Effects of Price Policies on Yam Production and Consumption among Yam Farming Households in Nigeria

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Abstract

Several efforts have been made through research, government programs and Non-Governmental Organisations (NGO) interventions to improve yam production in Nigeria. However, there has not been any significant improvement in yam production over the time. Yam output declined from 36.7 tonnes in 2006 to 31.1 tonnes in 2007 (FAOSTAT, 2008). In addition, some policies targeted at improving agricultural production have weakened the production and consumption of different commodities, especially yam. As the world leading producer of yam, Nigeria has the potential of achieving one of the Millennium Development Goals of poverty reduction. This study analysed the effects of policy changes on yam production and consumption in Nigeria. A multi-stage sampling technique was used to select 700 respondents for the study. Primary data were collected using pre-tested structured questionnaire while interview guide was used to collect information in a Focus Group Discussion. Data were analysed using Multi-Market Model.

The results showed that yam farming households produced about 253 tonnes of yam and consumed 789 tonnes. This suggests that yam production is at subsistence level and households consumed more yams than they produced. The producer price for yam was ₦81 per kilogram while the consumer price was ₦129 per kilogram. The simulation results indicating the effects of policy changes (Fertilizer policy, trade policy and price policy) showed that a 20 percent increase in rice yields (as a result of increase in the quantity of fertilizer in rice production) led to a decrease of 9 and 6 percent in yam and cassava production respectively. At the household level, yam and rice consumption increased by 2 percent and 5 percent for the poor, while price of yam and cassava reduced by 9 and 6 percent respectively. Similarly, land share for yam and rice production reduced by 13 percent and 15 percent respectively, while land share for cassava production increased by 6 percent. A 15 percent tariff on rice led to 66 percent reduction in the production of rice while yam production reduced by 47 percent. Also, prices for all products decline significantly, particularly yam (86 percent), rice (11 percent) and cassava (82 percent) leading to a decline in nominal incomes between 41 percent and 57 percent. On the contrary, an increase of 15 percent in rice tariff increased yam and cassava production increased by 61 percent and 91 percent respectively while rice production increased by 81 percent. Similarly, consumption increased by 116 percent, 7 percent and 186 percent respectively for yam, rice and cassava. In addition, caloric intake increased for all the groups except for the rich. Results of 20 percent reduction in market margin (Price policy) of all products, rice and fertilizer at the domestic market and the rest of the world brought about an increase in yam production more than rice. However, rice production reduced by 75 percent. Likewise, households' consumption increased more for cassava. Aside this, calorie intake increased while producer and consumer prices reduced significantly by 83 to 87 percent respectively leading to a reduced income for all household groups except the poor. In addition, real income reduced by 99 to 100 percent. However, land share moved from the production of rice and yam into cassava production.

The study concluded that policy changes on other commodities, particularly rice, have negative effects on yam production, prices, land share and real income among yam farming households in Nigeria.

Introduction

In neo-classical theory, free functioning markets automatically lead to static and dynamic efficiency so long as certain conditions, referred to as perfect competition is realised; which is too idealistic in any economy across the world because markets are generally imperfect (Okai, 1999). Failure to attain a perfect market situation leads to market failure which requires some forms of government interventions in order to guarantee that welfare is maximised. Evidences Besley and Kanbur, (1988), Tokman (1989) and Stone and Ranchhod (2006) showed that while government intervenes to correct for market failure, such interventions are inappropriate, insufficient, excessive or non-optimal leading to further distortions in private or market prices faced by producers and consumers. In other words, both market and government failure become established. These consequently leads to production and consumption decisions that are not economically efficient, and which invariably affect the income and welfare of both rural and urban households.

According to Lipsey (1999), government interventions are usually through policy formulation for changes. These policies could be fiscal, monetary, agricultural or through initiating a programme with the aim of improving welfare in the rural and urban areas. In the agricultural sector, these policies consist of decisions that influence the levels and stability of relative prices of inputs and outputs, choice of investments and the allocation of resources with the common aims of improving (i) efficiency- which is concerned with the allocation of resources to effect/ensure maximum output and income, (ii) equity- ownership, production and distribution of nations wealth, and (iii) welfare. Policies, which could be from within (domestic) or external (foreign) dictate or form the vacuum within which households and enterprises operate within the economy.

International agricultural policy affects domestic prices. Stifel and Randrianarisoa, (2004) studied the effects of changes in different agricultural policies (tariff, fertilizer subsidies and transaction cost) on Madagascar and inferred that the policies had a significant impact on the calorie consumption of the households in rural and urban areas. According to Hertel *et. al.* (2003); Godoy, (2005); and Olomola, (2006a), the Organisation of Economic Cooperation and Development (OECD) provides 1 billion dollars per day to farmers as a form of subsidy, the European Union spent 60 billion dollars in subsidizing farmers. They also estimated the support that farmers in OECD countries benefited as (75 percent) in Switzerland and (71 percent) in Norway, which varies depending on the commodity. Sahel and West African Club (2006) claimed that the support from OECD countries reduced competitiveness in production and consumption of farmers in sub- Saharan Africa. Olomola (2006a) further emphasised that most of the support from OECD countries is a deliberate action to prevent farmers in sub-Saharan Africa from international and domestic market because it impairs competitiveness in the sub-region.

In Nigeria, several agricultural policy instruments and programmes have been initiated after Structural Adjustment Programme (SAP) in 1986 to bring about positive changes in agriculture. These are rice trade liberalization, input subsidy, cassava initiative programme which were made to promote competition in the agricultural sector. The agricultural policy instruments according to Olomola (2006a), distorted the input market because of poor implementation and often benefit unintended target group who manipulate the supply of inputs such as fertilizer by creating artificial scarcity in the market. This affects the cost of production and consumption of crops across the country. As a result of poor market information coupled with bad infrastructures, the market women and buying agents usually worsen the situation by exploiting the farmers in offering a low farm gate price and ultimately low income. When the presidential initiative on cassava came on board in 2002, which aimed at using cassava as an engine of growth through export, many crop farmers responded to this incentive as a way of improving welfare. This further affected the production and consumption of other crops that are substitutes to cassava. In 2008, the government liberalized trade in rice (a substitute to other food crops in the market especially yam) so that the consumers can buy this commodity at a reduced price. Wunder (2005) inferred that trade liberalization and subsidy removal are powerful macroeconomic tools which have complex economy-wide effect on farmer's allocation of resources in production and consumption. Farmers attempt to reduce price risk by diversifying production activities and income sources and they are very flexible in switching between different crops in response to changing market condition.

When prices are affected, competitiveness will be affected and ultimately farmers welfare. Policies affect some crops and households indirectly. Dorosh (2003) studied the impact of agricultural policies on food crops and established that the indirect effect was very large and had largest impact on the poor. Peters (2004) added that agricultural policies often have adverse effects on root and tuber producers and consumers. However, since there is no policy or policy pronouncements specific to yam in Nigeria, any policy that affects its substitutes such as rice and cassava will certainly affect yam. Igbekele (2002) in a study on analysis of policy issues on small scale farmers affirmed that yam farmers are grossly inefficient. Since yam production has been said to be a very important crop in improving welfare and achieving the Millennium Development Goals of eradicating poverty by 2015 (IITA, 2010), then it becomes imperative to study how past policies has affected its production and consumption in Nigeria.

Literature Review

Conceptual framework

Farm household models offer a useful perspective for the analysis of production and consumption decisions at farm level (Singh *et al., 1986).* Farm households are considered to be the central decision makers regarding agricultural production. They represent the micro unit from which individual farmers have to decide which commodities to produce in which quantity, which method and in which seasonal time periods. It is the objective of the farmer to maximize their utility, which may deviate from pure profit maximizing behaviour in many cases. For example, risk aversion, leisure and provision of enough food for household consumption are important goals, which have to be taken into account, too. The decision making process is subject to physical and financial constraints (e.g., hectares of land, man-days of labour and limited credit availability) as well as uncertainty about the next planning periods. Uncertainty may arise, for example, in forecasting yield of crops, costs and prices. Linkages between production and consumption decision and characteristic for farm household operating under imperfect markets have to be included. Due to the market imperfection which exists in the rural areas of Nigeria which also necessitates the inseparability of both production and consumptions decisions by farm households, the farm household model represent a useful starting point for the analysis of effectiveness of policy instruments to enhance sustain welfare at the micro level.

Policy analysis for sustaining households welfare proves to be critically dependent on the specification of linkages between decision making procedures regarding resource allocation by farm households' and their supply response to changes in the economic, institutional and agro-ecological environment. Decision of the farm households are influenced by external factors. These decisions have in turn consequences for the agricultural production and the conditions of resources allocation especially for land, labour and capital. The agro-ecological and socio-economic environments are considered to probably be the most important external factors determining farm household decision making. The agro-ecological environment defines the potential agricultural activities from which the households can select. The socio-economic environment (markets and infrastructure) give incentive of disincentive to select from these activities. Policy interventions could lead to changes in the socio-economic environment resulting in different (dis)incentives for farm households. The final outcome of the decision making of the household is reflected in the production, consumption and welfare of the household. Therefore, the farm household framework can be use to assess the implications of different policy measures on production, consumption, market exchange and farm household welfare. Therefore a functional integration of policy simulation models, models that reveal the resource allocation implication of alternative policies, and farm household models that capture farmers behavioural priorities, represents a major challenge.

Model Selection

In analyzing policy effects on household's production and consumption or better put welfare, no single model can handle it but some models are better at showing these effects than the other. The starting point of policy analysis is usually with the partial equilibrium (PE) model. PE is a synonym for demand and supply analysis. It analyses equilibrium in a single market and does not consider what is happening between inter linked markets. Agricultural producers are price takers which makes them to select the level of output and generate input demand that will maximize profit given their level of technology. In other words, profit will be maximized when the production occurs where marginal cost (MC) is equal to the price of inputs (P). If at a market price, supply exceeds demand, price may fall or the excess is exported to deficit countries. If price changes, it will affect all related markets. A decrease in price will have negative effect not only on output but also on demand for land, labour and other inputs. Adjustment of these inputs would cause a change in equilibrium price and quantity across interlinked markets. To assess the effect of agricultural policy in a single market, Domestic Resource Cost (DRC) and Effective Protection Rate (EPC) had been used. These are summary indicators from Policy Analysis Matrix (PAM) and show the ratio of domestic price to international prices. DRC and EPC can partially handle the issue being considered in this study because it tells nothing about the effects of tax or subsidy on consumption, income, government revenue. Another model that is usually used to analyse policy effect in a single market is economic surplus models. Similarly, it ignores the interactions between markets i.e. the substitution effects in production and consumption and gives very little insight into income distribution. Apart from these, it does not consider the direct and indirect effects on wages and is biases against welfare effects. A model that shows the direct and indirect effects of policies in several markets is Computable General Equilibrium models. A modified version of this is Global Trade Analysis Project (GTAP). This models the output and factor markets in all sectors and allows wages, prices and incomes to be determined endogenously. The main limitation with this model is that it is data intensive and very complex. Aside these weaknesses, the study at hand only requires effect of policy in a sector or interlinked markets which makes Multi Market Model (MMM) more suitable for this analysis because it is not so complex and data intensive like GTAP. MMM shows direct and indirect effects of agricultural policy on strongly interlinked markets. It reveals policy effects on production, consumption, producer and consumer prices, incomes, government revenues, expenditure and balance of trade (Sadoulet and de Janvry, 1995).

Multimarket model

The multimarket model was used to analyse the effect of agricultural policies on households in yam production and consumption. The agricultural policies considered include trade policy, infrastructure effect and yam substitute productivity effect. Amount of money incurred as transportation cost was used to capture the effects infrastructure on yam producers. The effects of these policies and yam substitute initiative programmes were quantified using the multimarket model.

The impact of different policies and price scenarios on selected agricultural markets, government revenue and incomes of different household groups were examined. A multimarket model reflects direct and indirect linkages between a certain numbers of agricultural markets. Production and consumption data was collected from each household group and the corresponding elasticity was used to examine the impact of changes on income and expenditure, production, consumption prices and quantities as well as trade balance and government revenue. Arulpragasam and Conway (2003) defined four steps for building a multi-market model:

(i) A market is defined where policy reform takes place (e.g Rice market). Then the interlinked markets were defined (yam and cassava markets)

(ii) The systems of demand and supply functions are developed. Own price and cross price elasticities of demand and supply as well as income elasticities are then calculated using Almost Ideal Demand System (AIDS) model because it yields elasticities that are consistent with consumer theory and are more flexible than those obtained from other commonly used demand systems.

(iii) The modeler had to decide which products are tradable and non tradable. Rice and fertilizer were taken as tradables, yam as non-tradables. After this, supply and demand has to balance out. For non tradables, this is done domestically by the price. For tradables the world market price and quantity adjusts by the size of trade (import or export).

(iv) Together with the household data available these relationship between prices and quantities can examine the marginal effects of different policy scenarios on different types of households.

For this study, the main focus of the MMM is on the yam market. The essence is to quantify the indirect effect of these policies on yam market. In addition, impacts of policy scenarios on other agricultural markets were analyzed.

Structure of the model

There are five blocks of equations in the multimarket model: prices, supply, consumption, income, and equilibrium. The price block defines the relationships between producer prices and consumer prices in the domestic market and between world prices, border prices, and consumer prices. The supply block represents the domestic production of food crops. The consumption block shows household demand for commodities, while the income block is defined as the sum of agricultural production and exogenous non-agricultural production. The equilibrium condition equates supply plus net imports to household and input demand. The following were the variables used in the model:

Sets:

c = all commodities consumed (yam, rice, cassava in tonnes)

i = all commodities less fertilizer in tonnes

im = importable commodity (rice in tonnes)

f = food crops (yam, rice, cassava in tonnes)

h = households (urban poor, urban rich, rural poor, rural rich)

PC_c	Consumer price for commodity c in kg
PP_c	Producer price for commodity c in kg
$RMARG_c$	Margin from rest-of-world (ROW) to border for commodity c in ₦
$IMARG_c$	Margin from border to urban area for commodity c in ₦
$MARG_c$	Margin from farm gate to urban area for commodity c in ₦
PM_{IM}	Border (import) price for commodity c in ₦
PW_c	World price for commodity c (fixed) in ₦
$PCWT_i$	Weighted share of national consumption of commodity i in ₦
tm_c	Import tariff on commodity c in ₦
er	Exchange rate (fixed)
$SH_{h,f}$	Share of land allocated to household h for food crop, f in hectares
$YLD_{h,f}$	Crop yield of crop f obtained by household h in tonnes/hectare
$SCR_{h,f}$	Household supply of crop f obtained by household h in tonnes
SCR_f	Total supply of crop f in tonnes
AREA	Total cultivated agricultural area (fixed) in hectares
$LOSS_f$	Loss for crop f
$CONV_f$	Conversion factor for crop f (e.g., from paddy to rice)
$DFERT_{h,f}$	Household demand for fertilizer in tonnes
$DFERT_f$	Total demand for fertilizer in tonnes
$HC_{h,i}$	Household demand of commodity i in tonnes
$CONS_f$	Total demand for commodity i in tonnes
YH_h	Total household income of household group h in ₦
$YHAG_h$	Total agricultural income of household group h in ₦
$YHNAG_h$	Total non-agricultural income of household group h (fixed) in ₦
M_c	Net imports of commodity c in ₦
$GOVIMP_c$	Net government imports of commodity c (fixed) in ₦

Price block

The price block comprised of four equations that reflect the relationships between producer prices, consumer prices, and international prices. Producer prices (PP) were linked to consumer prices (PC) through an exogenously determined domestic marketing margin (MARG) that is commodity-specific. The domestic marketing margin reflected transportation and distribution costs incurred from the movement of commodities (yam, rice, cassava) from farm gate to urban areas. Changes in the domestic margin can proxy changes in transportation costs that arise from improvements in infrastructure.

$$PP_c = \frac{PC_c}{(1 + marg_c)} \quad \text{.......(1)}$$

A price index is included that reflects changes in prices weighted by their share of consumption: PCWTi is the weighted share of national consumption of commodity i. The subscript on the PC terms refers to periods 0 and 1 (not the seasons) and denote starting prices and end of simulation prices. Since we do not include all consumption items on which households spend money the weights in the PINDEX must be multiplied by the actual weight of the consumption commodities included in the model.

$$PINDEX = \sum_i PCWT_i * \frac{PC_i}{PC0_i} \quad \text{.......(2)}$$

The next set of price relationships highlight the interaction of domestic markets with international markets. For non-tradable products, these equations did not enter the system. As a result, prices of non-tradable products were determined endogenously through the equilibration of domestic supply and demand. By contrast, the prices of tradable products are exogenously determined by the fixed world price, with net imports endogenously clearing the domestic market.

For importable products, there were two price relationships. First, the domestic consumer price was linked to the border price by way of an exogenously determined margin that reflects the transportation and distribution costs associated with the movement of the product from the border to the consuming area. Second, the border price was associated with the (fixed) world price, adjusted by the exchange rate and any tariffs applied to the product. PC_{im} is the consumer price for imported commodity.

$$PC_{im} = PM_{im} * (1 + IMARG_{im}) \qquad (3)$$

$$PM_{im} = PW_{im} * er * (1 + RMARG_{im}) * (1 + tm_{im}) \qquad (4)$$

Supply block

There are six equations in the supply block, which included output supply and input demand. In the model, production of agricultural crops and demand for fertilizer were differentiated by household type. This specification allows for targeted simulations with respect to agricultural productivity and input use. For food crops, supply was determined by the quantity of land used for a particular commodity and its associated yield. It was assumed that land share and yield can vary by household type. The total amount of land under cultivation was kept fixed, representing short-run constraints of bringing new land into production. However, land can be reallocated among each food commodity depending on changes in relative prices. The share equation and yield equation are represented in a log-linear form as a function of prices, with the coefficients representing the price elasticities. The share equation is a function of output prices only, while the yield equation was a function of both output and input prices. The elasticities were analysed using Linearised Almost Ideal Demand System (LAIDS) model.

$SH_{h,f}$ is the share of land for commodities f (yam, rice and cassava) by households h (rural rich, rural poor, urban rich, urban poor), PP is the producer price of these commodities f

$$\log(SH_{h,f}) = \alpha^{s}_{h,f} + \sum_{f} \beta^{s}_{h,f,ff} \log(PP_{ff}) \qquad (5)$$

YLD $_{h,f}$ is the yield of commodities f (yam, rice and cassava) by households h (rural rich, rural poor, urban rich, urban poor), PC_{in} is the consumer price of input i.e. fertilizer

$$\log(YLD_{h,f}) = \alpha^{y}_{h,f} + \beta^{y}_{h,f,f} \log(PP_{f}) + \gamma^{y}_{h,f,in} \log(PC_{in}) \qquad (6)$$

$SCR_{h,f}$ is the total crop supply of commodities f by households h, $loss_f$ is the quantities of commodities f lost

$$SCR_{h,f} = AREA * SH_{h,f} * YLD_{h,f} * (1 - loss_{f}) \qquad (7)$$

$$SCR_{f} = \sum_{h} SCR_{h,f} \qquad (8)$$

Likewise, fertilizer demand was a log-linear function of output prices and the price of fertilizer at the household level.

$$\log(DFERT_{h}) = \alpha^{f}_{h} + \sum_{f} \beta^{f}_{h,f,f,in} \log(PP_{f}) + \gamma^{f}_{h} \log(PC_{in}) \qquad (9)$$

$$DFERT = \sum_h DFERT_h \text{ ....(10)}$$

Consumption block

Two equations defined consumer demand in the model. Consumer demand was differentiated by urban demand and rural demand, with total demand equal to the sum of demand. Urban and rural demands were specified as an Almost Ideal Demand System (AIDS) (Deaton and Muelbauer, 1980).

$$\log(HC_{h,i}) = \alpha_{h,i}^{h} + \sum_j \beta_{h,i,j}^{h} \log(PC_j) + \gamma_{h,i}^{h} \log(YH_h) \text{ ....(11)}$$

$$CONS_i = \sum_h HC_{h,i} \text{ ....(12)}$$

Income block

Two equations represent household income in the model. Agricultural income was the sum of crop income less expenditures on fertilizer. Non-agricultural income was determined exogenously. Total income was the sum of agricultural and non-agricultural income, with non-agricultural income adjusted by the price index as defined in equation 14 to show the real income.

$$YHAG_h = \sum_f (PP_f * SCR_{h,f}) + (PP_l * SLV_{h,f}) - (PC_{in} * DFERT_{h,in}) - \sum_f AREA * SH_{h,f} * LT_{h,f}$$

..........(13)

$$YH_h = YHAG_h + YHNAG_h * PINDEX \text{ ....(14)}$$

Market clearing

An equilibrium equation closes the system. Equilibrium was defined by setting total supply plus net imports (private and government) equal to household demand.

$$SCR_f + SLV + SNF + M_c + GOVIMP_c = CONS_i + DFERT \text{ ....(15)}$$

In total, the model contains 15 equations and 15 endogenous variables, including a dummy objective function, omega, which was used to solve the model. The model was originally designed in GAMS using the NLP solver.

Simulations

The multimarket model will be simulated to reflect different scenarios:

(i) If rice tariff increases by 15 percent
(ii) If rice tariff decreases by 15 percent
(iii) If rice productivity increases by 20 percent
(iv) If market margin for all products decreases by 20 percent
(v) If market margin for fertilizer decreases by 20 percent
(vi) If market margin for rice reduces by 20 percent
(vii) If rest of the world margin for fertilizer decreases by 20 percent
(viii) If rest of the world margin for rice decreases by 20 percent

Strengths, weaknesses and possible extension of the model

The advantage in using this model is that it shows the indirect effects of policies on other related markets and household groups which are rural and urban households in the yam producing zones in Nigeria. This model will show more explicitly the effect of policies on these groups of households. Since production and yield function was separated, the elasticities from each function will enable us to see more clearly how input and output prices affect each

function differently (Stifel and Randrianarisoa, 2003). The major weakness of this model is that it is data demanding and very expensive to analyse. Also, this model was not able to capture the effect of infrastructure beyond the use of transaction cost and market margins in the sense that: is the margin a true reflection of transaction and marketing costs or the producers are being exploited unnecessarily? It is not also able to check whether the charges of the transporters are unnecessarily inflated in the name of increased cost of petrol and that of the farm gate buying agents in the name of transportation cost. Possible extension to this model in relation to yam producers include (i) including more food crops and livestock products (ii) Making the model more explicit in tracking the effect of infrastructure on welfare of the households. (iii) Carrying out a similar study in the other countries in West and Central Africa so that cross country comparism can be done which will be more helpful in helping the countries involved.
The result from this analysis served as base line for the following simulations.

Expected signs of independent variables

TABLE 1: Summary of the A priori expectations of each parameter for each household group

Household groups	**Price elasticity of demand**			**Cross price elasticity of demand**			**Income elasticity**		
	Yam	**Rice**	**Cassava**	**Yam**	**Rice**	**Cassava**	**Yam**	**Rice**	**Cassava**
Rural Rich	+	+	-	+	+	+	+	+	-
Rural Poor	-	-	+	+	+	+	+	+	-
Urban Rich	+	+	-	+	+	+	+	+	-
Urban Poor	-	-	+	+	+	+	+	+	-

Source: Adapted from Lipsey, 2002

Results and Discussion

Effect of agricultural policy on yam production and consumption.

The baseline result of the multi market model showed that yam farming households produced 253 tonnes of yam, 2,025 tonnes of rice and 369 tonnes of cassava. These reveal that the producers produce more of rice and cassava than yam. Also, the producers consumed 789 tonnes of yam, 1011 tonnes of rice and 241 tonnes of cassava. These suggest that yam producers consume more yams than they produced. In other words, yam production is reducing to subsistence level in these areas. It also expressed that yam producers produce more rice and cassava than they consumed per annum. The consumer prices for yam, rice and cassava were ₦1, 294, ₦1, 782 and ₦774 per 10kg. The producer prices for yam, rice and cassava were ₦809, ₦1, 114 and ₦360 meaning that cassava had largest price margin. Therefore, yam producers would make more returns from the sale of cassava relative to yam and rice. This model was simulated in other to see the behavior of these parameters under different policy scenarios. This will enable us see the indirect effects of policy intervention on closely related markets. The policy instruments used were: improvement in rice productivity, trade liberalization and improvement in infrastructure.

Improvements in rice productivity

The first simulation looked at an overall 20 percent increase in rice yields that could arise from soil intensification practices (Tables 3 - 6). A 20 percent increase in rice yields led to a decrease of about 9 and 6 percent in yam and cassava production respectively in Nigeria,

TABLE 2
Elasticity estimates from AIDS model

	Yam	Rice	Cassava
Land share elasticity			
Yam	0.7	-0.3	-0.3
Rice	-0.2	0.3	-0.1
Cassava	-0.2	-0.8	0.02
Crop yield elasticity			
Yam	0.4	-0.5	-2.1
Rice	-1.1	0.4	-0.1
Cassava	-4.6	-4.5	2.3
Price elasticity Urban			
Yam	-0.2	0.7	1.4
Rice	0.4	-0.1	1.3
Cassava	1.3	2.2	-0.1
Price elasticity Rural			
Yam	-1.60	1.08	1.16
Rice	4.26	-3.3	4.6
Cassava	1.54	1.54	-0.62

Source: Data analysis, 2011

while consumption of yam, rice and cassava increased by 1 percent, 10 percent and 4 percent respectively. This reveals that household increased the consumption of rice more than yam and cassava when rice yield increases because of the largest fall in consumer price of rice. The productivity shock led to a substantial 53 percent increase in rice imports, as domestic production couldn't meet up with the domestic demands. Fertilizer demand reduced by 0.05 percent with an increase of 11 percent in government revenue.

At the household level, consumption of rice increased by 5 percent for the rural poor while consumption of yam for the rural poor and rural rich increased by 2 percent and 0.8 percent, with significant gains of 4 percent for all household groups in cassava consumption. Producer and consumer prices did not change for fertilizer, however, the prices reduced by 9 percent, 10 percent and 6 percent for yam, rice and cassava respectively. This is because yam, rice and cassava were substitutes and a drop in the price of rice as a result of the increase in yield affected yam and cassava prices negatively. The improvement in rice yields led to reduced prices which caused the aforementioned increase in consumption. Total real income rose between 5 percent for the rural rich and rural poor to 6 percent for the urban poor. Caloric intake also rose, particularly among the poorer groups, caloric consumption increased by 2 percent for the urban poor and 3 percent for the rural poor. Rich groups, however, experience only a slight improvement in calorie consumption. Similar to the first simulation, a targeted 20 percent increase in rice yield led to reduced land share for yam and rice production by 13 percent and 15 percent and an increase of 6 percent land share for cassava production.

Trade policy

The results from changes in trade policy (Tables 3 – 6) expressed that the reduction of the rice tariff by 15 percent led to a reduction in the production of rice (66 percent), while rice consumption rises by 54 percent, owing to a decline in the price resulting from a 15 percent increase in rice import tariff. Production of yam reduced by 47 percent as a result of the decrease in producer price while its consumption increased by 69 percent because the consumer price reduced. However, cassava consumption increased by 140 percent because of the decrease in consumer price. Poor households benefited most from the reduction in the rice tariff in terms of consumption, while the urban poor increased their consumption of rice by 43 percent. Prices for all products decline significantly, particularly yam (86 percent), rice (11 percent) and cassava (82 percent), which combined with the reduction in production led to a decline in nominal incomes of between 41 percent and 57 percent. However, while nominal incomes declined, nominal income for the urban poor increased by 25 percent and real income reduced by 100 percent for all household groups. In this scenario, caloric intake rose for all groups, with 186 percent rise for urban poor.

The situation changed when rice tariff was increased by 15 percent. In this scenario, yam consumption increased by 116 percent, rice and cassava consumption increased by 7 percent and 186 percent respectively, indicating more consumption of yam and cassava and less of rice. This similarly affected food production because yam and cassava production increased by 61 percent and 91 percent, rice production increased by 81 percent. The demand for fertilizer also increased by 3.8 percent while rice and fertilizer import increased by 321 percent and 4.5 percent leading to 81 percent increase in government revenue. Total caloric intake increased for all the groups with the highest (264 percent) for the urban poor households and a loss (3 percent) for the rural rich. The real incomes of all household groups declined.

Improvements in infrastructure

The result of these simulations examined the effects of improving infrastructure and reducing distribution costs in Nigeria. Internal marketing margins of 20 percent from farm-gate to urban areas and external marketing margin of 20 percent to the ROW was used for rice and fertilizer. The result as shown in Table 3 to Table 6 revealed an increase in yam production more than other food crops. However, rice production reduced ranging between 71 percent and 79 percent. Consumption of cassava increased most followed by yam and rice. Fertilizer demand also increased between 2 percent and 4 percent with an increase in government revenue of 12 percent to 42 percent. Aside this, household consumption and calorie intake also rose with the largest by the urban poor for yam, rice and cassava but rural rich reduced rice consumption from 13 percent to 15 percent which is in agreement with the findings of Stifel (2004). Producer and consumer prices reduced significantly in this simulation by 83 percent to 87 percent respectively leading to a loss in income for all the groups except the urban poor. For all the household groups there was reduction in real income between 99 percent and 100 percent. Land share moved away from rice and yam production into cassava production in all the simulation.

TABLE 3: Production, consumption, and trade effects of all simulations

	Baseline (thousand tones)	20percent increase in rice yield	15% decrease in rice tariff	15% increase in rice tariff	20% reduction in internal marketing margin for all products	20% reduction in market margin for fertilizer	20% reduction in market margin for rice	20% reduction in ROW margin for fertilizer	20% reduction in ROW margin for rice
Change in production									
Yam	253	-9%	-47%	61%	-58%	58%	51%	56%	52%
Rice	2025	2%	-66%	81%	-79%	-79%	-71%	-77%	-73%
Cassava	369	-6%	61%	91%	-99%	66%	71%	72%	73%
Change in consumption									
Yam	789	1%	69%	116%	107%	106%	83%	100%	87%
Rice	1011	10%	54%	7%	12%	11%	12%	11%	11%
Cassava	241	4%	140%	186%	198%	152%	154%	157%	159%
Fertilizer (input demand)	6	-0.05%	1%	3.8%	3.7%	4%	2%	3%	2%
Change in net imports									
Rice	169	53%	570%	321%	322%	310%	224%	286%	239%
Fertilizer	6	7%	2%	4.5	4.5%	4.7%	2.6%	4%	2.9%
Government net revenue in Nm	257	10%	-24%	81%	42%	38%	15%	32%	19%

Source: Model Simulations, 2011

TABLE 4: Effect on household consumption and caloric intake of all simulations

	Baseline (thousand tonnes)	20% increase in rice yield	15% decrease in rice tariff	15% increase in rice tariff	20% reduction in internal marketing margin for all products	20% reduction in market margin for fertilizer	20% reduction in market margin for rice	20% reduction in ROW margin for fertilizer	20% reduction in ROW margin for rice
Yam									
Urban poor	47	0.7%	43%	64%	60%	58%	49%	56%	51%
Urban rich	14	0.3%	111%	129%	129%	111%	117%	115%	119%
Rural poor	590	2%	39%	86%	76%	78%	52%	71%	57%
Rural rich	138	0.8%	71%	64%	69%	67%	69%	67%	69%
Rice									
Urban poor	37	1%	162%	206%	205%	200%	177%	194%	181%
Urban rich	152	0.4%	22%	15%	20%	14%	20%	15%	19%
Rural poor	309	0.5%	26%	26%	31%	31%	27%	29%	27%
Rural rich	513	1%	7%	-21%	15%	-15%	-11%	-15%	13%
Cassava									
Urban poor	6	4%	140%	186%	198%	152%	155%	157%	159%
Urban rich	1	4%	140%	186%	198%	152%	155%	157%	159%
Rural poor	193	4%	140%	186%	198%	152%	155%	157%	159%
Rural rich	35	4%	140%	186%	198%	152%	155%	157%	159%
Caloric intake	**Base value in Kilocalories**								
Urban poor	327	2%	186%	264%	255%	245%	211%	236%	218%
Urban rich	890	1%	14%	9%	14%	7%	13%	9%	12%
Rural poor	764	3%	45%	69%	72%	60%	53%	59%	55%
Rural rich	1924	1%	5%	-3%	3%	-1%	2%	-0.1%	1%

Source: Model Simulations, 2011

TABLE 5: Price and income effects of all simulations

	Baseline	20% increase in rice yield	15% decrease in rice tariff	15% increase in rice tariff	20% reduction in internal marketing margin for all products	20% reduction in market margin for fertilizer	20% reduction in market margin for rice	20% reduction in ROW margin for fertilizer	20% reduction in ROW margin for rice
Change in consumer Prices/10kg									
Yam	1294	-9%	-86%	87%	-87%	86%	-86%	-86%	-86%
Rice	1782	-10%	-11%	11%	0%	0%	-5%	0%	-3%
Cassava	774	-6%	-82%	86%	-87%	-83%	-83%	-83%	-84%
Fertilizer	2500	0%	0%	0%	0%	-5%	0%	-3%	0%
Change in producer Prices/10kg									
Yam	809	-9%	-86%	87%	-86%	-86%	-86%	-86%	-86%
Rice	1114	-10%	-11%	11%	8%	0%	-5%	0%	-3%
Cassava	2360	-6%	-82%	86%	-86%	-83%	-83%	-83%	-84%
Fertilizer	1563	0%	0%	0%	8%	-5%	0%	-3%	0%
Total nominal income	Thousand naira	**% change in nominal income**							
Urban poor	545	-0.3%	25%	76%	62%	60%	40%	56%	45%
Urban rich	1663	-0.7%	-46%	39%	-41%	-44%	-44%	-44%	-43%
Rural poor	725	0.2%	-41%	30%	-33%	-33%	-38%	-34%	-37%
Rural rich	1009	-0.3%	-57%	56%	-57%	-57%	-56%	-56%	-56%
Total real Income		**% change in real income**							
Urban poor	545	2%	-100%	100%	100%	-99%	-100%	-100%	-100%
Urban rich	1663	6%	-100%	100%	100%	-100%	-100%	-100%	-100%
Rural poor	725	5%	-100%	100%	100%	-100%	-100%	-100%	-100%
Rural rich	1009	5%	-100%	100%	100%	-100%	-100%	-100%	-100%

Source: Model simulations, 2011

TABLE 6: Effect on land share of all simulations

	Baseline (thousand tones)	20% increase in rice yield	15% decrease in rice tariff	15% increase in rice tariff	20% reduction in internal marketing margin for all products	20% reduction in market margin for fertilizer	20% reduction in market margin for rice	20% reduction in ROW margin for fertilizer	20% reduction in ROW margin for rice
Yam									
Urban poor	0.548	-13%	-93%	-93%	-93%	-93%	-93%	-93%	-93%
Urban rich	0.6	-13%	-93%	-93%	-93%	-93%	-93%	-93%	-93%
Rural poor	0.449	-13%	-93%	-92%	-93%	-93%	-93%	-93%	-93%
Rural rich	0.572	-13%	-93%	-92%	-93%	-93%	-93%	-93%	-93%
Rice									
Urban poor	0.256	14%	-76%	75%	-74%	-81%	-75%	-79%	-75%
Urban rich	0.198	15%	-76%	75%	-74%	-81%	-75%	-78%	-75%
Rural poor	0.326	15%	-76%	75%	-74%	-81%	-75%	-79%	-75%
Rural rich	0.23	15%	-76%	75%	-74%	-81%	-75%	-78%	-75%
Cassava									
Urban poor	0.196	6%	61%	-91%	98%	68%	70%	72%	73%
Urban rich	0.201	6%	61%	-92%	99%	69%	71%	73%	74%
Rural poor	0.225	6%	61%	-91%	99%	68%	71%	72%	73%
Rural rich	0.198	6%	61%	-91%	99%	69%	71%	73%	74%

Source: Model simulations, 2011

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