In the light of the foregoing, the non-price factors can be incorporated into the output supply function as shifter variables. Hence, introducing these measures into the agricultural output supply function equation (7) could be rewritten as:

$Q_t = a_o + a_1P_{t-1} + a_2ARN + a_3Q_{t-1} + a_4GEA + a_5RWR + a_6RIG + a_7POG + a_8EDA + U_t$……..(8)

Where:

Q_t	=	Agricultural output at time t.
ARN	=	Average Rainfall
GEA	=	Public Sector expenditure on the crop sub sector
RWR	=	Rural wage rate
RIG	=	Rural infrastructure (measured as Government Expenditure for upgrading rural roads)
POG	=	Population growth
EDA	=	Education (Adult Literacy: No Admitted)
P_{t-1}	=	Price lagged by one period
Q_{t-1}	=	Output lagged by one period
t	=	Year under consideration
u	=	Error Term

Equation (8) is therefore used for the estimation of the parameters. Positive parameters are expected for all explanatory variables.

5.1 Relevance of the Model

Among all the econometric models used in measuring the responsiveness of agricultural supply to policy measures, the Nerlovian model is considered one of the most influential and successful, judged by the large number of studies which utilized this approach, [26], [27], [28], [29].

In this study, the researcher prefers using the model because it recognizes the effect of time lag on the current level of output. It takes sometime before farmers can embrace new policies such as the adoption of new farming methods like crop spacing, planting of new improved seeds and application of modern inputs like fertilizers and chemicals etc, which improve crop yield. Nerlove has built in this time lag into his model as part of the explanatory variables where output lagged by one period, (Q_{t-1}) and real price lagged by one period (P_{t-1}) are meant to capture the length of time needed by farmers to adopt new policies. Other models such as the profit function, production function, error correction and co-integration model, linear programming and ordinary least square methods often used by researchers do not recognize the influence of time lag on agricultural production. In addition, the model is very flexible. It can handle the growth process in the agricultural output and the estimation of long-run and short-run elasticities.

Furthermore, in the Nerlovian model, the stochastic disturbance term U is uncorrelated with the lagged explanatory variable Q_{t-1}. In this model $U = \gamma U$, where $O < \gamma < 1$. Therefore, if U satisfies the assumptions of the classical linear regression model so will γU. Thus, ordinary least square (OLS) estimation of the Nerlovian model will yield consistent estimates in the coefficient of the variables [30]. The reason for consistency is this. Although Q_{t-1} depends on U_{t-1} and all the previous disturbance terms, it is not related to the current error term U. Therefore, as long as U is serially independent, Q_{t-1} will also be independent or at least uncorrelated with U, thereby satisfying an important assumption of OLS, namely, non-correlation between the explanatory variable and the stochastic disturbance term.

In addition, in order to ensure the normality of the residuals, it is possible to express the Nerlovian model in logarithmic form. The transformation ensures that the errors are both homoscedastri and normally distributed, [31]. The logarithmic form also allows the interpretation of coefficient as elasticities.

VI. Empirical Estimation and Assessment

The parameter estimates are presented in table 2. The Durbin – Watson statistics indicates no serious serial correlation in the error term. In addition, in the Nerlovian Model, the lagged explanatory variable, output lagged by one period is uncorrelated with the current error term U, thereby satisfying an important assumption of OLS, namely, non – correlation between the explanatory variables and the stochastic disturbance term. Overall, the model is considered to be reasonably specified based on its statistical significance and ability to explain the variation in aggregate agricultural output. The signs of all the coefficient are positive as predicted by theory. The coefficient of price lagged by one period and the coefficient of average rainfall index are significant at one percent level. In addition, the coefficient of output lagged by one period and rural wage rate are significant at five percent level respectively. However, government expenditures on aggregate agricultural output and for upgrading rural roads (rural infrastructures) are not significant. Moreover, the coefficient of adult education and population are also not significant. The coefficient of the real price variable is positive and this is an indication that a price increase will be followed by an increase in aggregate output in the subsequent period. In addition, the positive sign of all the coefficient shows that aggregate output varies directly with these variables. As these variables increases, aggregate output tends to increase, and conversely, as the variables decline, output tends to fall. This makes economic sense because producers tend to expand output as these variables increases and vice versa. The coefficient of determination (R^2 = 0.842905) shows that the explanatory variables explained about 84% variation in the dependent variable. What is deduced from the estimation is that price incentive, policy variables such as government expenditure on agriculture, government expenditure for up-grading rural roads, adult education and non-policy. Variables like rainfall, rural wage rate, population growth affect aggregate output supply. However, the coefficients of the variables were very low. What these low coefficient portrays is a weak or minimal contributions of the variables to aggregate output growth in Akwa Ibom State of Nigeria. Hence, based on this finding, one can conclude that Akwa Ibom State is faced with food insufficiency and the demand is greater than the supply.

TABLE 2
Regression Results (In Log) for Aggregate Agricultural Output for Akwa Ibom State from 1988 – 2012

Variable	Coefficient	t – value
C	8.427489	2.141089
LGEA	0.060374	0.506613
LP_{t-1}	0.084899*	3.452806
LQ_{t-1}	0.358234**	2.010710
LRWR	0.202900**	2.329539
LARN	0.027543*	4.976565
LPOG	0.248882	1.059459
LEDA	0.032466	0.178082
LRIG	0.038199	1.223769

R^2 = 0.842905
Adjusted R^2 = 0.759121
F – Statistic = 10.06044
Prob. (F – Statistic) = 0.000085
Durbin – Watson Statistics = 1.957291
* = indicates significance at the 1% level
** = indicates significance at the 5% level.

6.1 Elasticity Results and Interpretation

TABLE 3: Elasticity Estimates

E with Respect to	Short-run	Long-run
GEA	0.060374	0.094075
P_{t-1}	0.084899	0.132289
RWR	0.202900	0.316159
ARN	0.027543	0.042918
POG	0.248882	0.387808
EDA	0.032466	0.050589
RIG	0.038199	0.059522
Coefficient of Adjustment		0.641766

The short-run and long-run elasticities are presented in table 3. From the results, it can be generalized that both short-run and long-run elasticities are fairly inelastic. A 10 percent increase in the price of the agricultural output would lead to an expansion of the output by 0.85 percent in the short-run and by 1.32 percent in the long-run. The long-run estimates are much larger than the short-run values. The reason is that the response of price incentives and non-price variables to changes in agricultural output are low in the short-run because most factors of agricultural production are fixed in the short-run. Land, capital and labour account for a greater percentage of the cost of agricultural production. Most of these resources must be devoted to agriculture in order to obtain a large agricultural output. This is difficult in the short-run considering the relative fixity of these resources. In the short-run, land availability cannot be altered without considerable investment, supplies of capital cannot increase rapidly, agricultural technology cannot be increased without considerable amount of capital investment and labour availability cannot change without population growth or migration among sectors or regions. Variable inputs such as fertilizers and pesticides are the only factors whose quantities can be quickly adjusted to policy incentives, but the amount of these inputs used in agricultural production are very low so as to make any appreciable impact in the short-run.

In contrast to the short-run supply response of agricultural output, the long-run supply response is large. It ultimately is a result of an expansion of labour and capital following farmers' decision to invest and adopt new technology. The long-run supply response also depends on the time frame, since the translation of capital and labour (re) allocation into output growth takes time.

The adjustment coefficient which measures the speed and magnitude of changed in planned output in response to anticipated output is above average. It is 0.641766. According to (Olayemi, [32]), if $y \geq 0.5$, the adjustment speed is said to be big. What this portrays is that farmers in Akwa Ibom State are more responsive to policy incentives. More of these factors should be committed to agricultural production so as to improve productivity.

6.2 Comparison with Results from other similar studies

These results are similar to those obtained from supply response of agricultural output to price incentives and non-price incentives policies from other countries. For instance, Bond, estimated the supply response of agricultural output to policies for various crops in nine countries of Sub-Saharah Africa and reported that price elasticities ranges from 0.1 to 0.5 in the short-run and from 0.6 to 1.8 in the long-run. In Zerihun [33] study, using Nerlovian model, the response of individual crops and aggregate output for twelve years 1982 to 1993 for Ethiopia, reported that producer price, weather, technological changes, infrastructures and output lagged by one period had the expected signs and explained 99 percent of the variation in agricultural production. Furthermore, (Van Walbeek, 2003), using an adapted Nerlovian model to study the effect of government policies on tobacco production in Zimbabwe from 1938 to 2000, reported a short-run elasticity of 0.34 and a long-run elasticity of 0.81, suggesting that tobacco farmers are highly responsive to policy changes.

VII. Conclusions and Recommendations

The study estimated the supply response of agricultural output to price incentives and non-price incentive policies for the aggregate agricultural output of Akwa Ibom State of Nigeria. The Nerlovian adjustment model was used for the estimation. The deduction from the estimation is that price incentive, policy variables such as government expenditure on agriculture, government expenditure for upgrading rural roads, adult education and non-policy variables like rainfall, rural wage rate and population affect aggregate output supply. The estimated coefficient were very low, indicating weak or minimal contributions of the variables to output growth in Akwa Ibom State.

The estimated short-run and long-run elasticities are fairly inelastic. However, the long-run estimates are much larger than the short-run values. The reason is that the response of price incentivesi and non-price variables to changes in agricultural output are low in the short-run because most factors of agricultural production are fixed in the short-run. In contrast to the short-run supply response of agricultural output, the long-run supply response is large. It ultimately is a result of an expansion of labour and capital following farmer's decision to invest and adopt new technology.

The adjustment coefficient which measures the speed and magnitude of changes in planned output, in response to anticipated output is above average. What this portrays is that farmers in Akwa Ibom State are more responsive to policy incentives. Therefore, the recommendation is that more of these factors should be committed to agricultural production so as to improve productivity.

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