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Abstract

This paper set out to investigate the impact of Central Bank of Nigeria's interventions on the agricultural sector within an economy-wide framework of general equilibrium modelling. The paper adopted a dynamic (recursive), two-sector general equilibrium model of the Nigerian economy with some modifications on the standard model developed by the Centre for Econometric and Applied Research (CEAR) and incorporated the contributions of the CBN's agricultural based interventions as increases in the stock of agricultural capital so as to have a more robust size of interventions into the agricultural sector. The SAM used for the CGE model analysis was derived from the updated Input and Output Table for 2011. Results indicated that interventions contributed positively (although marginally) to GDP during the periods of intervention; contributed to a marginal decline in government subsidy expenditures and improvement in government revenues; led to an increase in exports of agricultural commodities and marginal reduction in the volume of imports of intermediate goods used in the agricultural value chain; prices of agricultural commodity exports increased marginally in the fifth period as a result of the interventions; interventions impacted positively on the incomes and utility of rich farm owners. However, poor farmers were worse off with interventions, as their income and utility increased steadily at a faster pace without intervention than it did with interventions. It is recommended that targeted extensive support must be provided to poor farmers to improve their competitiveness and ensure they are not crowded out by the rich farm holders and access to markets for fair and competitive prices needs to be encouraged.

Keywords: Impact, Evaluation. Computable General Equilibrium, Interventions, SAM, Agriculture

JEL Classification: D1, D5, D57, C68

I. Introduction

Sustained public sector interventions in agriculture are critical to the growth and transformation of the sector in Nigeria. This is due to the low level of investment in the sector compared to its huge potentials to create employment, generate wealth and reduce poverty (Olomola *et al.,* 2014). The agricultural sector in Nigeria is endowed with fertile soil, complimented by streams, lakes, forests, lush grassland, as well as huge demand driven by a large active population, estimated at 182 million as at 2016 (representing 2.35 per cent of global population). The abundant resources, if properly harnessed can

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support self-sufficiency in food, supply of raw materials to the industrial sector and provide gainful employment to the teeming population, of which about 50 per cent of them are employed in the sector (World Bank, 2017).

To ensure improved investments and output within the sector, various governments embarked on different growth enhancement programmes. The focus of these programmes comprised providing improved access to finance and other farming inputs such as fertilisers and seedlings to agriculturalists, price support mechanisms through implementation of protectionist policies on tariffs and taxes, among others. These interventions were done at all levels by government agencies and international development partners. An agency of the government, the Central Bank of Nigeria (CBN), has been actively involved in intervening within the agricultural sector with the aim of improving access to finance (mostly at single digit rates) to agriculturalists. The impact of these interventions within the agricultural sector by the Bank has not been captured within an economy-wide framework of general equilibrium modelling in the past, hence obscuring the impact of its sectoral contribution to growth in the economy.

The aim of this paper is to provide an insight into the estimated impact of various agricultural interventions by the CBN on the economy. To this end, we adopt a dynamic (recursive), two-sector general equilibrium model of the Nigerian economy and incorporate the contributions of the CBN's agricultural based interventions as increases in the stock of agricultural capital so as to have a more robust size of interventions into the agricultural sector. Following the introductory section, section 2 presents an overview of Nigeria's agricultural sector, while section 3 presents the nature of government interventions in agriculture. Section 4 reviews the empirical literature while the 5th section presents the methodology adopted in the paper. Intervention scenarios and simulation results are presented in sections 6 and 7, respectively while recommendations and conclusions of the paper are presented in the 8th and final sections, respectively.

II. Overview of Nigeria's Agricultural Sector

Agricultural activities are dominated by peasant small holder farmers who constitute about 90 per cent of farm holding in the country. These farmers practice mostly traditional methods and produce mostly for subsistence purposes. Interventions by government have been influenced by the need to provide access to inputs and other support to peasant farmers so as to boost their productivity and enable them transit to mechanised agricultural practices, while commercial farm holders were supported through the provision of credit facilities, input subsidies, capacity building initiatives and export incentives.

Although its rate of growth has declined consistently over time, agriculture has remained a growth driver in Nigeria. Between 2000 and 2005, the sector grew by 15.9 per cent (although this high figure could be attributed to the huge growth recorded in 2002 (55.9 per cent), without which it would have grown at 6.0 per cent). Its growth however declined to 6.5 and 4.1 per cent within the period 2006-2010 and 2011 -2016 respectively. Similarly, the sector has remained dominant in the economy of Nigeria due, partly, to its contribution in value added to GDP and the share of the population employed within the sector which is put at about 50 per cent of Nigerians. During the period 2000-2005, the sector contributed 36.3 per cent of total value added to GDP. Its average contribution however declined consistently over time to 31.7 per cent in the period 2006-2010 and further down to 21.3 per cent during the period 2011-2016. One of the objectives contained in most agricultural policies or programmes of the government has been to improve self-sufficiency of the nation, reduce share of imported food and encourage the export of agricultural commodities. Table 1 below indicates that the period 2000-2016 witnessed a sustained improvement in the share of agricultural raw material exports as a percentage of total merchandise exports. Its share grew from a paltry 0.1 per cent during the period 2000-2005 to 1.0 and 4.3 per cent during the period 2006-2010 and 2011-2016 respectively. However, significant gains that were achieved in reducing the share of import of agricultural raw materials to total merchandise imports at the beginning of the period under consideration was reversed towards the end of the period. Its share in total merchandise imports reduced from 1.3 per cent recorded in 2000-2005 to 0.9 per cent during the period 2006-2010. This later jumped to 2.1 per cent during the period 2011-2016.

Table 1: Selected Agricultural Based Indicators (2000-2016)

S/No.	Agricultural Indicators	2000-2005	2006-2010	2011-2016
1	Agricultural GDP Growth (per cent)[1]	15.9[2]	6.5	4.1
2	Agriculture, value added (per cent of GDP)	36.3	31.7	21.3
3	Agricultural raw materials exports (per cent of merchandise exports)	0.1	1.0	4.3
4	Agricultural raw materials imports (per cent of merchandise imports)	1.3	0.9	2.1
5	Employment in agriculture (per cent of total employment)	44.6	48.6	-
6	Cereal yield (kg per hectare)	1293.9	1513.0	1392.3

Source: World Bank Open Data

[1]GDP figures for constant basic prices was used and sourced from the CBN Statistical database.
[2]The figure is high due to the influence of an outlier of for 2002 which was included; without which the average growth would have been at 6.0 per cent.

II.1 Nature of Government Intervention in Agriculture

Post-independence, with the discovery of crude oil and the boom that marked that era, agriculture lost its position as the main export earner to crude oil. To enhance the importance of the sector and ensure food security, several agricultural policies were initiated to improve the performance of the sector. Most of these initiatives are embedded in the various National Development Plans (1960-1985), the Structural Adjustment Programme (1986-1988), National Economic Empowerment and Development Strategy (2004-2007), Agricultural Transformation Action Plan (ATAP) (2011-2015) as well as in various transformation initiatives adopted by governments. These initiatives focused on four broad areas within the agricultural value chain. These include to; improve access to land, boost the production of selected crops, provide input support mechanisms through import waivers and export incentives as contained in fiscal policies of the government as well as the provision of credit to agriculturalists at single digit rates.

In the area of improving access to land as a critical factor in agricultural production, more notable efforts were made by some state governments to encourage private sector participation in commercial agriculture in their states. For instance, Kwara and Cross River states embarked on public-private sector partnership programmes in the establishment of commercial farms. In Kwara State, the initiative, which began in 2004, led to the arrival of Zimbabwean farmers who went into the production of cereals, rice, cassava, vegetables, dairy, poultry products, and tobacco. In order to support these farmers, the state government provided facilities such as feeder roads, security, and telecommunication equipment and irrigation facilities. The marketing strategy put in place was for the farmers to sell to potential bulk buyers such as flour and feed mills, etc.

Similarly, the Cross River state government improved access to land for commercial agricultural purposes with the leasing of 22 farms constituting about 71,809 hectares to private farmers and ensured timely delivery of legal title documents to them. In addition, it provided enabling environment through provision of seedlings, fertilisers, technical and financial assistance to a number of privately owned farm estates. Also, many hitherto moribund state-owned oil palm, rubber and cocoa estates were revitalised, privatised and in most cases leased in smaller blocs to private farmers.

To support the local production of selected staple and cash crops, recent government administrations rolled out various presidential initiatives

(Iwuchukwu & Igbokwe, 2012). In 2001, the Federal Government adopted different strategies which involved massive production and supply of improved seedlings, procurement and distribution of critical inputs, facilitation of fiscal incentives required for profitable production and effective coordination of institutional support, as well as capacity building for farmers and processors.

Consequently, the Presidential Initiative on Increased Rice Production was designed to reverse the rising rice import bill which stood at N96.012 billion in 2002, meet domestic demand by 2006 and produce for export by end of 2007. By 2007, it was targeted that 3.0 million hectares of land would be put under cultivation to produce 15 million tons of paddy or 9.0 million tons of milled rice. It was planned that the importation of rice would be banned in January 2007 to give stimulus for local production.

The initiative on cassava production and export was intended to raise the production level of cassava to 150 million MT per annum by the end of year 2010. The programme was also expected to realise an income of US$5.0 billion per annum from the export of 37.6 million tons of cassava products, such as starch, cassava chips, pharmaceuticals, adhesives and other value added products.

The Agricultural Transformation Agenda (ATA) of the Government set up the Growth Enhancement Scheme to register small holder farmers and provide targeted input subsidies such as access to fertilisers and seeds. Between 2011 and 2014 subsidies were provided to about 14 million farmers (Federal Ministry of Agriculture and Rural Development, 2016).

Similarly, government sought to attain self-sufficiency in vegetable oil production over a period not exceeding 3 years through the implementation of the Presidential Initiative on vegetable oil and tree crops development. Under this programme, attention was focused on the promotion of eleven scheduled oil seed crops, among which were: oil palm, groundnut, soya beans, Beni seed, cotton, sunflower, cashew, coconut and cocoa. Production target was set for each crop under the programme, thus; oil palm: 1 million hectares capable of producing 15 million fresh fruit bunches, groundnut: 15 million tons annually, soya bean: 670,000 to 1 million tons annually and seed cotton: 1 million tons over the plan period.

Fiscal incentives were also used to support agricultural output through various import waivers, export incentives, tax holidays and exemptions in the sector. For instance, from January 31, 2012, duty on agricultural machinery and equipment was waived. Export incentives were administered by the Nigerian Export and Import Bank (NEXIM)'s Export Credit Insurance Facility, which was designed to

protect exporters in Nigeria against the risks of non-payment for goods and services exported on credit terms and the Nigerian Export Promotion Council (NEPC) who initiated the Export Expansion Grant Scheme for the stimulation of export oriented activities that leads to significant growth of the non-oil export sector, especially agriculture.

Tax incentives were also given to boost agricultural production comprising: a five–year tax holiday for agricultural products' processing companies granted pioneer status; tax exemptions on Interests earned by financial Institutions on loans granted for agricultural trade or businesses; enhanced capital allowance of up to 50 per cent for agro-allied plant and equipment and; exemptions from Value Added Tax (VAT) on machinery and equipment purchased for agricultural purposes.

Various agencies such as NEXIM, CBN, Bank of Industry (BoI), Bank of Agriculture (BoA), etc. have been involved in providing credit to agriculturalists at single digit rates. These interventions (especially those of the CBN) are done through various programmes as summarised below:

- **Interest Drawback (IDP).** Under the IDP of the CBN, farmers could borrow from lending banks at market–determined rates, while the programme pays an interest rebate of 40.0 per cent to farmers who repay their loans on schedule;

- **Agricultural Credit Guarantee Scheme Fund (ACGSF)**. Administered by the Central Bank of Nigeria, the fund was introduced in 1978 to assist banks to support agricultural activities. It provides up to 75.0 per cent guarantee for loans granted by the commercial banks for approved agricultural activities. A total of 1,020,299 loans valued N98.860 billion had been guaranteed from inception in 1978 to May, 2016;

- **Commercial Agricultural Credit Scheme (CACS)** was established in March 2009 by the CBN in partnership with the Federal Ministry of Agriculture and Rural Development (FMARD) to fast track the development of commercial agriculture in the country. The applicable interest rate under the fund was retained at 9.0 per cent. From inception in 2009 to May 2016, the sum of N364.477 billion had been released to the economy for 452 projects;

- **Agricultural Credit Support Scheme (ACSS).** The ACSS is granted at 14.0 per cent interest rate, while beneficiaries who fully repay their loans on schedule are entitled for a refund of 6.0 per cent of interest paid.

- **Anchor Borrowers' Programme:** Under the programme, the CBN set aside N40 billion, out of the N220 billion Micro, Small and Medium Enterprises Development Fund (MSMEDF) to be given to farmers at single digit interest rate of maximum 9 per cent per annum.

- **The Nigerian Incentive-Based Risk Sharing system for Agricultural Lending (NIRSAL).** The programme was launched in 2011 and incorporated in 2013 by the CBN as a dynamic, holistic USD500 Million public-private initiative. Its aim is to define, measure, price and share agribusiness related credit risk. Its approach involves fixing the agricultural value chain, so that banks can lend to the sector with confidence; and encouraging banks to lend to the agricultural value chain by offering strong incentives and technical assistance. It has five pillars which include:

    - Risk-sharing Facility (USD300 Million). NIRSAL uses this facility to address banks' perception of high-risks in the sector by sharing losses on agricultural loans.
    - Insurance Facility (USD30 Million). The facility's primary goal is to expand insurance products for agricultural lending from the current coverage to new products, such as weather index insurance, new variants of pest and disease insurance etc.
    - Technical Assistance Facility (USD60 Million). NIRSAL uses this facility to equip banks to lend sustainably to agriculture, producers to borrow and use loans more effectively and increase output of better quality agricultural products.
    - Holistic Bank Rating Mechanism (USD10 Million). This mechanism is used by NIRSAL to rate banks based on two factors, the effectiveness of their agricultural lending and the social impact.
    - Bank Incentives Mechanism (USD100 Million). This mechanism offers winning banks in Pillar four, additional incentives to build their long-term capabilities to lend to agriculture. It will be in terms of cash awards.

- **Cassava Bread Development Fund**. Established by the Government in 2008 to fund the cassava value chain (from processors to bakers), including providing equipment to master bakers. N3.44 billion was disbursed to farmers at 5 per cent interest per annum in the funding structure of 50 per cent term loan and 50 per cent grant.

- **National Programme for Food Security Fund**. It was established in 2009 to benefit registered members of Apex Farmers' Associations (AFA),

registered co-operative groups and SMEs, in the structure of 40 per cent grant and the balance divided into 80 per cent loan and 20 per cent equity contribution by the beneficiaries.

III. Review of Empirical Literature

Computable General Equilibrium (CGE) models have been used widely by researchers in analysing impact of various policies. Borojo (2015) applied a recursive dynamic computable general equilibrium model to examine the economic impact of investment on infrastructure for electricity in Ethiopia using an updated 2009/10 social accounting matrix. The findings of the study showed improvement of the real gross domestic product (GDP), output of industrial and service sectors in all simulations. Nonetheless, mixed effects were found on household consumption and trade balance. The highest growth of real GDP is registered when the investment on electricity is fully financed by domestic household and enterprise saving.

Mband (2011) analysed the impact of public infrastructure investment in South Africa using dynamic Computable General Equilibrium (CGE) analysis under different financing options to finance public infrastructure investment. The results showed that financing public infrastructure investment by direct taxation gives better results in terms of impact on aggregate output production, private investment, job creation, and household income. On the other hand, deficit financing seems to result the worst impacts on the economy in terms of above variables.

Dissou and Didic (2011) assessed the growth, sectoral and welfare implications of increased spending on infrastructure in Benin, using a multi-sector inter temporal general equilibrium model with public capital and heterogeneous agents using domestic financing through discretionary taxes and foreign financing through increased foreign aid. The results show that increased public investment on infrastructure has positive impacts on private investment for all agents in the long-run irrespective of financing method.

Estache et al. (2008) constructed a standard CGE model to explore the impact of scaling up infrastructure in six African countries. The study compared various infrastructure investments funded with different fiscal tools. These investments scenarios are compared to nonproductive investment that can be interpreted as a business as usual scenario. Their results show that foreign aid does produce Dutch disease effects, but the negative impacts are strongly dependent on the type of investments performed. Moreover, growth effects contribute to attenuate the negative effects.

Aydin (2010) analysed the potential long term impacts of the hydro power expanding shock on some macroeconomic variables of interest such as GDP, real consumption, real investment, exports, imports, trade balance, and carbon emissions using a dynamic multi sectoral general equilibrium model of the Turkish economy. They analysed the impact of hydro power shock under policy scenario doubling hydro power generation. The simulation results show that doubling hydro power have slightly positive effects on macro indicators and carbon emissions for Turkish economy.

Strzepek et al. (2006) analysed the economic impact of high Aswan dam in Egypt. In their study, they used a CGE model of the Egyptian economy to estimate the impact of the High Aswan Dam. The results of simulations show how Egypt's economy would have performed in 1996/97 without the dam. The shock is applied to agriculture, transport, tourism, and power generation. According to their result, if the High Aswan Dam were not there, agriculture gains (especially summer crops with high value) and the burden of the shocks falls on the non-agriculture sectors, with declines in power, transportation, and tourism.

Galinis and Leeuwen (2000) used a CGE model to analyse the future of nuclear energy in Lithuania using increases and keeping limited nuclear capacity. In the first case export sector, agriculture and bulk goods industry is stimulated. In the second case economic growth is relatively low, especially in the trade (commercial and public) sectors, services, and transport.

In Nigeria, Opeyemi et al. (2017), investigated the extent to which the removal of fuel subsidy influences the level of carbon emissions in Nigeria over a 5 year period. The study adopted the recursive dynamic version of the partnership for economic policy computable general equilibrium model based on the 2006 Nigerian social accounting matrix. Simulating a partial, gradual and complete removal of import tariff on imported petrol indicated reduction of emissions only when subsidy removal was partial. Findings from the results showed carbon emissions marginally increasing under the gradual and one shot removal.

Odior (2011) investigated the dynamic (direct and indirect) effects of government policy on education and its relation to the cyclical economic growth in the long-run using an integrated sequential dynamic computable general equilibrium (CGE) model of the Nigerian economy. The paper found out that the re-allocation of government expenditure to education sector is significant in explaining economic growth in Nigeria.

This paper contributes to the body of existing literature through conducting a

detailed assessment of the impact of CBN's agricultural based interventions on the economy. It also uses a dynamic recursive CGE model and an updated 20111 SAM to analyse the impact of the interventions.

IV. Methods

IV.1 Description of the Dynamic CGE Model

Computable General Equilibrium (CGE) models are models that adapt Walrasian General Equilibrium concepts into economy-wide applications. They provide a valuable framework for modelling the interaction between the agents and their interdependences within the economy. This is done by making a vivid representation of the behaviour of economic agents within the economy. Market equilibrium and model assumptions (which lead to breakeven conditions) must be established through the expression of market clearing equations. These blocks of the CGE model are presented in this section.

With some modifications, the dynamic CGE model described below adopts the standard model developed by the Centre for Econometric and Allied Research (CEAR), University of Ibadan. In addition to the standard blocks of CGE models, recursive dynamic general equilibrium equations which incorporate annual interventions in the agricultural sector by the CBN have been added. The recursive dynamic behaviour of the model implies that its agents' behaviour is based on adaptive projections rather than on the forward-looking projections that underlie alternative inter-temporal optimisation models (Cabral, Cisse, Diagne, & Siwa, 2017). Since a recursive model simulates one period at a time, it is possible to separate the static (within-period) component from the dynamic (between-period) component, where the latter dictates the model's dynamics.

IV.2 Description of the Static Model

This describes a one-period static CGE model which is presented according to the standard block of Production Structure, Household behaviour, Government behaviour and the Rest of the World. Equilibrium is maintained through a series of system constraints which are discussed at the end of this section.

IV.2.1 Production Structure and Technology

In the model, we adopt two productive sectors or activities that combine primary inputs with intermediate commodities to determine aggregate output levels. Two inputs, labour and capital, are identified in the model. Economic decisions of producers are guided by the motive for profit maximisation subject to constant returns to sale. Choice of production factors are guided by a

constant elasticity of substitution (CES) function. This allows for relatively easy substitution of factors by producers so as to derive a final value added. In the different production activities, we assume that factors of production are remunerated by the representative firm who also gives returns to the government in the form of taxes and dividends to households.

The value added is formed by the combination of labour (L_i) and capital *(KD)* based on the CES production function (equation 1) through which the demand functions of labour and capital-land are derived.

$$VA_i = aF_i * (\aleph F_i * KD_i^{-\rho Fi} + (1 - \aleph F_i) * L^{-\rho Fi})^{-1/\rho} \quad (1)$$

Where: aF_i is the efficiency coefficient and $\aleph F_i$ and (1-$\aleph F_i$) are the distribution parameters of the production function. Parameter aF_i between the production factors KD_i and L_i The production structure further incorporates the depreciation of capital, which is modeled as a fixed proportion from the current level of the capital stock in the dynamic analysis.

IV.2.2 Household Behaviour

The behaviour of households in the economy is simulated by introducing two representative households – rich and poor. Households are assumed to generate income from factor returns derived as an outcome of the production process. Production inputs such as capital is assumed fixed within a given time-period and across sectors, while labor supply is assumed to be perfectly elastic at a given real wage.

Households generate factor incomes proportional to the implied share of each factor stock that they control. In addition to factor returns, households also receive transfers in the form of returns from other households, government, other institutions, and the external sector. Household disposable income is net of personal income tax (based on fixed rates), savings (based on fixed marginal propensities), and remittances. Stone-Geary Linear Expenditure System (LES) (Equation 2) which explains consumer preferences subject to budget constraint is used to explain this behaviour.

$$U = \prod_j (_{C_j} - \mu HJ)^{\alpha i} \text{ where } \sum_j \alpha HLES_j = 1 \quad (2)$$

Where: U is the consumer's utility, C_j is the amount of consumption of the j-th commodity, μHJ represents the subsistence level of consumption of each u-th commodity and $\alpha HLES_j$ is a preferential parameter of the respective j-th commodity in the consumer basket.

In line with survey findings from the NBS, households are classified according to

income levels (rich and poor) across both sectors in the analysis. While rich households earn 90 per cent of income from capital in agriculture, they earn only 10 per cent of labour income from agricultural sector and vice versa.

IV.2.3 Government Behaviour

The government performs the function of collecting taxes, paying subsidies (if necessary) and purchasing goods and services in the model. It maximises the utility modeled by the Cobb-Douglas utility function subject to budget constraint and dependent on volume of tax receipts:

$$U = \prod_j CG_j^{\alpha CGj} \text{ where } \sum_j \alpha CG_j = 1 \quad (3)$$

Where: CG_j is the government consumption of a commodity j and αCG_j represents the preferential incomes in the government consumption basket.

The closure of the government account is achieved by fixing a ratio of the governmental consumption to GDP. Government savings are thus adjusted to the difference between the government incomes and expenditures.

IV.2.4 Foreign Sector (Rest of the World)

The model adopts the Armingtonian composite goods system function in which locally produced goods and imported ones are regarded as imperfect substitutes in aggregate demand, given an elasticity of substitution. The final ratio of imports to domestic goods is determined by the cost of minimising decision-making of domestic consumers based on the relative prices of imports and domestic goods (both of which include relevant taxes). Foreign prices are regarded as given due to the small open nature of the economy.

The functional form of the Armington CES function is provided in equation 4.

$$X_j = aA_j(\aleph A_j . M_j^{-\rho Ai} + (1 - \aleph A_j) XDD_j^{-\rho Aj})^{-\rho Aj} \quad (4)$$

Where: X_j is the amount of the total supply of the j-th commodity in the domestic market, M_j is the amount of imports of j[th] commodity from the Rest of the World, XDD_j is the amount of domestic production of j-th commodity supplied to domestic market. Analogically to the CES function, aA, γA_j and $-\rho A$ are the parameters of the CES function.

Substitutions between domestic and foreign market production are also possible. The producer's decision is guided by a constant elasticity of transformation (CET) function, which distinguishes between exported and domestic goods, thereby taking note of any differences in time or quality

between the two products. The motive for profit maximisation drives producers to sell in those markets where net returns are highest based on relative differences between domestic and export prices.

IV.2.5 Macroeconomic Closures and Equilibrium in the Model

In line with earlier works by (Annabi, Cockborn, & Decaluwe, 2004) and more recently, (Cabral, Cisse, Diagne, & Siwa, 2017), equilibrium within the model is achieved by the equality between supply and demand of goods and factors and the investment-savings identity within each period. In the goods market, equilibrium requires that demand for commodities equals supply. Aggregate demand for each commodity comprises consumption expenditures by household and government, transaction demand, investment spending, and export. Supply comprises both goods produced locally and commodity imports. Equilibrium is attained through the endogenous interaction of domestic and foreign prices, and the effect that shifts in relative prices have on sectoral production and employment, and hence institutional income and demand.

To balance factor demand and supply, it is assumed that capital is sector-specific and fully utilised while there is competition in the labor market thereby making the supply of labour to be responsive to changes in actual wages, so as to adjust to ensure the same level of equilibrium for demand and supply. To ensure equilibrium in macro accounts, 'macro closure' rules are specified for the current account, the government balance, and the savings and investments account. These rules provide a mechanism through which adjustment is assumed to take place.

Various macro variables were assumed fixed in the model. The world prices of exports, intermediate and final imports; value of labour and capital endowments and stock of capital in the agricultural sector were fixed to initial levels in the static model. However, the value of capital, labour and foreign savings are assumed to grow at same rate as population growth in the dynamic models.

The model adopts a neoclassical savings-driven closure, in which the domestic investments are passively driven by aggregate savings to ensure equilibrium between savings and investment spending. However, the inclusion of dynamics into the model allows past investments to influence economic growth, and thereby the level of savings available for investments in the current period.

Finally, the price index is chosen as the numeraire. The model is also homogenous of degree zero in prices, implying that doubling all prices does not

alter the actual allocation of resources.

IV.3 Incorporating CBN Interventions into the CGE Model

As stated earlier, interventions by the CBN in the agricultural sector are principally the Agricultural Credit Guarantee Scheme (ACGS) and the Commercial Agricultural Credit Scheme (CACS). Modelling the impact of the interventions into the agricultural sector is based on the assumption that such interventions impact the production decisions of agriculturalists leading to increased output/ yield. Given that the interventions by the Bank are provided to both small and large scale agriculturalists, it is plausible to assume that those interventions act as increases in the stock of agricultural capital and thus have direct effects on the production decisions of the farmers.

Due to the fact that interventions are given to going concerns, modelling their impact is seen as additions to existing stock of capital in the agricultural sector. This is introduced in the model through incorporating the share of additional CBN interventions to the total sock of agricultural sector capital in the recursive dynamic CGE equations on an annual basis as displayed in equation 5:

$$AC_t = \left[\sum AC_{t-1} * 1 + nc\right] \quad (5)$$

Where: AC is total stock of agricultural sector capital while nc is the share of CBN interventions to total stock of agricultural capital.

IV.4 Description of the SAM[3]

The SAM used for the CGE model analysis was derived from the updated Input and Output Table for 2011 whose data was generated principally from the National Bureau of Statistics (NBS), the Central Bank of Nigeria (CBN), the Federal Ministry of Agriculture and rural Development (FMARD) and national household surveys; and was balanced using the cross entropy estimation method.

While the updated 2011 Input-Output (I-O) table comprehensively covered selected sectors, the Social Accounting Matrix (SAM) is aggregated to be a 2-sector square matrix comprising agricultural and non-agricultural sectors of the economy. The agricultural sector aggregates 4 activity sectors of crop production, livestock, forestry and fishing; while the non-agricultural sector aggregates 9 activity sectors including; mining and quarrying, manufacturing, utilities, building and construction, transportation, communication, wholesale and retail, finance and insurance, as well as, other services.

[3]Special appreciation goes to the painstaking efforts of Dr Aminu Alarudeen of CEAR, University of Ibadan, for his tutelage and support throughout the work.

It provides an economy-wide data framework, which represents the aggregated structure of the Nigerian economy; the links among production activities, income distribution, consumption of goods/services, savings and investment, and foreign trade of the economic agents in year 2011. It begins with activities account, followed by commodities account and thereafter accounts for the economic agents in the Nigerian economy.

Each cell in the matrix represents the flow of economic activities in monetary terms from a column account (expenditure or outflow) to a row account (income or inflow).

IV.5 Intervention Scenarios

In addition to five intervention scenarios modelled in this paper, corresponding baseline scenarios were simulated to forecast economic outcomes in the absence of any intervention. Since all scenario results significantly depend on the baseline forecast, the results of the baseline forecast is important in evaluating the long term welfare impact of the interventions.

In the baseline/ static scenario, growth of labour supply and foreign savings are assumed to grow at 2.8 per cent being the assumed growth rate of population per year.

The five policy simulations are designed to reflect additions to agricultural capital stock net of depreciation. An analysis of Table 2 indicates that the share of CBN interventions to total agricultural capital for the years under review are infinitesimal as they are less than 1 per cent of total agricultural capital stock. This has implications for the anticipated impact of the magnitude of the interventions on the economy.

Table 2: Ratio of Agricultural Interventions by CBN to Total Agriculture Capital

Year	Total Agricultural Interventions (₦bn)*	Ratio of Agricultural Interventions to Total Agriculture Capital (Per cent)**
2011	73.88	0.20
2012	58.54	0.16
2013	27.33	0.07
2014	38.37	0.10
2015	67.50	0.18
2016	65.17	0.18

Source: **Author's computations; *CBN

A simple comparison of the growth trends between the baseline and policy scenarios for each of the simulation periods is the policy impact of the interventions on the economy.

V. Simulation Results

This section presents the outcome of baseline and intervention simulations.

V.1 Impact of CBN Interventions on the Dynamics of Economic Growth

Results of both models presented in table 3 indicate that interventions contributed positively (although marginally) to GDP during the years (periods) of intervention. Similar to simulation results of the model without interventions, in which contributions to growth in GDP were at rates above 0.8 per cent annually, impact of interventions on growth became visible from the fourth period of interventions.

Table 3: Impact of CBN Interventions on the Dynamics of Economic Growth (per cent growth rates)

VARIABLES	BASE PERIOD	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
Gross Domestic Product Without Interventions	36636.80087	0.82106	0.89627	0.97609	1.06061	0.68150
Gross Domestic Product with Interventions	-	0.82106	0.89627	0.97610	1.06063	0.73575

Source: Author's computations

V.2 Impact of CBN Interventions on Fiscal Variables

The impact of CBN's agricultural interventions on selected fiscal variables such as expenditures on government subsidies and government revenue were assessed. Results from both models presented in table 4 indicated that CBN's interventions in the agricultural sector contributed to a marginal decline in government subsidy expenditures and improvement in government revenues. This is in line with *a priori* expectations since increase in the stock of agricultural capital should lead to increases in productivity and sustainability of agricultural operations thereby leading to reduced need for subsidies and increased fiscal revenues through improved taxes.

Table 4: Impact of CBN Interventions on Fiscal Variables (growth rates in per cent)

VARIABLES	BASE PERIOD	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
Government Subsidy Expenditure Without Intervention	15.8596	0.54284	0.64511	0.75716	0.87909	4.18793
Government Subsidy Expenditure with Intervention	-	0.54278	0.64498	0.75703	0.87897	3.87206
Government Revenue Without Intervention	161.43849	0.48136	0.50220	0.52257	0.54241	-2.21156
Government Revenue with Intervention	-	0.48142	0.50225	0.52262	0.54250	-1.92265

Source: Author's computations

From Table 4, while the counterfactual periods without interventions indicated that government subsidies increased consistently from 0.54284 per cent in period 2 to 0.87904 per cent in period 5, interventions by the Bank in the agricultural sector contributed to a marginal reduction in the amount of subsidies expended by the government in all periods of the simulation as government subsidies grew at a slower pace from 0.54278 in period 2 to 0.57897 in the fifth period.

Likewise, government revenues increased during all periods, in both models. In the simulations without interventions (counterfactual), government revenues increased by 0.48136 per cent in period 2 and rose consistently through the simulation periods to 0.54241 in period 5. However, government revenues showed a marginally better growth in the periods when the CBN interventions were simulated in the model as revenues grew by 0.48142 per cent in period 2 to 0.54250 in period 5.

V.3 Impact of CBN Interventions on Supply of Agricultural Commodities

The supply of agricultural commodities at various stages of the production process was also assessed in the model. This way, the impact of the agricultural interventions on export of goods produced locally and import of final goods were ascertained.

Simulation results indicated that CBN's interventions on the agricultural sector led to an increase in exports of agricultural commodities and marginal reduction in the volume of imports of intermediate goods used in the agricultural value chain. While model results presented in table 5 indicated that in the simulations without intervention, exports of agricultural commodities would have increased by 2.89207 per cent in the second period and rise consistently through the periods to 3.27203 per cent in the fifth period; the simulations with interventions showed more increases in export of agricultural commodities by a slightly higher magnitude as export of goods produced locally from the agricultural sector increased by 2.89221 per cent in period 2 of intervention through to 3.27219 per cent in period 5. The marginal increase in export of goods produced locally could be attributed to increased output arising from increased agricultural interventions from the CBN.

Table 5: Impact of CBN Interventions on Supply of Agricultural Commodities (Growth rates in per cent)

VARIABLES	SECTOR	BASE PERIOD	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
Export of Goods Produced Locally Without Intervention	Agric Sector	6791.97759	2.89207	3.01951	3.14629	3.27203	12.69557
	Non-Agric Sector	15182.1939	0.64321	0.62583	0.60655	0.58526	-4.08416
Export of Goods Produced Locally with Intervention	Agric Sector	-	2.89221	3.01962	3.14641	3.27219	11.74402
	Non-Agric Sector	-	0.64318	0.62580	0.60651	0.58521	-3.61064
Imported Intermediate goods without Intervention	Agric Sector	100.1891	0.80752	0.89235	0.98100	1.07339	8.19010
	Non-Agric Sector	582.27494	-0.31692	-0.33474	-0.35281	-0.37103	-3.50518
Imported Intermediate goods with Intervention	Agric Sector	-	0.80750	0.89235	0.98098	1.07338	7.47096
	Non-Agric Sector	-	-0.31691	-0.33474	-0.35280	-0.37101	-3.18784

Source: Author's computations

Similarly, imports of intermediate goods declined marginally as a result of the interventions compared to the counterfactual periods apart from the third period when it showed no impact. Reduction in imports of intermediate agricultural commodities could be due to improved capacity of the sector to produce commodities to be used for further production within the value chain. In line with this, simulation results of the counterfactual periods indicated that imports of intermediate goods increased by 0.80750 per cent in the second period and continued a steady increase to 1.07338 per cent in the fifth period. Results from the model with interventions indicated a lower magnitude of increase from the second to the fifth period except in the third period when it showed no impact as stated earlier. In line with this, the intervention contributed to a decrease of imported intermediate commodities by 0.80750 per cent in the second period and increased at a lower magnitude compared to the counterfactual to 1.07338 per cent in the fifth period.

V.4 Impact of CBN Interventions on Prices of Agricultural Exports

Simulation results from both models presented in table 6 indicated that prices of agricultural commodity exports increased marginally in the fifth period as a result of the interventions. This could be due to improvements recorded in the quality of products through improved processing and transformation of the otherwise primary commodities.

Table 6: Impact of CBN Interventions on Prices of Agricultural Exports (growth rates in per cent)

VARIABLES	SECTOR	BASE PERIOD	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
Price of Export without interventions	Agric Sector	1.00000	1.76746	1.80438	1.84166	1.87451	0.93007
	Non-Agric Sector	1.00000	1.76746	1.80438	1.84166	1.87451	0.93007
Price of Export with interventions	Agric Sector	-	1.76746	1.80438	1.84166	1.87544	1.03980
	Non-Agric Sector	-	1.76746	1.80438	1.84166	1.87544	1.03980

Source: Author's computations

V.5 Impact of CBN Interventions on Household Income and Utility

The impact of CBN interventions on household incomes and utility was also assessed and presented in table 7. In this regard, households were classified based on rich and poor agricultural households. Simulation results indicated that CBN interventions impacted positively on the incomes and utility of rich farm owners. Interestingly, poor farmers were worse off with interventions, as their income and utility increased steadily at a faster pace without intervention than it did with interventions.

More specifically, results from the model without interventions show that the income of rich households increased by 0.59890 per cent in the second period to a rate of 1.25904 per cent in the fifth period, and increased by a larger magnitude during the simulations of the intervention periods as it increased from 0.60878 in second period to 1.27125 per cent in the fifth period.

On the other hand, incomes of poor households without interventions increased at declining rates from 1.14108 per cent in period 2 to 0.42561 per cent in the fifth period. It recorded declines with higher magnitudes during the intervention period as incomes of poor farming households increased by 1.11985 per cent in period 2 to an increase of 0.398880 per cent in the fifth period of intervention. Household utility behaved in a similar pattern with incomes. This seemingly surprising outcome could be due to the capital intensive nature of investment in agriculture.

Agriculture is expensive, and CBN agriculture intervention is more easily accessed by the rich farm holders and would cost the small farmers more to engage in. This is helped by their access to big markets for their products at fair and competitive prices, ability to take advantage of scale efficiencies and warehousing or storage capacity, and to readily meet the intervention conditions. Further, most of the interventions seem to support mechanised agriculture, doubling their advantages in scale and scope efficiencies. This is in

addition to the weak capacity of poor farming households to cope with structural shocks inherent in agricultural practices such as disease outbreak, seasonal flooding, and security related risks are harder to mitigate by the poorer farmers. These challenges make the larger farm-holders more visible in the market relative to the small ones, crowding out their benefits. This subdues competitiveness and hence, erodes incomes, making the poorer farmers worse off with intervention.

Table 7: Impact of CBN Interventions on Household Income and Utility (growth rates in per cent)

VARIABLES	SECTOR		YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
Household Income without Interventions	Rich	24347.00807	0.59890	0.83556	1.05226	1.25904	0.52909
	Poor	11879.98909	1.14108	0.85171	0.62206	0.42561	-0.02271
Household Income with Interventions	Rich	-	0.60878	0.84340	1.06108	1.27125	0.64434
	Poor	-	1.11985	0.83494	0.60299	0.39880	-0.01383
Household Utility without Interventions	Rich	1.65824	0.03317	0.06028	0.08495	0.10775	-0.06374
	Poor	7.30904	0.16289	0.13263	0.10959	0.09097	0.13994
Household Utility with Interventions	Rich	-	0.03437	0.06089	0.08615	0.10955	-0.04209
	Poor	-	0.16043	0.13073	0.10741	0.08785	0.13125

Source: Author's computations

VI. Recommendations

This study reiterate that allocation of additional funds to agriculture especially by various agencies can maximise the impact of the sector. However, considering the impact of the intervention on the income and utility of the poorer households, it is recommended that:

a) For the programme to be more effective, targeted extensive support must be provided to poor farmers to improve their competitiveness and ensure they are not crowded out by the rich farm holders;
b) Access to markets for fair and competitive prices needs to be encouraged; and
c) Adequate monitoring and evaluation mechanisms should be put in place to ensure that intervention programmes meant for poor households reach the intended beneficiaries and achieve desired impact.
d) To further improve access to markets, commodity exchanges need to be made more functional. The enablers for the commodity exchange to be effective include:
    i. Improved warehousing and storage capacity;
    ii. Improved enabling communication and transport infrastructure;
    iii. Strengthened regulatory framework to govern the

enforcement of contracts in spot markets to guarantee property rights; and

iv. Strong and effective policies and legal framework.

VII. Conclusion

With the aid of a recursive dynamic CGE model, the paper presented the impact of CBN agricultural intervention schemes on the economy. However, it was noted that the impact across various indicators were mostly positive, though marginal. This could be attributed to the conservative nature of the model parameters and the relative amount of interventions. Also, an update in the Social Accounting Matrix (SAM) for Nigeria beyond 2011 should be conducted so as to have more precise impact of interventions.

Disaggregated sectoral effects of the interventions are proposed as areas for further study. Other intervention schemes of the government for the agricultural sector can be incorporated to reflect a more holistic picture of the impact as well. It is therefore recommended that more funds should be allocated to agriculture especially by various agencies so as to maximise the impact of the sector.

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APPENDIX: TWO-SECTOR SOCIAL ACCOUNTING MATRIX FOR 2011

		Activities (ACT)		Commodities (COOM)		Factors		Institutions		Taxes		Capital Account		
		AGR	NAGR	AGR	NAGR	LABOUR	CAPITAL	HHOLDS	GOVT	IND.TAX	SUBSIDY	(CAP)	ROW	TOTAL
ACT	AGR			9050.585833									6791.97759	15842.56342
	NAGR				27774.06368								15182.1939	42956.25759
COMM	AGR	2715.912683	1536.530567					3670.007269	54.67779891			1378.875462		9356.00378
	NAGR	1997.710456	15245.262					11343.61552	2603.674207			2200.141269		33390.40346
Factors	LABOUR	3472.079818	8988.688599											12460.76842
	CAPITAL	7517.098834	16249.12991											23766.22874
Institutions	HHOLDS					12460.76842	23766.22874							36226.99716
	GOVT									177.2980939	-15.85960466			161.4384892
Taxes	IND.TAX	9.564732057	167.7333618											177.2980939
	SUBSIDY	-13.4663079	-2.393296765											-15.85960466
CAP	CAPITAL ACCT	43.47411414	189.0314959					21213.37437	-2496.913517				-15369.94974	3579.01673
	ROW	100.1890998	582.2749413	305.4179471	5616.339771									6604.22176
	TOTAL	15842.56343	42956.25758	9356.00378	33390.40346	12460.76842	23766.22874	36226.99716	161.4384892	177.2980939	-15.85960466	3579.016731	6604.22176	184505.338