INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
sustainable solutions for ending hunger and poverty
Supported by the CGIAR

NSSP Background Paper 13

Enhancing the Competitiveness of Agricultural Commodity Chains in Nigeria: Identifying Opportunities with Cassava, Rice, and Maize using a Policy Analysis Matrix (PAM) Framework

Lenis Saweda Onipede Liverpool
International Food Policy Research Institute (IFPRI)

Gbolagade B. Ayoola
President, Farm and Infrastructure Foundation (FIF)

R.O. Oyeleke
National Food Reserve Agency, Abuja Nigeria

Nigeria Strategy Support Program (NSSP)

Background Paper No. NSSP 013

December 2009

IFPRI-ABUJA
International Food Policy Research Institute
c/o International Center for Soil Fertility and Agriculture Development
No.6/ Plot 1413 Ogbagi Street
Off Oro-Ago Crescent
Cadastral Zone 11, Garki, Abuja
Nigeria
E-mail: ifpri-nigeria@cgiar.org
www.ifpri.org

IFPRI HEADQUARTERS
International Food Policy Research Institute
2033 K Street NW
Washington, DC 20006-1002 USA
Tel. +1-202-862-5600
Fax +1-202-467-4439
E-mail ifpri@cgiar.org
www.ifpri.org

THE NIGERIA STRATEGY SUPPORT PROGRAM (NSSP)
BACKGROUND PAPERS

ABOUT NSSP

The Nigeria Strategy Support Program (NSSP) of the International Food Policy Research Institute (IFPRI) aims to strengthen evidence-based policymaking in Nigeria in the areas of rural and agricultural development. In collaboration with the Federal Ministry of Agriculture and Water Resources, NSSP supports the implementation of Nigeria's national development plans by strengthening agricultural-sector policies and strategies through:

- Enhanced knowledge, information, data, and tools for the analysis, design, and implementation of pro-poor, gender-sensitive, and environmentally sustainable agricultural and rural development polices and strategies in Nigeria;
- Strengthened capacity for government agencies, research institutions, and other stakeholders to carry out and use applied research that directly informs agricultural and rural polices and strategies; and
- Improved communication linkages and consultations between policymakers, policy analysts, and policy beneficiaries on agricultural and rural development policy issues.

ABOUT THESE BACKGROUND PAPERS

The Nigeria Strategy Support Program (NSSP) Background Papers contain preliminary material and research results from IFPRI and/or its partners in Nigeria. The papers are reviewed by at least one reviewer from within IFPRI network but are not subject to a formal peer review. They are circulated in order to stimulate discussion and critical comment. The opinions are those of the authors and do not necessarily reflect those of their home institutions or supporting organizations.

This paper received support from the Agricultural Policy Support Facility (APSF), funded by the Canadian International Development Agency (CIDA).

Enhancing the Competitiveness of Agricultural Commodity Chains in Nigeria: Identifying Opportunities with Cassava, Rice, and Maize using a Policy Analysis Matrix (PAM) Framework

Lenis Saweda Onipede Liverpool
International Food and Policy Research Institute (IFPRI)

Gbolagade B. Ayoola
University of Agriculture Makurdi, Nigeria

R.O. Oyeleke
National Food Reserve Agency, Abuja Nigeria

Table of Contents

Introduction 1

An Overview of Agriculture in Nigeria 2

The Case for Rice, Maize, and Cassava as High Potential Commodities for Food Security and Economic Growth in Nigeria 4
- Cassava Production in Nigeria 5
- Rice Production in Nigeria 8
- Maize Production in Nigeria 10

Policy Analysis Matrix Results for Cassava, Maize, and Rice Production in Nigeria 12
- Methodology 13

Findings on Nigeria's Comparative Advantage in Rice, Cassava, and Maize Production 15
- Cassava 15
  - Cassava Production for Domestic Consumption and Export in Nigeria 15
  - Policy Options in Cassava Production 20
- Global Prices 25
- Rice 26
  - Overview of Rice Production for Domestic Consumption and Export in Nigeria 26
  - Divergences in Rice Production 27
  - Policy Options 28
- Maize 30
  - Overview of Maize Production for Domestic Consumption and Export in Nigeria 30
  - Divergences in Maize Production 32
  - Policy Options 32

Conclusions 33

References 35

Appendix 1: Tables 38

List of Figures

Figure 1. Contribution to GDP by sector 3
Figure 2. Trends in cassava production in Nigeria (1961–2006) 6
Figure 3. Trends in Nigeria's cassava production and food consumption (1961–2003) 6
Figure 4. Trends in Nigeria's cassava exports (1990–2005) 7
Figure 5. Rice production & consumption in Nigeria (1960–2007) 9
Figure 6. Nigerian rice imports (1970–2007) 9
Figure 7. Trend in Nigeria's maize production and consumption (1980–2007) 11
Figure 8. World production and consumption of maize (1990–2007) 12
Figure 9. Cassava production cost shares in Ogun State, Nigeria 16
Figure 10. Social cost benefit ratio for Ogun State cassava production for export of cassava by export price and gender of household head 19
Figure 11. Simulation of social profitability of cassava production for export for farmers in Benue State, Nigeria 20
Figure 12. Social cost benefit ratio for Ogun State cassava production for export of cassava chips at $200/ton by yield and gender of household head 21
Figure 13. Simulation of social cost benefit ratios for cassava profitability with transportation cost reduction 22
Figure 14. Simulation of private and social profits with a 25 percent reduction in labor costs 23
Figure 15. Simulation of social profitability of cassava production under various labor reduction strategies 24
Figure 16. Simulation of social profitability of cassava production under various combinations of policies 24
Figure 17. Simulation of social profitability of cassava production for export for farmers in Ogun State, Nigeria 26
Figure 18. Distortion source shares in the rice production system in Niger State 27
Figure 19. Social profitability of rice production by group 28
Figure 20. SCB ratios for different rice producing farmer groups 28
Figure 21. Maize production cost shares in Kaduna State, Nigeria 31
Figure 22. Social cost benefit ratio of maize producers in Kaduna State 33

List of Tables

Table 1. Illustrative Policy Analysis Matrix..... 38
Table 2. Summary of PAM results for cassava tuber production for local market—base scenario (yield of 15.7 tons/ha)..... 38
Table 3. Summary of PAM results for cassava tuber production for local market for female-headed households 38
Table 4. Summary of PAM results for cassava tuber production for domestic cassava chip market—base acenario (yield of about 15.7 tons/ha) 38
Table 5. Summary of PAM results for cassava tuber production for domestic cassava chip market—with increased yield of about 30tons/ha 39
Table 6. Summary of PAM results for cassava production for cassava chip export market—base scenario (yield of 15.7 tons/ha) and an export price of $200 39
Table 7. Summary PAM results for cassava production for cassava chip export market at and an export price of $200 for female-headed households 39
Table 8. Summary of PAM results for cassava production for cassava chip export market—base scenario (yield of 15.7 tons/ha) and an export price of $300 39
Table 9. Summary of PAM results for cassava production for cassava chip export market for an export price of $300 for female-headed households 40
Table 10. Summary of PAM results for cassava production for cassava chip export market—base scenario (yield of 15.7 tons/ha), an export price of $200, and based in Benue not Ogun State..... 40
Table 11. Summary of PAM results for cassava production for cassava chip export market—base scenario (yield of 15.7 tons/ha), an export price of $500, and based in Benue not Ogun State 40
Table 12. Summary of PAM results for cassava production for cassava chip export market—base scenario (yield of 15.7 tons/ha), based in Benue with a 30 percent reduction in transportation costs with an export price of $350 and increased yield to 30 tons 40
Table 13. Summary of PAM results for cassava production for cassava chip export market—base scenario (yield of 15.7 tons/ha), based in Benue with a 90 percent reduced TP with an export price of $200 and increased yield to 35 tons..... 41
Table 14. PAM results for cassava production for cassava chip export with 25 percent reduction in labor costs at FOB price $200 41
Table 15. PAM results for cassava production for cassava chip export with 25 percent reduction in labor costs at FOB price $200 41
Table 16. PAM results for cassava production for cassava chip export in Ogun State with 25 percent reduction in labor costs at FOB price $300..... 41
Table 17. PAM Results for representative rice farmers in Niger State with average yield of about 2.3 tons/ha..... 42
Table 18. PAM results for rice farmers in Niger State who do not participate in the Fadama Project with average yield of about 2 tons/ha 42
Table 19. PAM results for rice farmers in Niger State who participate in the Fadama Project with average yield of about 2.5 tons/ha..... 42
Table 20. PAM results for rice production by OLAM farmers 42
Table 21. PAM results for rice production for farmers using improved variety 43
Table 22. PAM results for rice production for farmers not using improved variety 43
Table 23. Mean crop yield by farmer type (kg/hectare)..... 43
Table 24. PAM results for representative maize farmer in Kaduna State for domestic market..... 43
Table 25. PAM results for fadama maize farmers with about 5.2 tons/ha 44
Table 26. PAM results for non-fadama maize farmers with about 2.5 tons/ha..... 44
Table 27. PAM results for maize farmers using improved varieties 44
Table 28. PAM results for maize farmers using local varieties..... 44

Introduction

Since registering a disappointing growth of 1.2 percent in 2002, Nigeria's economic performance has rebounded, averaging growth at 7.3 percent between then and 2007(Global insight 2008). However, the pressing challenge for the nation lies in maintaining and improving current economic growth indicators and translating these recent gains into an improved standard of living for the majority of its citizens. Poverty within Nigeria remains staggeringly high with over 50 percent and 70 percent of its general and rural population respectively, living on less than US1$ a day (World Bank 2007). Similarly, though Nigeria is often cited as one of the largest oil exporting countries, agriculture still remains the main employer of over 70 percent of the country's labor force and accounts for about 31 percent of the nation's GDP (World Bank 2008). Consequently, the importance of this sector in national development and poverty alleviation cannot be overemphasized.

The years since Nigeria's transition to democratic rule in 1999 have seen an increase in agricultural production. Potential for further growth is also encouraged by recent government emphasis on the sector and commitment to restoring agriculture to its past prominent position in the country's economy. During the second term of President Olusegun Obasanjo (2003-2007), the nation's National Economic Empowerment Development Strategy (NEEDS) was put in place to promote this goal. This program emphasized the importance of private sector development to support wealth creation and poverty reduction in Nigeria. It was geared towards providing an enabling environment for agricultural activity to flourish. Still in line with this recent re-emphasis on agriculture, the immediate past government introduced a "Presidential Initiatives on Rice, Cassava, Vegetable Oil Development and Tree Crops" in 2003. Subsequently, the "doubling maize production initiative was also launched to double maize output between 2006 and 2008" (IITA 2006). These initiatives were meant to stimulate production and distribution of the associated crops as a vehicle via which agriculture could contribute to the nation's fight against poverty; leading Nigeria back to its previous self-sufficiency status in food production as well as enabling it take advantage of global changes in the world food economy via exportable surpluses. Following the nation's successful transition to another civil dispensation in 2007, the current administration's seven point agenda cites cassava, rice, wheat, cocoa, and maize among a group of selected targeted crops to play a significant role in the country's bid to promote national food security and promote economic growth. Goals have been set to double cassava and rice yields between 2008 and 2011(FMAWR 2008).

While the production of cassava, rice, and maize responded to policy incentives in recent times, other factors including poor infrastructure and limited market outlets have served as a great disincentive to farmers. In Nassarawa State, for example, in response to the national root tuber expansion program as well as promises by the state and federal government to link farmers to markets in various ways, the state's production at the end of the 2002 harvest was said to have tripled from the previous year's production, only for farmers to be left with an abundance of the product at harvest. Consequently farmers faced highly depressed prices and the burden of unpaid loans taken in excitement at the potential gain of increased investment in cassava production (Ahmed 2009). Similar stories abound across the nation of how limited market access, poor infrastructure, and exorbitant transportation costs translating into low farm gate prices serve as disincentives to farmers (IITA 2009; USAID 2007). These reiterate the issue of failed government promises and inconsistent policies which have been a critique of policy in Nigeria (Walkenhorst 2006). They also highlight the importance of the role of infrastructure and markets in the success of any attempt to sustainably encourage increased production of key crops for food security and/or foreign exchange in Nigeria.

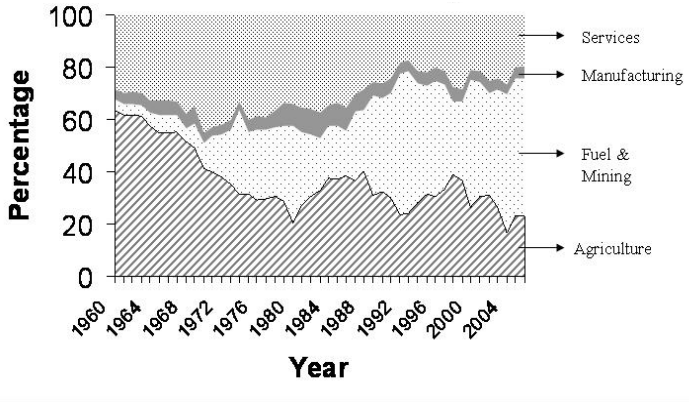
In this light, this report examines the comparative advantage of Nigerian farmers in the production of a subset of commodities (cassava, rice, and maize) in the light of current national policies and infrastructural development. Paying attention to gender dimensions in the various commodity chains, it reviews the current national economic policies and their impact on agriculture at-large, as well as on various key commodities. Using a "Policy Analysis Matrix" (PAM) framework, it assesses private efficiency, social efficiency, and the divergence between the two in the production and marketing of these three commodities. It analyzes the direct and indirect effects (negative or positive) of current policies. It also considers the effect of the agricultural production environment on farmer productivity exploring the potential effects of various proposed policy interventions. The report proceeds as follows. Part 1 provides a general overview of the Nigerian agricultural sector within the broader economy. Part 2 comprises a discussion of current trends in production and consumption of the three commodities (rice, maize, and cassava), given the current national policies and global market conditions to motivate the case for their selection as high potential commodities for food security, economic growth, and poverty reduction in Nigeria. Part 3 contains a discussion of the methodology and the "Policy Analysis Matrix" model. Part 4 presents findings for each commodity including an analysis of the potential effects of proposed interventions. Part 5 summarizes and concludes the report.

An Overview of Agriculture in Nigeria

The Nigerian economy is considered the second largest economy in Africa, after South Africa (Africa Research Bulletin 2006). Despite the fact that oil accounts for 95 percent of Nigeria's export revenues and 76 percent of government revenues, it has done little for poverty alleviation in the country (Ronchi 2005). Agriculture still remains a crucial sector, employing over 70 percent of the Nigerian labor force and serving as a potential vehicle for diversifying the Nigerian economy and enabling economic development. With a very diverse agroecology, Nigeria has numerous farming systems including: Pastoral, Agro-Pastoral (millet/sorghum), Irrigated, Cereal-Root Crop Mix, Highland Temperate Mix, Root Crop, Tree Crop, and Coastal Artesian Fishing (FAO 2001). Consequently, it also has a broad range of agricultural commodities, with the main ones being cassava, maize (corn), cocoa, millet, palm oil, peanuts, rice, rubber, sorghum, and yams.

The decline of the Nigerian agriculture sector began in the 1970's and was heavily driven by the country's discovery and exploration of oil. It was also a reflection of how national policies and fluctuations therein acted as disincentives to farmers (Walkenhorst 2006). As shown in Figure 1, agriculture was the mainstay of the Nigerian economy prior to the oil boom of the 1970's. However, with the increasing importance of oil in the country, the agricultural sector was largely de-emphasized. The newfound wealth from oil was accompanied by an increased value of the Nigerian currency (naira) and a consequent decline in non-petroleum exports, which were mainly agricultural products. While agriculture and oil composed about 65 percent and 5 percent of GDP respectively when Nigeria got political independence in 1960, the sectors accounted for about 32 percent and 37 percent, respectively, in 2006 (World Bank 2006; US DOS 2009).

Figure 1. Contribution to GDP by sector



Source: Generated from World Bank Indicators and Walkenhorst 2006.

Farming in Nigeria largely remains at the subsistence level. It is characterized by mostly small-scale farming carried out by peasant farmers with an average of about 2 hectares of land which are usually scattered holdings (Ukeje 2006). While the sector's performance has improved in recent years, it is still described as one with a great deal of unrealized potential. Though the sector employs well over half of the nation's labor force, it is said to only account for about one third of gross domestic product (GDP). Out of 70 million hectares of land classified as agricultural land in the country, only about 42 million hectares of this is currently either under permanent crop or pasture. This leaves about 28 million hectares of land for arable farming. Similarly, irrigation remains underexploited. While most of the nation's agricultural land is traversed by perennial or annual rivers, only about 10 percent of such area is presently under irrigation, corresponding to 1 percent of cropped land (Oladapo 2007).

Another problem faced by the sector is its inability to harness the entire human capital available. In Nigerian subsistence agriculture, though women are responsible for more than 60 percent of the food and fiber production, there is not enough attention given to gender issues in agricultural development initiatives (Walabai 2005). While gender issues may be increasingly included in the agenda of agricultural development discussions, little is done to ensure that these words translate into real changes for most Nigerian women. Studies on gender differences in agriculture indicate that rural women work longer hours than men with the intensity of their work varying over time and among ethnic groups (Olusi 1997). Even though women are actively involved in the production of agricultural commodities, while extension services for men have typically focused on increased crop and livestock production, services for women focused on cooking, child care, sewing, knitting, and similar skills (Walabai 2005). Limited access to credit, a common problem of poor Nigerian farmers, is also felt disproportionately by women who often have limited access to land or other assets that could serve as collateral for loans. This occurs despite studies, such as Ayoola (2009), which have demonstrated the high payoffs to female entrepreneurship in rural households. While attention is being increasingly directed towards assisting women (via directing the flows of technical information directly to women farmers and encouraging the adoption and use of innovations to increase productivity and income by women), this effort has been largely restricted by the lack of adequate information about women's actual contribution to the agricultural sector and their problems therein. Thus, there has been a lack of widespread political effort from grassroots to national levels to understand and address gender specific constraints and challenges (Walabai 2005).

Yet another key problem in Nigerian agriculture is the limited quality and quantity of input use, stemming from the small farm sizes and inadequate capital for investments to expand

agricultural production. Rudimentary implements are still being used for all levels of agricultural production and the consumption of fertilizer per hectare in Nigeria is still below 20 kg while Senegal, Gambia, and South Africa consume about 52 kg/ha, 55 kg/ha, and 330 kg/ha, respectively (Ukeje 2006). Nigeria's tractor density is put at 0.03 horsepower per hectare compared with FAO recommended tractor density of 1.5 hp/ha. Another serious problem in the agricultural sector is the poor level of supporting industries and infrastructure. Poor storage facilities and road networks limit the proper timing and feasibility of agricultural produce distribution. Similarly an underdeveloped manufacturing and processing sector limits the ability for value to be added to agricultural products so as to facilitate exportation or import substitution.

In this light, numerous plans and policies have been developed by the Nigerian government to address these problems and create an environment for the agricultural potential of the nation to be fully explored. This has included both macro and micro level policies and programs geared towards increasing farmer access to necessary inputs and encouraging private investment in the agriculture and allied sectors. Within this framework and the global trends that the Nigerian economy finds itself, the next section focuses on three agricultural commodities of key importance to the current national focus on agriculture as a vehicle for economic growth and poverty reduction in Nigeria.

The Case for Rice, Maize, and Cassava as High Potential Commodities for Food Security and Economic Growth in Nigeria

Nigeria's position in the world market has drastically changed over the last century. The country commanded more than 1 percent of world agricultural exports in the mid-1960s and had a leading position for several of its export crops. Nigeria supplied more than half of all traded palm kernel, more than a third of all groundnuts, and more than a fifth of all palm oil. Currently Nigeria is a net importer of food and subject to global food price fluctuations (Walkenhorst 2006). Current trends in global markets, particularly the world food economy, creates certain challenges and opportunities for Nigeria's agricultural sector, and hence, its economy. The increasing prices of grains, like wheat (Nigeria's largest import) and rice, imply increased import bills for Nigeria and higher prices for local consumers if the agricultural sector does not increase production of these commodities or provide alternative commodities to substitute for them. Similarly, increased demand for meat by emerging economies, especially in Asia, has necessitated expansions in meat production and consequently an increased demand for feed and sources of feed like grains and cassava products. In addition to being a feed source, cassava, in particular, is also being used in the production of yeast and alcohol. It is demanded as a starch for various industrial purposes and could serve as a source of ethanol for fuel (Taiwo 2006).

Nigeria is currently the largest producer of cassava in the world with over 34 million tons produced in 2007 (FAO 2007). However, most of what is produced is consumed locally, with over 50 percent of the harvested produce wasted due to production and post harvest inefficiencies (Ezedinma et al. 2007). However, if these inefficiencies are addressed alongside the current development of improved varieties of the crop (and the associated increased yield), Nigeria could take advantage of the increased national and international market opportunities mentioned above. With regard to maize, the expansion of maize production beyond local demand in collaboration with improved access and participation in world markets could enable Nigerian farmers to benefit from these higher world prices as well as cushion themselves from the same via fewer imports. Another important crop in Nigeria is rice. Nigeria's consumption and production of rice have increased significantly since independence in 1960. However, consumption demand exceeds production levels such that Nigeria remains a net importer of rice, incurring significant import bills. From about 1,400 tons of milled rice imported in 1965, Nigeria has imported between 500,000 and 1 million tons of rice between 2005 and 2007 (FAO 2008). According to the FAO, Nigeria's

2007 rice import bill was about $200 million and this significantly increased with the global price hike of 2008. With the advent of the drought tolerant and high yielding rice variety, “NERICA” (New Rice for Africa), and other initiatives by the government, Nigeria has the potential to further increase its domestic production of rice, thus reducing its import bill and becoming self-sufficient in rice.

These recent trends indicate great potential for the Nigerian rice, maize, and cassava subsectors in the nation’s bid to expand agricultural production, diversify the economy, improve food self-sufficiency, and reduce poverty. However, this necessitates a proper understanding of the efficiencies of production and distribution of these commodities to ascertain the necessary steps that need to be taken to translate these potentials into realities. The next section discusses the production and consumption trends of these three commodities as justification for their choice as crops with the potential to improve Nigeria’s food security position and promote economic growth.

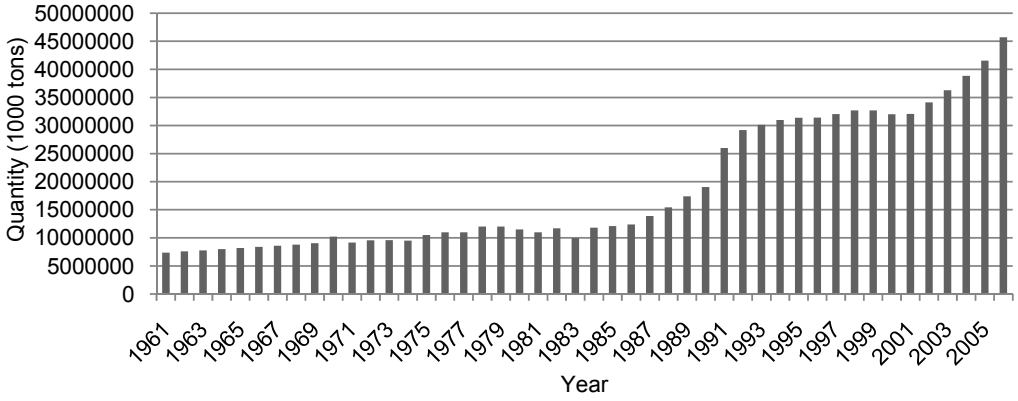
Cassava Production in Nigeria

Like most crop production in Nigeria, cassava production is concentrated in the hands of numerous small holder farmers and located mostly in the central and southern regions of the country. Similarly, female participation in cassava production, processing, and marketing is clearly evident. Ezedinma et al., in their analysis of cassava production and commercialization in 20 states, found that land clearing and preparation for cassava production was done mostly by men (in 87 percent and 86 percent of farms surveyed respectively). They found women to be mostly engaged in the planting of cassava as well as in the weeding and harvesting of the commodity (Ezedinma et al. 2007). Adetola and Taiwo (2006) found that women were responsible for 100 percent of cassava processing. In another recent study, women were found to be the ones responsible for land clearing, in addition to the other activities of cassava planting, weeding harvesting, processing, and preservation with men being responsible for ridging and some marketing. Given that gender roles are culture specific, it was revealed that in the middle belt region of Nigeria, women make ridges and mounds while in the Eastern part of the country that would be a job done by men (Walabai 2005).

Recent Cassava Production and Consumption Trends

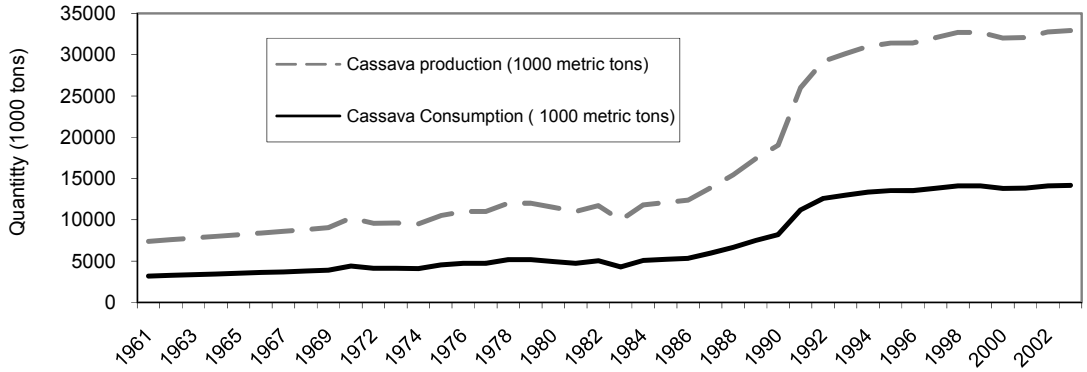
From independence to the mid-1980’s cassava production in Nigeria was roughly stagnant. Production of the commodity began to increase between the mid-1980’s and the early 1990’s. Then cassava production remained almost constant during the 1990’s (see Figure 2) beginning to increase again at the turn of the century, which coincides with the country’s return to civilian rule in 1999. Figure 3 shows that while cassava consumption has also increased over time, production has increased more rapidly, indicating potential as an industrial input or export crop. The Nigerian cassava market is composed of a more traditional food-oriented section which is fairly well understood and a newly emerging industrial market (where cassava is used for the production of pharmaceutical products, feed, and confectionary flour) which needs to be further explored and developed.

Figure 2. Trends in cassava production in Nigeria (1961–2006)



Source: FAOstat, 2008.

Figure 3. Trends in Nigeria's cassava production and food consumption (1961–2003)



Source: FAOstat 2008.

The Obasanjo administration's Presidential Initiative on cassava production as well as the current government's seven point agenda have contributed to the recent growth in the country's cassava production. Between 2005 and 2006, there was a 73 percent increase in cassava production, partially due to the initiative (Reuters 2007). While the recent increase in cassava production has been said to have resulted in a surplus of cassava production which decreased prices and caused significant financial losses for cassava producers, this is most likely driven by the inefficient cassava commodity chain characterized by a poor distribution network, poor storage capacity, and a generally underdeveloped cassava downstream sector.

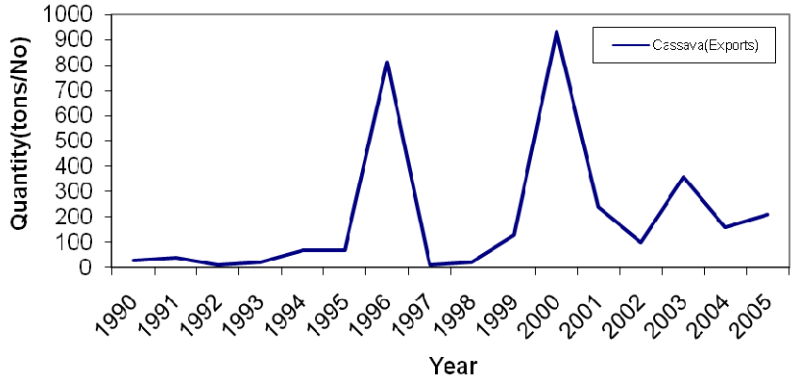
The Presidential Initiative had as a goal the promotion of cassava as a foreign exchange earner in Nigeria as well as ensuring that national demand is satisfied. Its objective is to expand primary processing and utilization to absorb the excess national cassava production and to identify and develop new market opportunities for cassava export. It also aimed to ensure the availability of clean (disease free) planting materials targeted at the emerging industries as well as to increase the yield, productivity, and to expand annual production to achieve global cassava competitiveness (Nigeria First 2005).

Other key contributors to the development of Nigeria's cassava subsector include the National Root Crops Research Institute (NRCI), The International Institute of Tropical Agriculture, Ibadan (IITA) and The Root and Tuber Expansion Program. For much of modern

Nigerian history, these institutions drove the cassava subsector development. NCRI, located in Umudike and established in colonial times, has always focused on improving the local farming systems for root crop production. It has played a significant role in the development of improved seed stock and currently works with the IITA on several projects. IITA, which is one of the 15 international agricultural research centers, has the African mandate for cassava development (Nigeria First 2005). In addition to improving cassava production, IITA is also focused on improving the cassava downstream sector development. Three of the many projects implemented through IITA, but particularly with regards to cassava, are the preemptive management of the cassava mosaic disease (CMD), the cassava enterprise development project (CEDP), and the cassava biofortification project. The works of CEDP and CMD complement each other as the former focuses on supporting micro and small scale agro-processing activities for cassava while the latter aims at properly addressing the cassava mosaic disease that has reduced cassava yields in the past. This combined effort is called the Integrated Cassava Project (ICP). It has already set up four small-scale plants in Abia, Akwa Ibom, and Delta State and formed a network of cassava equipment fabricators in Nigeria. It has also assisted women and vulnerable groups with microprocessing centers (Nigeria First 2005).

With regards to cassava exports, Nigeria began exporting in the 1990's which corresponded with the time the gap in cassava production and consumption growth initially increased significantly. As can be seen in Figure 4, cassava exports are quite low at best and very unstable. Nigeria's cassava exports are mostly in the form of cassava starch and dried cassava and are primarily sold to other African and Asian countries. In 2005, Nigeria's cassava export was 2100 tons compared to the leading exporter, Thailand, with 4,384,350 tons. World demand for cassava is increasing with import for cassava starch increasing from 976,960 tons to 1,415,000 tons between 2001 and 2005 (FAOstat 2008). If Nigerian farmers have comparative advantage in the production of cassava, the continued cassava expansion could increase Nigeria's role in the international cassava market. With the continued exploration of alternative fuel sources and various initiatives to shift from crude oil use to biofuel use, various possibilities exist for the Nigerian cassava market. This ranges from being an input source for local biofuel production plants as well as serving as an input to foreign industries in need of dried cassava or cassava starch.

Figure 4. Trends in Nigeria's cassava exports (1990–2005)



Source: FAOstat 2008.

In addition to exporting surplus cassava, the Nigerian government has also been encouraging the diversification of domestic cassava use. Recent research has shown cassava to be a possible partial substitute for wheat flour and a recent government decision insisted that all flour mills use cassava flour in bread (FewsNet 2007). Some studies have shown that cassava flour and starch are suitable for bread and biscuit making because they

have no fat content (which enables longer storage life) and because of their bland taste which prevents them from adding foreign odors or tastes (Taiwo 2006). However, the acceptability of cassava as a substitute is still an issue. Cassava-based bread is still considered inferior to wheat-based bread and the use of cassava as composite flour still needs to be improved. If the use of cassava can be expanded to serve as a partial substitute to wheat, this will also go a long way towards reducing Nigeria's import bill as wheat remains Nigeria's largest import. Nigeria ranked as the 14th largest importer of wheat as of 2004 (FAOstat 2008).

The above discussion reveals several ways cassava could play an instrumental role in Nigeria's journey towards diversifying its economy, increased export earnings, food security, and consequently poverty reduction. However, one question that needs to be answered to justify the current focus on the sector, as well as the need for further investments, is the comparative advantage of Nigerian farmers in the production of cassava, given the current and proposed production and distribution system and the current policy environment. Do current policies support or stifle the cassava subsector? Do they prevent Nigerian farmers and traders from being able to participate fully? Can we say anything about the distribution of current policy implications across gender lines? Also, what could be the effect of further attempts (currently being proposed) to improve the subsector on the comparative advantage of cassava farmers? These questions will be the focus of the PAM analysis in Part 3.

Rice Production in Nigeria

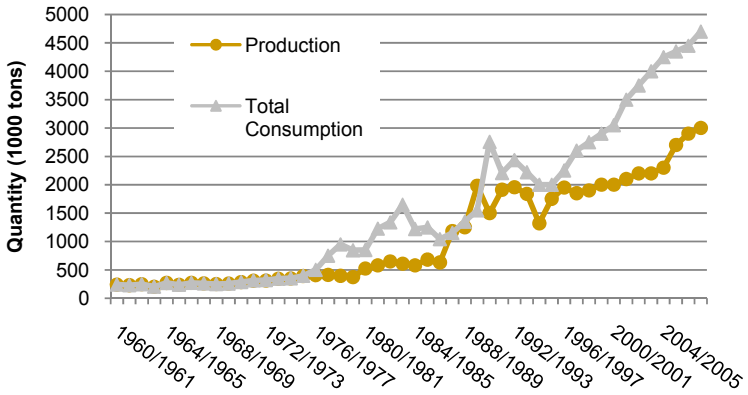
Rice is cultivated in virtually all the agroecological zones in Nigeria although with varying prospects. Within the various regions, most of the rice grown in the middle belt comes from Benue, Kaduna, Kano, Niger, and Taraba States, while that grown in the East typically comes from Enugu, Cross River, and Ebonyi States. Ekiti and Ogun States are the major rice producing areas in Western Nigeria (Ajani et al. 2007). Rice production in Nigeria is still predominantly rain fed with an emphasis on lowlands. In line with previous findings, recent studies reflect a less than 10 percent use of irrigation amongst rice producers (Ajani et al. 2007; Ogundele et al. 2003). There is a clear gender division of labor in rice production and processing in the country. According to Ogundele et al., rice production is clearly the domain of men, whereas rice postharvest activities are clearly the domain of women. Still, participation rates over the various rice production and processing activities vary. Land preparation is the most male dominated activity. A number of other field activities, such as crop establishment, weeding, fertilization, and harvesting, show a substantial contribution of women. Thus, although men are involved in these operations in 80–90 percent of the 41 villages studied, women are also involved in about two-fifths of the villages. Similarly, men are also involved in postharvest activities in around 30 percent of the villages, whereas women are involved in 90 percent of the villages (Ogundele et al. 2003).

Recent Trends in Rice Production and Consumption

As mentioned earlier, both Nigeria's production and consumption of rice have increased significantly since independence. However, as can be seen from Figures 5 and 6, the production increase has been insufficient to match that of consumption, necessitating increased rice imports to make up the shortfall. Recent trends depicted in Figure 5 seem to indicate an increasing gap between rice production and consumption. Figure 6 partially reflects the policy changes in Nigeria with respect to rice. Since the 1970's, during the years prior to the ban on rice importation (prior to 1986), there was an increase in rice imports. This was followed by a decline between the mid-1980's and the mid-1990's when the ban was in place and then another upward surge from the late 1990's. While it was illegal to import rice into the country in the ban era, illegal importation of the commodity through the country's borders persisted during this period (Akande 2003). In the post-ban period (1995–present), the prohibition of rice was lifted but in the last administration an import duty of 120 percent was imposed on the commodity. In 2006 the duty was reduced to 50 percent

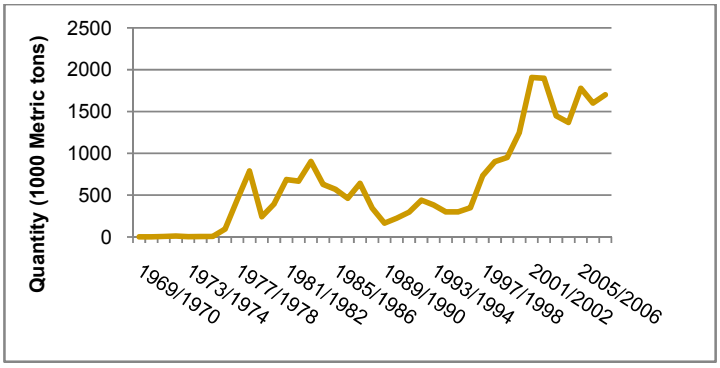
(Reuters 2007). It returned to 100 percent and was temporarily suspended in 2008 due to the high cereal prices. Despite the import duty and unstable rice import quantities, rice imports into Nigeria still remain positive.

Figure 5. Rice production & consumption in Nigeria (1960–2007)



Source: United States Department for Agriculture: International Database 2008.

Figure 6. Nigerian rice imports (1970–2007)



Source: United States Department for Agriculture: International Database 2008.

Historically, rice has not always been a major staple food in Nigeria. During the 1960's, Nigeria had the lowest per-capita annual consumption of rice in the sub-region (average of 3 kg). Since then, Nigerian per-capita consumption levels have grown significantly at 7.3 percent per annum. Per-capita consumption during the 1980's averaged 18 kg and reached 22 kg in 1995–1999. Despite these increases, Nigerian consumption levels still lag behind the rest of the West African subregion at 34 kg in 1995–1999 (Akande 2003). A combination of various factors seems to have triggered the structural increase in rice consumption. Like elsewhere in West Africa, urbanization appears to be the most important cause of the shift in consumer preferences towards rice in Nigeria. Rice is easy to prepare compared to other traditional cereals, thereby reducing the chore of food preparation and fitting more easily in the urban lifestyles of rich and poor alike. Rice indeed is no longer a luxury food in Nigeria and has become a major source of calories for the urban poor (Akande 2003). With rice now being a structural component of the Nigerian diet and rice imports making up an important share of Nigerian agricultural imports, there is considerable national interest in increasing local rice production.

Several efforts have been made to improve rice production in Nigeria. One key player was the Presidential Initiative on rice (2004–2007) which aimed at addressing the widening demand-supply gap in rice production and attaining self-sufficiency, as well as reducing the huge import bill on rice. The Presidential Initiative proposed a national rice project with the following highlights: private sector led, based on an intensification policy, NERICA varieties to be used for upland areas while other varieties adaptable to all agricultural zones of the country would also be used, and the provision of certified rice seeds by the government. To achieve this, and in pursuance of its rice self-sufficiency policy, the Federal Government released N1.5 billion for multiplication and distribution of certified rice seeds (Bello 2004; USAID 2003).

The Presidential Initiative on increased rice production, processing, marketing, and export had four components. These were production (inputs and crop protection), irrigation and land management, processing and marketing, and project management. The marketing of rice just like maize and other cereals is generally private-sector led. Rice marketing is now fully in the hands of private businesses, unlike in the past when government intervened in the rice and maize markets through the operations of the Nigerian Grains Board. Similarly, the Federal Government of Nigeria has entered into a joint venture partnership with Vee-Tee Rice Company, Ogun State, and private individuals to form Ofada Vee-Tee Limited for the purpose of producing and processing paddy (Ajani et al. 2007). Other efforts to stimulate the Nigerian rice subsector include the organization of workshops to sensitize rice farmers to form more cooperative groups so as to enable them to participate effectively in the Presidential Rice Initiative. Zonal mobilization of farmers to produce selected rice varieties to feed large scale processing mills such as Vee-Tee Rice in Rice Zones were also conducted to discourage importation of raw paddy to feed the local mills.

Despite the numerous efforts and goals, Nigeria's rice production did not meet its target of food sufficiency in 2007. However, rice production has still been on the increase from about 2.1 million tons at the turn of the century to 3 million tons in 2007(USPSD, 2008). This production increase is a positive sign but warrants further investigation to ascertain the true potential of this subsector. For this, the comparative advantage (CA) of Nigerian farmers in rice production needs to be further explored, especially in the light of the nation's current policies. On one hand the CA analysis will reveal if such a huge investment (as is currently being made) in rice production is worth it for Nigeria, or if it is better for the country to import the commodity. The analysis will also inform better what effect current and planned government policies could have on rice farmers.

Maize Production in Nigeria

Maize is a major staple crop in Nigeria and across Africa. Maize is said to be the second most common cereal food crop after rice (Ajani et al. 2007). Green fresh maize is cooked or roasted and hawked by women and children, providing a livelihood for many urban poor households. It is also used for animal feed and in various industries such as flour mills, breweries, and confectioneries. Thus, any attempt to boost maize production will enhance food security, serve as import substitution, and earn foreign exchange for the country through export to neighboring food deficient countries and potentially beyond (IITA 2006). Though gender roles have evolved with changing cultures in many communities across Nigeria, there is still a significant amount of distinction between male and female roles in maize production. While land clearing, threshing, and marketing of maize are more male-dominated activities, women are more often responsible for the planting, weeding, harvesting, winnowing, and processing of the grain (Walabai 2005).

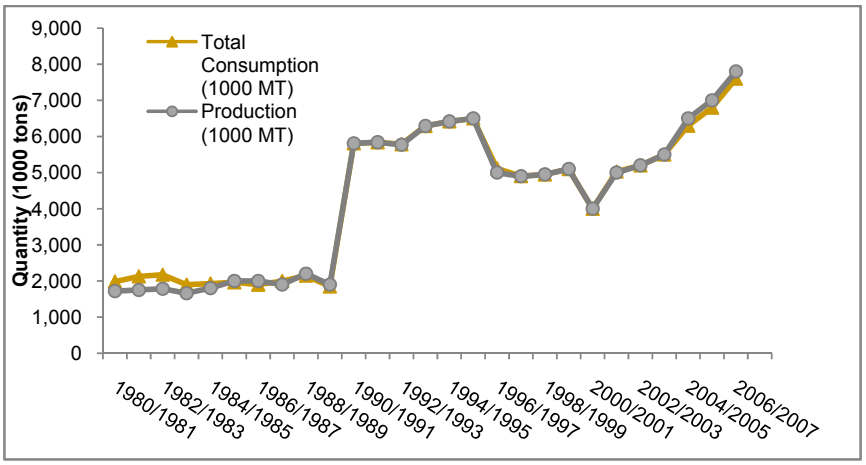
Trends in Maize Production and Consumption

For the most part of the last two decades, Nigeria has been largely self-sufficient in maize. In the last couple of years, production has overtaken consumption indicating exportable

surplus. Historical trends have suggested that the majority of increased maize production in Nigeria reflects an expansion in land under its cultivation rather than an improvement in yields. Currently, Nigeria's yield per hectare remains lower than what the world average was in the 1960's (1.9 tons/ha). It ranged between 1.63 and 1.76 tons per hectare between 2004 and 2007, much lower than the world average which has ranged between 4.88 and 4.93 tons per hectares for the same period (USDA 2008). This reveals significant room for the improvement of maize production in Nigeria which is necessary if the newly developing trend of exportable surplus is to be sustained and expanded.

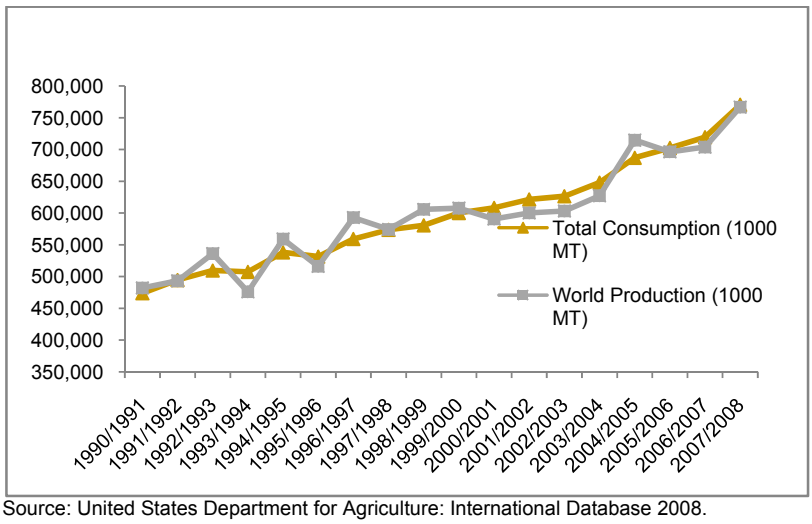
A look at the world market for maize seems to paint a slightly different picture from the Nigerian situation and one which could be beneficial. Figure 8 depicts how world production and consumption of maize have been increasing since the 1990's. Though there has been a lot of fluctuation in the market, current statistics reveal that current production levels are not sufficient to meet current world demands. Consequently there is a role for Nigeria and other maize producing nations to increase their supply of the commodity to meet this excess demand.

Figure 7. Trend in Nigeria's maize production and consumption (1980–2007)



Source: United States Department for Agriculture: International Database 2008.

Figure 8. World production and consumption of maize (1990–2007)



Source: United States Department for Agriculture: International Database 2008.

As mentioned above, yield/ha for Nigerian maize is very low compared to other countries. Understanding the reasons for this low yield is the first step towards understanding how increased production of maize can be fostered and maintained in the nation. Some reasons proffered for low maize production include: little or no use of improved seeds, herbicides, or fertilizers. Not only does the little or no use of fertilizers and organic manure limit crop yield, but it has also resulted in soils becoming poorer with an opportunistic expansion in Striga infestation problems. Another major problem facing maize farmers is high input prices. Prices of inputs have tripled in the last ten years. Other contributing factors include global warming and its associated effects which have led to erratic and unreliable rainfall in some cases resulting in drought (IITA 2006).

Recognition of these problems is what led to the establishment of the doubling maize production initiative. The overall strategy of the initiative was to ensure that maize production was doubled in two years (2006–2008). It was meant to be a private sector driven project, but with substantial contribution from research and extension. Its focus was to be on major maize producing states of the federation with high and medium production potential (IITA 2006). While maize production increased between 2005/2006 and 2006/2007, an excess supply of maize, low demand, and consequent price declines are said to have served as a disincentive to farmers (USAID FewsNet 2006). This raises, yet another crucial issue in the maize commodity chain, the problem of inadequate storage facilities and post harvest inefficiencies. The goal of doubling of maize production has not been realized. But the nation's current experience where increased production in 2006 had limited benefits due to other inefficiencies in the maize commodity chain provides an opportunity for careful consideration of the maize commodity market and Nigerian farmers' comparative advantage. Similar questions posed about cassava and rice need to be investigated for maize also to inform the impact that current policies are having on farmers and report how these policies can be supported, changed, or modified to ensure that the necessary environment for the subsector to develop and thrive is provided.

Policy Analysis Matrix Results for Cassava, Maize, and Rice Production in Nigeria

This portion of the commodity value chain analysis report uses a Policy Analysis Matrix (PAM) framework to assess private profitability, national economic growth, and the divergence between the two in the production and marketing of three agricultural commodities in Nigeria (cassava, maize, and rice). It analyzes the direct and indirect effects

(negative or positive) of various government policies along with the agricultural production environment on farmers' profitability. It also provides results that can be used to infer the potential effects of various proposed policy interventions to stimulate agricultural productivity in Nigeria.

Methodology

The PAM framework uses detailed information on a farm level production budget as well as on other processing and affiliated costs related to the production and marketing of commodities, in this case cassava, maize, and rice. It explores the composition of the production and other system related costs and how changing various production constraints and/or the policy environment can change the profitability of rice, maize, and cassava production. A PAM analysis enables the identification of likely outcomes of particular public policy or investment decisions on the general performance of the economy, as well as the private income of farmers. Combined with information on the distribution of poverty, the results concerning farm income can inform likely impacts of policy or investment on poverty alleviation. In this case, we consider the conditions under which Nigerian farmers have comparative advantage in the production of rice, maize, and cassava and under what circumstances this comparative advantage will be increased or decreased.

In a PAM model, the farm budget is divided into four categories: revenues, costs of tradable inputs, costs of domestic factors, and profits, with profits being the difference between revenue and total input costs. Looking at the illustrative PAM in Table 1, the Policy Analysis Matrix consists of three rows and four columns representing the budget for an activity. The first row of the matrix contains private prices. This captures production costs and revenues expressed in terms of the market prices that farmers face. Consequently, in private prices, profits are calculated by subtracting the two cost categories (B and C) from revenues (A) expressed in terms of market prices.

The second row of the PAM presents the costs and revenues of farmers under a scenario where farmers are facing the prices that would emerge in the absence of government policies or market failures. These prices reflect the true value of inputs and outputs and measure the contribution of an activity to national income and are referred to as "social prices". For example, in the presence of an input subsidy on some imported agricultural input like fertilizer, the social price of the input will include the actual value of the good plus the value of the subsidy and the private and social price will therefore differ by the subsidy. In a PAM framework, while the private profits measure the contribution of an activity to private incomes, the social profits measure the contribution of an activity to national income. In Table 1, these social profits are calculated as the social revenue (E) minus the social costs (F and G).

An activity is appealing to farmers once the private profits are positive. However, to be continuously sustainable without government support, an activity must have positive social profits. Thus, conclusions about the presence of comparative advantage in this framework are drawn based on the presence of positive social profits. It is very possible, and often the case, that an activity is profitable in private terms (and therefore attractive to producers), but is unprofitable socially (and therefore actually reduces national income). Divergences captured in the third row of the PAM are the difference between the private budget and the social budget which contains the critical information about the level of price distortion due to various policies. The first column of the divergence row reveals the divergence emerging through policies affecting output prices. For example, a policy such as an import duty, which raises local prices above the level that would otherwise exist, would inflate the private output prices and cause a positive divergence between A and E, and this would be captured by I.

The PAM considers tradable input costs separately from other domestic costs because these two types of costs tend to be affected by different policies. For example, trade and exchange rate policy, such as an import subsidy on fertilizer, will usually have a direct effect on the costs of intermediate inputs, which can be imported, but not on capital and labor. Similarly, a provision of low interest loans for capital equipment purchase or hire could lower the cost of capital such that, while the country is using these resources, private agents are not paying the full cost of them and this in turn would lead to a divergence between the social price (which will be higher) and the private price, captured by K in the illustrative matrix. L in the matrix reflects the full effect of policies on profits.

Some other key indicators of comparative advantage can be abstracted from the PAM. One is the domestic resource cost ratio (DRC). It indicates how many domestic resources are needed to generate an additional value of export revenue. A value of less than one indicates that it costs less in domestic resources to generate an additional dollar of foreign exchange. Thus it is cheaper for the country to produce such a commodity locally than to import it. In such a situation, the country has comparative advantage in producing that commodity. It is calculated as G divided by the difference between E and F. Another is the Social Cost Benefit (SCB) ratio. This value tells you how much greater the value of output created is relative to the associated cost of production estimated in social prices. It is calculated as the sum of (F) and (G) divided by (E). If this ratio is less than one, an activity is profitable and the difference between the ratio and one indicates the rate of return on an investment in this activity. Prior to the application of the PAM model to evaluate Nigeria's comparative advantage in the production of the three selected commodities, it is important to note that understanding current farmer attitudes towards various agricultural programs, as well as the prevailing nature and dynamics of various farmer relations[1], necessitates some knowledge of the history behind such relationships. The very nature of a policy can serve as an incentive or disincentive for the production of various agricultural commodities. A long-standing experience of government intervention in the sector (for example via subsidy provision) plays an important role in the ability and willingness of farmers, all of a sudden, to engage in such activities on their own. Still, in many other instances the implementation (or absence thereof) of agricultural programs determines the level of trust that exists between government and farmers or farmer groups.

The current national policy aims to improve the lives of rural dwellers and is centered on increased production of food and cash crops using modern technology to enable national self-sufficiency in basic food supply and attainment of food security, as well as to serve the production and processing of export crops. It also focuses on employment and rational utilization of natural resources. It lays significant emphasis on a public-private partnership approach to promoting sustainable agricultural development. The major policy interventions that currently exist and run through the entire analysis are the subsidization of chemical fertilizers to the tune of 25 percent at the national level with possible additional subsidy at the state level, depending on the state. There is also an export promotion strategy which provides a 30 percent export subsidy on cassava based products to which value has been added. Another key policy is the 100 percent import duty on rice[2].

[1] This refers to farmer-to-farmer relations, farmer to trader, and farmer to government relations.

[2] While the 100percent import duty on rice is a long-standing policy, the government introduced a policy of import waiver for a period of three months in 2008 in its policy response to the FAO's Initiative on Soaring Food Prices, which led to large-scale increase in rice imports during the period.

Findings on Nigeria's Comparative Advantage in Rice, Cassava, and Maize Production

Cassava

The PAM analysis reveals that Nigerian cassava growers with yield of about 15.7 tons/ha do not have comparative advantage in the production and export of the root tuber. First of all, cassava tuber is a highly perishable commodity with a short shelf life once harvested. Consequently, given the relatively low export price for tubers[3] and the high transportation costs in Nigeria, it is not profitable for Nigerian farmers to export cassava tubers. It is actually more advantageous for local farmers to produce for local consumption rather than for export. Value added to cassava by conversion to cassava starch for industrial uses and cassava chips[4], a product highly demanded on the world market to serve as feed for livestock and as an input for ethanol production, reveal potential opportunities to increase the profitability of cassava production and farmer incomes.

Depending on the export price (FOB) of cassava chips, local farmers might still be better off producing for local industries than for export, though this depends largely on their cost of production, yield, and proximity to export zone. In any case, local demand for cassava for the production of cassava based products creates a current viable market for cassava tubers to feed mills and other agro-allied industries with cassava as a major input. Major hindrances to the profitability of cassava to small scale farmers include the high transportation costs, the high labor costs in production (land clearing and weeding), as well as processing (peeling and cutting the chips), which if not done by the farmers often increases the cost of conversion for processors and lowers the price for tubers offered to farmers.

Cassava Production for Domestic Consumption and Export in Nigeria

The Policy Analysis Matrix framework used to analyze cassava production in Nigeria was conducted with data from various sources. The main source of data was from a survey of 50 randomly selected farmers each from two local governments (Odeda LGA and Ado-Odo LGA) in Ogun State, Nigeria. Ogun State was chosen for this study because it is considered to be a state with a high potential for cassava production, hence a natural location to study when exploring issues of cassava production expansion and export opportunities. Additional data was gotten from secondary data from various government publications and research studies, as well as interviews with key informants including farmers, processors, transporters, and government officials in various ministries between 2008 and 2009.

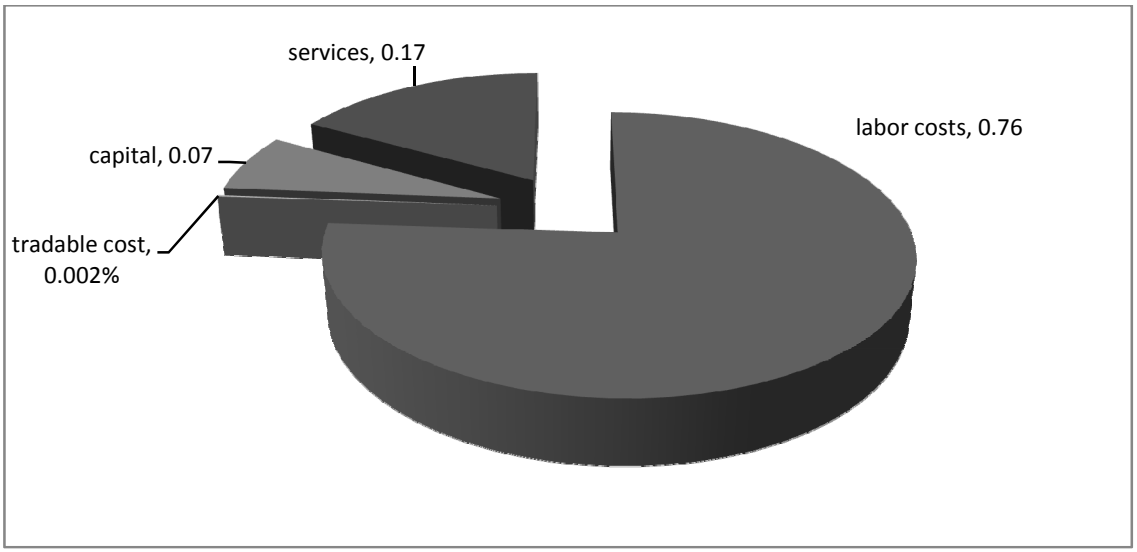
Several studies on cassava production in Nigeria reveal wide variation in yields per hectare from 10 to 50 tons. While a study carried out by IITA in 2007 slated yield per hectare for a sample of cassava growers as ranging between 10 and 17 tons, researchers from the National Root Crop Research Institute claimed that the national average was about 15 with farmers using improved varieties able to get much higher yields of 45-55 tons/ha . The average yield among farmers in our sample from Ogun State was 15.7 tons per hectare, which we use for the base scenario. Using farm level production budget data, our PAM calculations reveal that it costs the average farmer about N5,200 to produce a ton of cassava. This value covers the cost of production for a farmer planting on soil with an average level of fertility, with adequate (but not the most efficient) agronomic practices, and using mostly manual labor. For such a farmer, the major tradable inputs are fertilizer and

[3]We use the producer prices for Thailand (as it is the largest exporter of cassava) as an estimate of the maximum export price (FOB). This was $35 in 2009.

[4] The export price for chips was stated to be $400 per ton by the SME report on cassava chip production for export. SME is the small- and medium-scale enterprise organization geared towards promoting the successful establishment and running of SME's in Africa. Other trade websites tend to have lower prices and a broader range from $150–$600.

chemicals while the other major production costs go towards labor. Over 110 man days are needed for the cassava production process from land clearing and planting, to weeding, to harvesting and labor costs account for almost 80 percent of total production costs (see figure 9). Interviews with key informants revealed weeding and harvesting as the most tedious and laborious tasks. Most farmers in the survey region did not engage in post-harvesting processing of cassava into garri, cassava flour, or chips for sale to the market.

Figure 9. Cassava production cost shares in Ogun State, Nigeria



Source: Generated by author from PAM model.

We consider three base scenarios for analysis of cassava production in Nigeria. One is the production of cassava tubers for local market and or export. The second is the production of cassava to serve as an input for other agro-allied industries, particularly for cassava chips. The third scenario is the production of cassava for cassava chip as an export. Throughout the analysis, we distinguish between female-headed households and the typical representative farmer in the sample who is male-headed and has significantly different input uses, costs, and yields form those headed by females. In Ogun State, female-headed households tend to use fewer inputs.

On average, female-headed households do not use chemical fertilizers and herbicides at all on their cassava plots and they tend to allocate fewer labor hours to cassava production, particularly land clearing and preparation. While the representative farmer uses over 110 labor days/ha, female-headed households tend to use less than 70 days. Consequently, yields for female-headed households are lower at 12.8 tons/ha compared to the representative farmers at 15.7tons/ha. Understanding the reasons for the varying input use by farmers with female versus male household heads could be informative regarding the differential constraints faced by these households and on how best to develop appropriate interventions to ensure that all farmers have timely access to the inputs necessary for production, where there use has potential to significantly increase agricultural productivity.

With regards to root tuber production, local price information from the Nigeria Agri-market information service indicates that the urban market price of cassava tuber in the Ogun State at Abeokuta was about N28/kg during the survey month[5]. However, our survey data

[5] Actually cassava prices in the state have ranged between N25 and N30 from April to December 2008.

revealed that farmers were receiving on average N11/kg. When we account for estimated transportation cost to the urban market, usually about 7-10km, with transportation costs of about N7/kg[6], it appears that a large portion of the N17 difference between the urban market price and farm gate price is captured by traders, about N10/kg, which is a significant portion of the final value.[7] Farmer's revenue from cassava production for sale to the markets is calculated as the sum of revenue from the sale of tubers (which is the market price multiplied by the quantity produced) and the sale of cassava stems/cuttings. From Table 2 we can see that with a price of N11,000 per ton a farmer can generate N176,275.94 per hectare of land allocated to cassava production from the sale of tubers and stems[8]. With an average cost of production of N82,000 per ton a farmer can make a profit of about N94,000 per hectare of land allocated to the production of cassava tubers, which is about N6/kg. In Table 2, we distinguish between the private and social revenue of farmers. As explained in the methodology, private revenue reflects the market prices faced by farmers while the social prices incorporate any distortions to the input or output markets associated with production of the commodity in question. In this case, since we are producing for the local market, we don't have any direct policy distortions on output prices. However, given the inputs subsidy on fertilizer currently offered by the Nigerian government, the social price of tradable inputs is actually higher than the private price indicating the true price of the commodity that would have prevailed without the government's intervention on the input market. For cassava, due to the low use of non-labor inputs, this distortion is very small.

The PAM analysis reveals a very slight distortion in cassava production of about N29.52 per hectare in the cost of tradable inputs due to the government fertilizer subsidy and the foreign exchange differences[9]. Another divergence of about N355 per hectare is caused by the difference between the private and social rate of interest. This difference reflects the credit constraint of the farmer due to an imperfect credit market. While the tradable input divergence lowers the farmer's actual production cost of cassava below the socially optimum level, the farmer's high discount factor indicated by his higher than socially optimal interest rate increases the private cost of capital in production. Thus, the PAM reveals a total divergence of about N330 (N0.06/kg) between the private and social revenues caused by the sum of the effects of the subsidized fertilizer, credit constraints, and the slightly overvalued naira[10]. Disaggregating the PAMs by gender reveals that both the private and social profitability of cassava production are lower for female-headed households relative to the typical average farmer. This is largely driven by their lower yields as well as the higher cost of labor and services associated with production. The household budgets revealed that while the male households tend to spend about N6,500 for services associated with production such as transportation and renting implements, female-headed households spend about N9000. Furthermore, female-headed households tended to pay almost N100 more for labor than male-headed households.

Next, we consider private and social profitability of cassava tuber production for the export market. The export price (FOB) for raw cassava tubers is very low at about $35[11]. This

[6] Transportation costs for major routes were provided by a local transporter and these were adjusted to per km costs per kg of cassava for shorter distances. These figures appear reasonably comparable to average costs per kg provided by local researchers that range between N5 for maize to N10 for rice.

[7] We recognize that this is not conclusive given the inability of our analysis to distinguish between quality of the crops for which prices are given and also because the N10 margin that seems to exist for the trader might be reflecting his/her attempt to incorporate the loss in transit due to the perishability of the crop.

[8] Yield and price of stems was gotten from the cassava production manual of the National Root Crop Research Institute.

[9] The slightly overvalued currency actually decreases the price paid for imports by about 1 percent which is reinforced by the 25 percent subsidy enjoyed by farmers on imported subsidies.

[10] The real and market exchange rate in 2006 were 148 and 149, respectively.

[11] This value reflects the producer price in Thailand, the largest exporter of cassava.

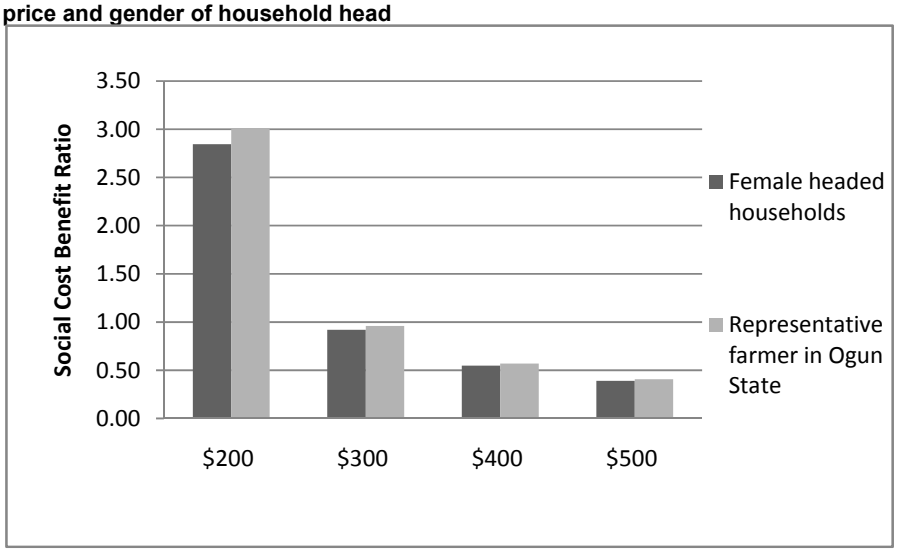
translated to about N5,180 at prevailing exchange rates in 2009, which is lower than the current farm gate price farmers are facing (N11,000). Given the perishable nature of the root crop as well as its bulkiness and corresponding higher per unit transportation cost, it can be seen that even if the cost of production and transportation of cassava tubers to the export zone was less than or equal to the FOB price of $35 per ton, farmers would be better off selling their produce on the domestic market rather than trying to produce for export. Discussions with farmers in Kaduna State (and confirmed by the NAMIS price reports of May 2008 and May 2009) revealed that a ton of cassava chips could be sold for about N65,000/ton in urban markets to various individuals, pharmaceutical companies, and other industries that use cassava as an input. After accounting for the cost of production, processing, conversion, and transportation costs, we find that farmers with reasonable access to markets and enough bargaining power with traders to prevent losing more than the N7/kg, and who are providing tubers as inputs for cassava chip production with average yield can make a slightly higher profit of about N2/kg[12]. Social profits could be almost N20,000 higher, at N123,896 versus N94,429, that farmers would receive producing the cassava tubers for the local market (Tables 2 and 4).

Subsequently, we consider the production of cassava for export as cassava chips. A global trade website called Alibaba lists a wide range of cassava chips with prices from about $100 to about $600 per ton. This indicates the lack of uniformity in the product, probably due to varying starch content and level of dryness. For the base scenario, we use the FOB price for Thai cassava producers at about $200/ton. The analysis here is similar to that conducted for the cassava chips production for the local market. The main differences are the existence of the export price and associated 30 percent export subsidies,[13] as well as the additional transportation costs associated with getting the cassava chips from production location to the export zone. At the current world price, the average farmer in Ogun State with yield of about 15.7 tons/ha does not have comparative advantage in the production of cassava for cassava chip export. For any export price lower than about $300, the associated production and transportation costs cause cassava chip production to be socially unprofitable for export. Tables 6–9 show the private and social costs and profits from cassava production with export price at $200 and $300 respectively for the typical farmer and a female-headed household. Given current practices and yield, it is only at about $300 that we see slight positive social profits for farmers. This is also clearly seen in the simulation results in figure 10 which further show that female households have lower SCB ratios at every export price compared to the male-headed households.

[12] Farmers currently receive N11/kg with traders margin included, with higher possible price from selling to chip producers still maintaining that margin, farmers can receive about N13/Kg.

[13] Nigeria has an export subsidy of 30percent available for the export of commodities to which value has been added versus raw materials.

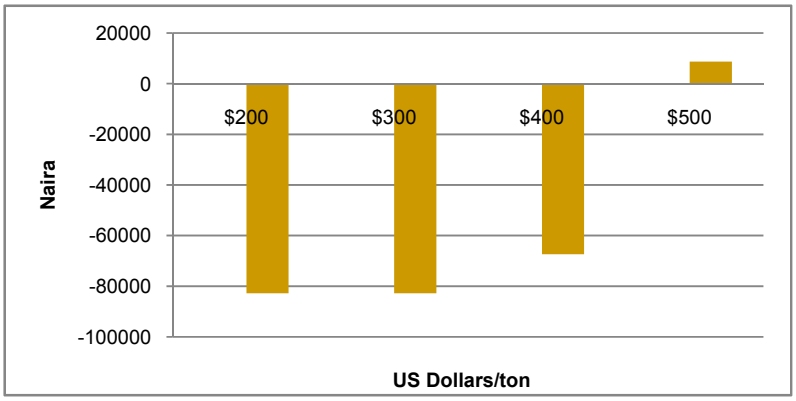
Figure 10. Social cost benefit ratio for Ogun State cassava production for export of cassava by export price and gender of household head



Source: Generated by author from PAM model.

A key issue in the profitability of cassava production in Nigeria is location and consequently transaction costs. Ogun State is located less than 150 km from Lagos, the port city. This is why it becomes socially profitable for farmers to produce cassava for the export of cassava chips at $300/ton. When we consider other major cassava producing regions in the country as a whole, particularly those more centrally located, like Benue State, the entire story changes. For such farmers, it is only if the export price of cassava gets to $500/ton that it becomes socially profitable for them to produce cassava for cassava chip export. See Tables 10 and 11. From Figure 11 we can see that location is a major factor in the comparative advantage of Nigerian farmers. Further analysis using more detailed regional PAMs might provide more insight for prioritization of strategies to address transportation and other challenges in cassava production. To enhance profitability of cassava production for Nigerian farmers, there is a need to reduce transportation costs combined with a need for increased yield. Tables 12 and 13 show that even with a 30 percent reduction in transportation costs with export price at $350/ton and an increased yield to 30 tons, only private profits would be slightly positive. At the current export price of $200, it is only when transportation costs are reduced to about 10 percent of their current cost that we see some social profitability, and even this would need to be combined with some other cost saving technique such as reducing labor costs or increasing yield which lowers per unit production costs.

Figure 11. Simulation of social profitability of cassava production for export for farmers in Benue State, Nigeria



Source: Generated by Author from PAM model.

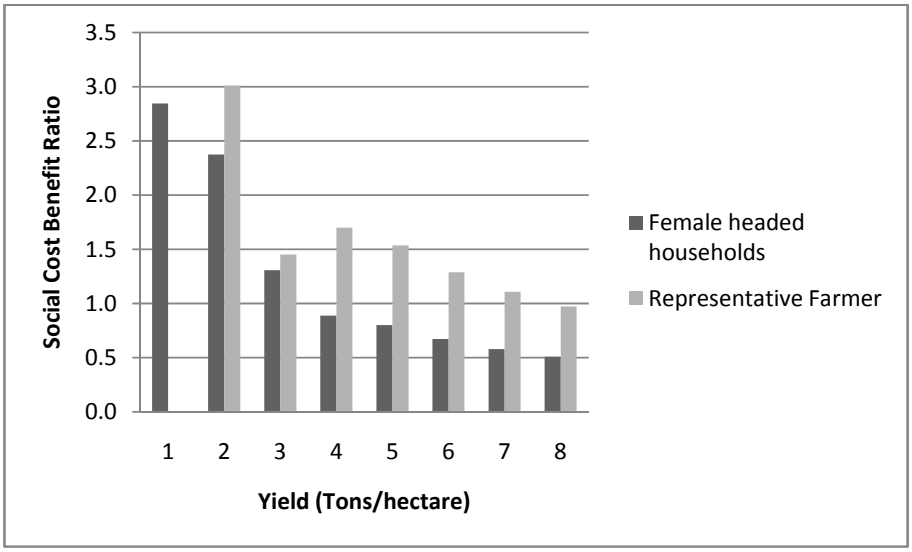
Policy Options in Cassava Production

There are several opportunities to address the challenges faced by the Nigerian cassava production system. The first policy consideration is one already on ground in the country, the promotion of improved varieties of cassava. Generally cassava is prized as a reliable crop given its ability to thrive under less than favorable conditions. Though potential yields are stated to vary within a wide range, the generally accepted yield per hectare in the country is about 15 tons, 15.7 tons for our sample[14]. The PAM analysis reveals that with such yields, Nigerian farmers do not have comparative advantage in cassava production for cassava chip export at the current global price. As can be seen in Table 10, at this yield, social profits are negative. Even at 30 tons, SCB ratios of cassava production for export are still greater than 1. From Figure 12, we can see that it is only if farmers can achieve the full potential of improved varieties of about 45 tons/ha without increasing production costs that we see a positive social profit and a social cost benefit ratio less than 1. This is somewhat unexpected as the high potential yield of 45–55 tons stated by the National Root Crop Research Institute (NRCRI) is the potential yield associated with the use of improved variety based on experimental sites with higher input use. With these higher production costs (we use the suggested input quantities from the cassava production manual of the institute at current prices), even with 60 tons/hectare, the farm gate price necessary to cover production and transportation costs (at social values) will not yield positive social profits[15].

[14] According to studies conducted by IITA, USAID and the Raw Materials Research and Development Council (RMRDC), there are about 46 newly improved varieties of cassava in Nigeria which are currently easily accessible and which yield between 30 and 55 tons/ha.

[15] With the increased cost of production, farmers can begin to make private profits at the current export prices with yields of about 33tons/ha due to the 30percent export subsidy

Figure 12. Social cost benefit ratio for Ogun State cassava production for export of cassava chips at$200/ton by yield and gender of household head



Source: Generated by author from PAM model.

Interestingly, discussions with researchers from the institute revealed that more critical than the use of improved varieties are issues related to the limitations of a highly labor intensive production process, efficiency limitations, and other management practices[16]. Due to the long-standing work on mosaic resistant cassava, most farmers are said to be using the improved varieties. However, the large divergence between potential yield (from demonstration sites) of 45–55 tons and actual yields of about 15 tons is said to be due to poor practices such as inadequate spacing and suboptimal timing of activities like weeding. It is also attributed to the labor-intensive nature of harvesting, short life span post harvesting, and reducing the amount harvested at each period. In this light, if yields can be significantly increased by training on the management related issues, application of strategies to increase harvesting capacity, and/or promotion of on-farm processing without increasing production costs too much, then at the potential yields of 55tons/hectare, farmers in Ogun State will most likely have comparative advantage in the production of cassava. We recognize that the role of hired labor at harvesting could be an important factor for labor-constrained farmers. While we do not expect much efficiency differences for cassava harvesting by hired or family labor, we recognize that higher yields will inevitably correspond to higher harvesting costs. One advantage of cassava production is that harvesting can be spaced out as the cassava root stores well under ground and only poses storage problems after harvesting. Estimates from the PAM model reveal private profits even if harvesting costs increase by the magnitude of the yield increase (about four fold). However, in the event that the harvesting cost increase can be maintained at less than 150 percent, cassava production could still yield positive social profits for cassava farmers.

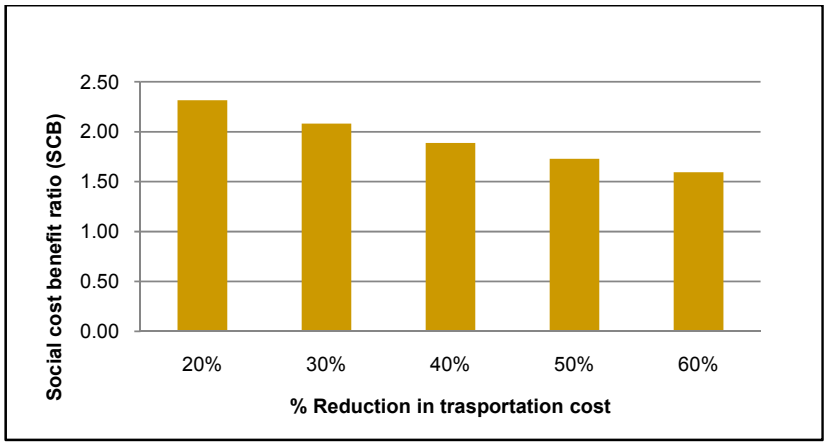
With regards to the gender of the household head, we see that female-headed households always have a lower social cost benefit ratio compared to their male-headed counterparts (Fgure 12). Though this is partly driven by their lower input costs, it appears to indicate that given the high cost of services and chemical inputs, the negative effect of the lower input use which contributes to the lower yields of female-headed households is less than the negative effect of the higher costs of inputs such that their overall benefit/cost ratio is higher (SCB is

[16] This indicates that there is at least some room for yield increase which does not necessarily require as high input use as required by the manual.

lower). This may be indicating that, given the constraints and market failures faced by households in Ogun State, the value of an extra naira spent on inputs is higher on a female-headed household's farm than their male counterparts.

As can be seen from Figure 12 at export price of $200/ton of cassava chips, farmers' yields have to increase to about 45 tons/ha[17] to be able to have comparative advantage in the production of cassava for cassava chip production for export. Reduction of other costs such as labor and transportation costs would also make a difference and lower the yield necessary to make it socially profitable for Nigeria to focus on cassava production for export. Figure 13 shows that irrespective of the extent of transportation cost reduction, SCB ratios remain above 1. This indicates that reduction of transportation costs alone will not be sufficient to make Nigeria competitive in the international cassava chip market at the current global prices. With a focus on the domestic market for cassava based products, Tables 2 and 3 show that even at the current yield, the social profits are positive (SCB is 0.35), indicating comparative advantage even in the absence of the current fertilizer subsidy. Both private and social profits are positive, indicating potential government savings from not having to subsidize the export of cassava based products, if there is sufficient local demand for these products. Given the potential capacity of Nigerian farmers in cassava production, these results indicate that the Nigerian government could benefit from exerting more effort to identify and execute strategies to reduce the cost of production and marketing of the product to make Nigerian farmers competitive in cassava chip production. Just incorporating the conservative effect (30 tons/ha) of the wide use of improved varieties of cassava with improved management and higher harvesting capacity, we see from Table 5 that farmers' yields could be more than doubled leading to a profitability increase over 20 fold in social prices. Social profit would increase to about N317,840.68 and the SCB would be reduced to about 0.20.

Figure 13. Simulation of social cost benefit ratios for cassava profitability with transportation cost reduction



Source: Generated by Author from PAM model.

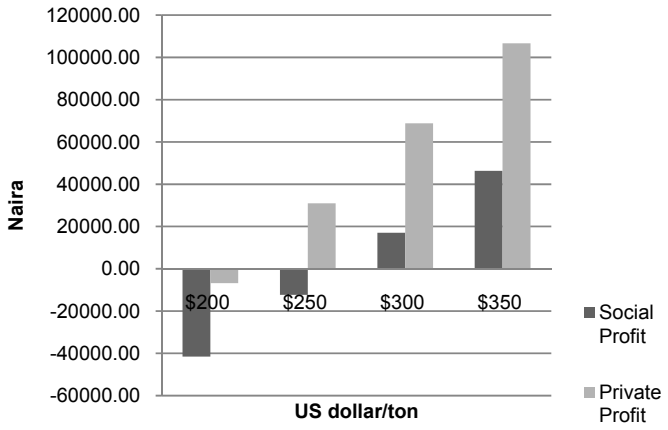
Given the high labor costs (about 75 percent of production costs), lower labor costs is another potential avenue to increase profitability of cassava production. Currently over 100[18] man days are needed for cultivating cassava on a hectare of land. This is due to the labor

[17] For female-headed households and about 80 tons for the representative farmer.

[18] Discussions with farmers lead us to believe that this number is much higher than this.

intensity of the cassava production process. Weeding and harvesting are considered the most labor intensive portions of cassava production, though processing is also labor intensive and predominantly a woman's activity. Due to inadequate data, we consider the effect of a labor saving strategy that reduces the number of farm days needed by 25 percent. This could be through the use of labor saving technology like herbicides to reduce weeding time, or tractors (or motorized ploughs) to speed up land preparation. Simulation results indicate that a 25 percent reduction of labor days needed for cassava production reduced domestic factor costs for the representative farmer to about N65,000 from about N80,000 (N5.22 to N 4.34/kg). With export price of $200 and yield at 15.7 tons, Tables 14 shows that a 25 percent reduction in labor costs actually increases social profits but not enough to reveal comparative advantage. However, export price simulations shown in Figure 14 indicate that with FOB price of $300/ton and higher for cassava chips, this reduction in labor cost significantly increases both social and private profitability as can be seen in Table 16. SCB also improves falling below 1[19].

Figure 14. Simulation of private and social profits with a 25 percent reduction in labor costs

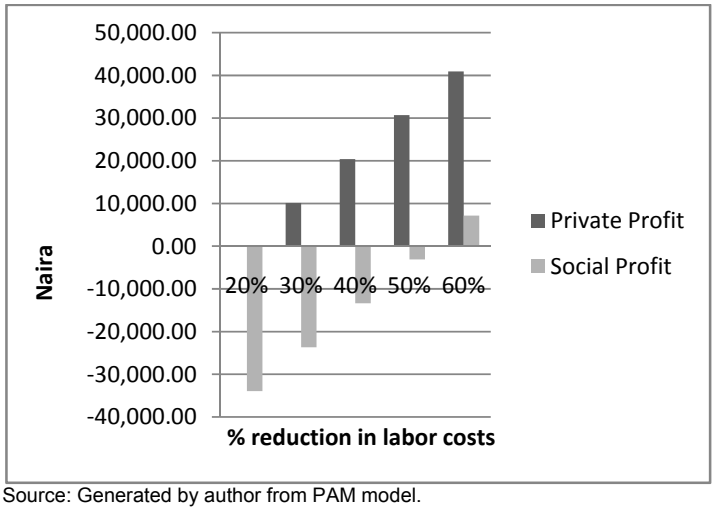


Source: Generated by author from PAM model.

Without a change in the price of cassava chips, simulation results shown in Figure 15 reveal that reduction of labor costs of about 60 percent would make Ogun State farmers have comparative advantage in cassava production for the export of cassava chips. However, this is quite an ambitious feat.

[19] This labor cost reduction calculation includes an additional N2,200 for the cost of hiring a tractor and an additional N10,000 for the use of chemicals based on recommendations in the cassava stem and root production manual of the National Root Crops Research Institute.

Figure 15. Simulation of social profitability of cassava production under various labor reduction strategies



Source: Generated by author from PAM model.

Even though Figure 15 shows that reduction of transportation costs alone would not be enough to generate positive social profits, simulation results in Figure 16 show that a combination of both strategies might be more effective. The most optimal combination yielding the lowest SCB ratio is a 60 percent reduction in both transportation and labor costs. Achieving this will be a significant challenge. However, there are other possible combinations, such as a 40 percent reduction in both transportation and labor costs, which could be more easily attained that would still allow Nigerian farmers to have comparative advantage in cassava production and enable the nation to participate in the international cassava chip market.

Figure 16. Simulation of social profitability of cassava production under various combinations of policies

		Labor cost reduction (%)					
Transport cost reduction (%)		0	20	30	40	50	60
	0	2.99	1.92	1.57	1.29	1.06	***0.87***
	20	2.32	1.58	1.32	1.10	***0.92***	***0.76***
	30	2.08	1.45	1.22	1.02	***0.86***	***0.72***
	40	1.89	1.34	1.13	***0.96***	***0.81***	***0.68***
	50	1.73	1.25	1.06	***0.90***	***0.76***	***0.64***
	60	1.59	1.16	***1.00***	***0.85***	***0.72***	***0.61***

Source: Generated by author from PAM model.

It should be noted that steps to reduce the labor costs could have potential implications for poverty alleviation if indeed labor supply is not a constraint and labor saving strategies would increase unemployment. However, anecdotal evidence suggests that this is not the case. Studies have shown that women are very involved in most, if not all of the cassava production and processing system. The study by Dickson et al. (2007) indicates that women often take much longer to execute the various tasks (land clearing, planting, weeding, and

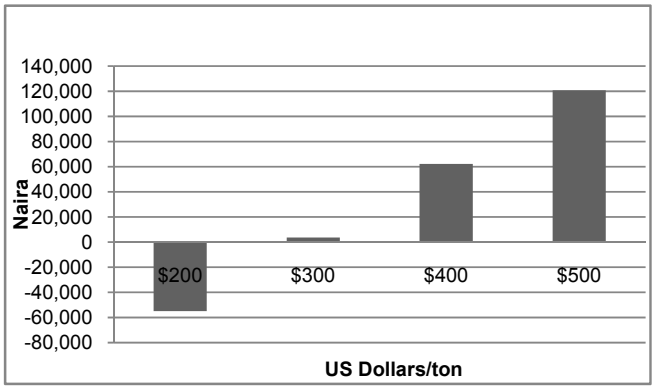
harvesting). This is probably due to the fact that women are further burdened with other household tasks necessitating their division of time for those activities as well as direct production activities, as was found in Ayoola and Ayoola (2000). Similarly, women are more involved than men in the current manual processing of cassava into garri, wet starch (fufu), cassava flour, and handmade cassava chips. If this is the case, then, not only will labor saving technologies reduce the production costs, they could potentially reduce the time needed for cassava production which could increase women's relative yield and be allocated to other household production activities. Further assistance of women is possible in the post-production process. Both the monetary and time saving benefits of these technologies could be harnessed if women are encouraged to establish small-scale cassava processing units. The potential benefit from access to labor saving techniques at affordable rates for all households indicates the need to consider different ways to increase farmer access to such technologies via mechanisms such as farmer groups or village development associations to assist in the coordination of procurement and use by farmers.

Global Prices

Figure 16 reveals the results of a sensitivity analysis done to identify the range of export prices for which it is socially viable for the average farmer in Ogun State to produce cassava for cassava chip production for export. With projected increased demand for cassava chips and other cassava products to diversify the input sources for ethanol production, as well as for use in livestock feed, the current upward trends in the price of cassava is expected to continue in the future. The simulation represented in figure 17 reveals that with the current yield levels, a world price of about $300 is necessary for maintaining cassava production profitability. However, if prices continue to increase, we see cassava production for export becoming increasingly profitable for Nigerian farmers. Consequently from the PAM analysis, we can see that at the current global price of cassava chips and given the infrastructure and other production constraints faced by Nigerian farmers, the average smallholder farmer does not have comparative advantage in the production of cassava for cassava chip export. From the analysis, it is only when we get to an export price above $300 ($500) that the local farmers in Ogun (Benue) State have comparative advantage in the production of cassava. At $300($500)/ton, the domestic resource cost ratio (SCB)[20] ratio is 0.839 (0.790).

[20] The domestic resource cost ratio indicates how much domestic resources are needed to generate an additional dollar of export revenue. Thus a value less than one indicates that it costs less in domestic resources to generate an additional dollar and thus the country has comparative advantage. With regards to the social cost benefit ratio, this value tells you how much greater the value of output created is relative to the associated cost of production estimated in social prices, that is after taking into account all distortions that exist in the associated markets with the product in question.

Figure 17. Simulation of social profitability of cassava production for export for farmers in Ogun State, Nigeria



Source: Generated by author from PAM model.

Rice

The PAM analysis reveals that at the current global price of rice, the average farmer in Niger State with about 2.3 tons/ha yield of rice has comparative advantage in the production of rice with ample room for improvements and higher profitability. Given the nation's high import bills over the last few years, the analysis reveals that if local Nigerian rice can favorably compete with imported rice, there are potential gains in terms of foreign exchange savings as well as potentially lower consumer prices not necessarily accompanied by broader losses by Nigerian local rice producers.

Overview of Rice Production for Domestic Consumption and Export in Nigeria

The main source of data for the rice PAM analysis was a survey of 50 randomly selected farmers from each of two Local Government Areas (Bida and Woshishi, in Niger State, Nigeria). Niger State, like Ogun State, was selected because of its high potential in rice production. The PAM analysis for rice production in Niger State was conducted with an average yield of 2.3 tons/ha for the base scenario. Yield statistics from the FAO list rice yields in Nigeria at about 1.55 tons/ha which is much lower than the USA (8.05 tons/ha) or even for other developing countries like the Philippines (3.7 tons/ha) and Cote D'Ivoire (1.97 tons/ha). While useful for informing on the nation's preparedness to pursue national policies on rice self-sufficiency, it should be noted that the yield of the average rice producer in Niger State is higher than the national average. Farmers in our sample record average yields of about 2.3 tons/ha, which is significantly higher than the 1.55 tons/ha national yield average. As in the case of Ogun State, additional data was obtained from secondary data from various publications as well as interviews with key informants including farmers, processors, transporters, and government officials in various ministries between 2008 and 2009. The calculations done in this study assume a quality differential of 0.25 between local and imported rice but discussions with rice farmers in Kaduna and Abuja reveal that this value might be higher due to problems of mixed grains which affect parboiling and due to high presence of stones resulting from the nature of drying.

In addition to looking at the overall representative farmer in Niger State, this analysis distinguishes between farmers who are participants in the Fadama program and those who are not. The Fadama program is a World Bank funded project in collaboration with the different levels of government in Nigeria. It is based on the community driven development approach geared to increase farmer incomes by providing assistance including demand driven extensions services, access to productive assets, and improved infrastructure. The analysis also distinguishes between farmers using improved varieties and those who are not. Unfortunately, because of the cultural practices in the state, no female-headed households

were found in our sample and therefore separate PAMs are not conducted in terms of gender. Though cultural practices might mean that the prevalence of female-headed households is lower in our sample state, we still consider our farmers representative of the area. However, anecdotal evidence from key informant interviews and discussions is used to highlight issues where gender dimensions are particularly crucial.

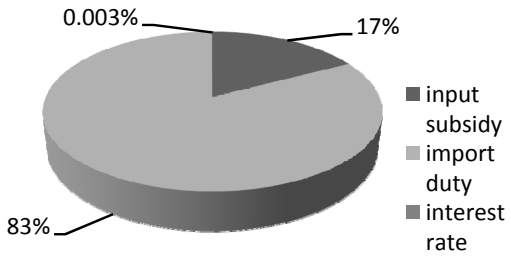
The PAM analysis traces back the farm gate price for rice paddy for farmers around the central part of Nigeria from the import price of milled rice in Lagos. Reconciling these prices indicates an appropriate accounting of the different parts of the rice value chain. It starts with the CIF[21] price of rice imported into Nigeria at Lagos. It then incorporates the 100 percent import duty imposed on imported rice and the necessary transportation costs to get the rice from the port to Abuja (about 880km). It also accounts for the quality differential between local and imported rice as well as the loss in weight due to the conversion of paddy rice to parboiled rice.

Divergences in Rice Production

The main reasons for the divergence between private and social prices in rice production in Nigeria stem from four main sources, three of which are the same as in cassava production.

The first is the 42 percent[22] import subsidy on fertilizer which causes the social price of fertilizer to be higher than the actual market price. The second source of divergence is the slight over valuation of the naira. The third divergence is due to the difference in the real interest rate which indicates the credit constraint faced by rural farmers. The fourth and largest cause of divergence is the 100 percent import duty on rice which raises the output price of farmers and causes social prices of rice to be lower than the actual price. The breakdown of these different distortion factors is displayed in Figure 18. We see that the major divergence between the private and social prices is driven by the high import duty on imported rice.

Figure 18. Distortion source shares in the rice production system in Niger State



Source: Generated by author from PAM model.

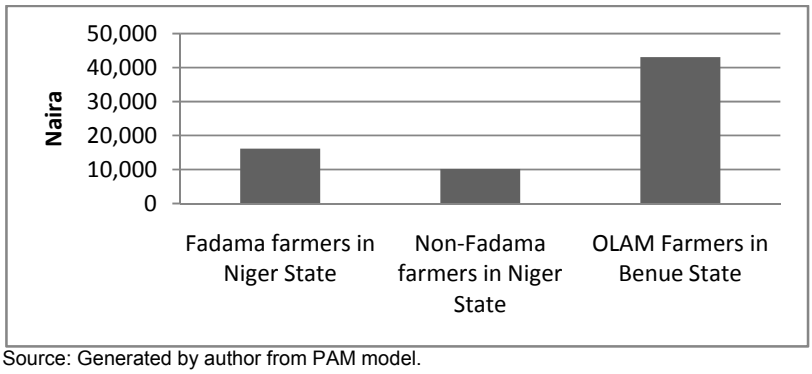
The PAM analysis finds positive private and social profits for the average farmer in Niger State with a yield of about 2.3 tons/hectare when characterized by average (but not the most efficient) input use and other agronomic practices. These farmers are assumed to have

[21] CIF refers to the cost insurance freight price which is basically the import price.

[22] The Niger State government provides an additional 16.63 percent beyond the national 25 percent fertilizer subsidy.

minimal amount of mixed grains in their paddy, and to have rice that has been parboiled appropriately with about 25 percent quality differential with the imported rice. When we disaggregate our sample into fadama and non-fadama participants we see that fadama participants tend to have higher average crop yields as well as higher input use compared to non-fadama participants. Interestingly, both of these farmer types exhibit positive private and social profits indicating that given their input use and yield, they both have comparative advantage in the production of rice. However, the fadama users have almost N20,000/ha higher private profits than non-fadama participants (See Tables 18 and 19). The social profits for fadama participants are also higher, indicating that both private and national income could be increased if farmers have proper access to the various inputs and productive assets associated with rice production in Nigeria (See Figure 19 below). Still in line with input use, the results further reveal the value of improved technologies in rice production. Distinguishing between farmers using local varieties and those using improved rice, the PAM analysis finds that farmers using improved varieties have higher social profits than those who do not (Tables 21 and 22).

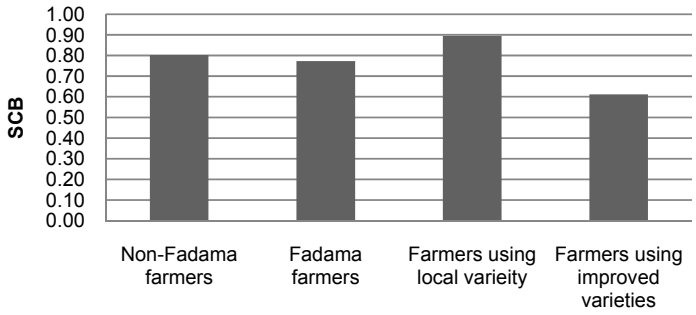
Figure 19. Social profitability of rice production by group



Source: Generated by author from PAM model.

As Figure 20 shows, farmers using improved varieties have the lowest social cost benefit ratio from all farmer groups considered in this analysis. Both of these findings corroborate numerous other studies that have highlighted the low use of inputs as key factors explaining the low agricultural productivity of Nigerian farmers.

Figure 20. SCB ratios for different rice producing farmer groups



Source: Generated by author from PAM model.

Policy Options

One of the key challenges to rice production cited by farmers during consultations held in May 2009 was marketing. The major reason for this problem appears to be the low quality of the local rice produced by most small farmers, hence the low market prices faced by these farmers for their crops, despite production costs incurred. Farmers claimed that different rice

varieties are brought and advertized to them with little or no proper education provided about the appropriate input application and management strategy associated with the various crops. To diversify their risk, farmers often accept the different varieties, planting all of them on small sections of their already small plots of land. Without adequate training on the separation of the various varieties, particularly at harvesting, rice varieties are often mixed, reducing the aesthetic value of the local rice compared with the consistency of imported rice and thus lowering the price received from rice millers, if they are even willing to buy it. Some millers are purchasing local paddy as inputs for their industries. A second issue is the further deterioration in terms of quality that occurs at parboiling stages where attempts are made to parboil different rice types which require different temperatures and duration of boiling. The third issue raised is the large presence of stones in local rice. This is partially due to the process of drying used by farmers, which involves laying the rice on the road to be sun dried. Ultimately these problems, due to lower quality paddy, often translate into very low prices for farmers, which is a consequent deterrent to future investments in improved rice variety usage. Discussion with farmer groups further revealed that gender differences are not properly addressed by extension agents and policies. Female rice farmers indicated that rather than focusing on the different issues female farmers faced in terms of access to inputs, rights to land, and government policies, often times extension services in a bid to be gender sensitive ended up further isolating women from the information they needed. Female farmers said they also needed training on proper separation of different rice varieties, appropriate weeding, and on harvesting. The women indicated that they needed more than trainings on health and home management as they were also farmers and not just home makers. Other factors mentioned include low input use due to poor quality of seeds, inadequate and untimely access to fertilizer, as well as high fertilizer cost.

To explore the effect of providing farmers with credit for inputs, timely access to inputs, and a guaranteed output market conditional on product quality on their yield and input use, we consider a unique outgrowers scheme that exists in Benue State. This scheme is run by a large-scale rice milling company called OLAM, a subsidiary of OLAM international which operates a large rice milling plant in Makurdi, Benue State. Identifying two key problems faced by small-holder farmers in Nigeria, limited access to inputs and output markets, OLAM has put in place an operational structure that simultaneously addresses these three issues of credit for inputs, timely access to inputs, and a guaranteed output market. They provide improved seed and accompanying inputs such as fertilizer to farmers on loan and provide a guaranteed market for the paddy rice thus produced. Since 2005, OLAM has worked with farmers in the state. In 2005/2006, OLAM worked with 1,000 farmers (with up to one hectare of land each incorporated into the program). In 2006/2007 the number of farmers was increased to 2500. Like the representative farmer in Niger State, OLAM farmers have a large share of production costs in tradable inputs (44 percent). However, they tend to use about double the NPK fertilizer used by the average farmers and though this results in higher costs (slightly reduced by the subsidy), the yield of those farmers at about 3.6 tons/hectare more than compensates for these higher costs[23]. As can be seen in Table 20, supported by Figure, 20, OLAM farmers record much higher private and social profits due to their higher yields and have a lower SCB of 0.65 compared to 0.95 for the representative farmer and 0.8 for fadama farmers[24].

The other critical issues to consider in the rice production system are the quality difference between locally produced rice and imported rice as well as the recent increase in world price

[23] While the OLAM/USAID manual slates 3.6 MT/ha as the yield, discussion with OLAM management revealed that the yield over the last 3 years has varied averaging at about 3 tons.

24 Our calculations for OLAM are based on the OLAM manual's prescribed input use for their farmers (with current prices) and their other associated costs adjusted by the consumer price index to reflect changes in prices since 2006, when the manual was written.

for rice. Currently, there is a large difference between locally produced rice and imported rice which reduces the substitutability of the two products. Given the already existing (or potential) comparative advantage in the production of rice, a smaller quality difference could increase substitutability of the two types of rice and increase the price for local rice. Apart from the 2008 hike in rice prices due to limited production in Australia and Bangladesh, rice prices (as with all cereals) have been on the increase in recent years ranging between $500 and $630 per ton since January 2009 (Mundi index 2009). Not only does this increase national incentive to produce the commodity locally to reduce import bills but also creates opportunity for the substitution from imported rice to local rice, if the quality of local rice was improved. To achieve this, increased attention is needed to develop strategies to ensure farmer yields can be increased. Methods to increase rural farmer access to affordable credit and timely access to inputs with particular attention to gender specific constraints are necessary Also needed is proper training on appropriate crop management techniques associated with improved rice varieties as well as their harvesting and post harvesting to increase competitiveness between local and imported varieties. This requires not only increasing farmer access to gender sensitive extension services but ensuring that extension agents are themselves well trained and equipped to handle the different crop management techniques associated with the different rice varieties being introduced in their region of the country.

Maize

The PAM analysis reveals that Nigeria does not have comparative advantage in the production of maize for export given the current world price, farmer yields, and particularly due to the high transportation costs. At world price of about $170/ton[25] and current transportation costs of about N90,000/ton which translates to over $600/ton, it is not viable for farmers to export the commodity. Even if farmer yields doubled to 10 tons/ha which is above world average, farmers in Kaduna State would still not be able to make a profit as the farm gate price necessary to cover the high transportation costs would still be too low. Only, if transportation costs were cut drastically, production costs significantly reduced, and higher yields gotten could we possibly begin to see some positive profits. However, as an import substitute, the PAM analysis reveals that consumers (the local populace, the large feed industry that consumes more than 50 percent of domestic production, and breweries) could benefit from lower prices that would be possible in the absence of higher priced imports competing with locally produced maize.

Overview of Maize Production for Domestic Consumption and Export in Nigeria

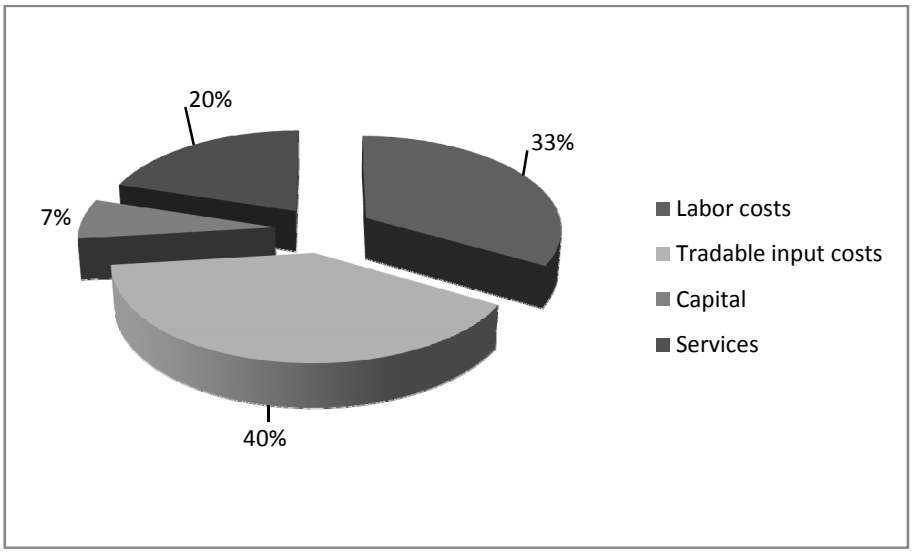
The main source of data was from a survey of 50 randomly selected farmers from each of Saminaka and Buruku Local Government Areas of Kaduna State, Nigeria. As with Niger and Ogun States, Kaduna was selected because of its high potential in maize production. Kaduna State was a participant in the Sasakawa Global 2000 initiative in the early 1990's which increased participant farmer maize yields by 3.8 t/ha (SAA 2006). Again farmers in this state, while representative of the potential of the country do not reflect the average maize farmer in Nigeria. Kaduna farmers appear to be ahead in the national move to double maize yields already recording about 2.3 tons/hectare on average compared to the national yield of 1.5 tons.

Interestingly it appears that this high yield of Kaduna farmers is driven by their significant investment in fertilizer and other inputs. Looking at Figure 20, it can be seen that the largest fraction of production costs for maize farmers in Kaduna goes towards tradable inputs,

[25] We use the yearly average between October 2008 and September 2009 gotten from the mundi index. http://www.indexmundi.com/commodities/?commodity=corn&months=12.

mostly chemical fertilizers (NPK and Urea) and then other herbicides and pesticides. Forty percent of maize production costs go to fertilizer and chemicals while only about 30 percent goes to labor compared to about 75 percent in the case of cassava. Like the cassava market, there are minimal distortions in the maize market currently with the largest being the import subsidy on chemical fertilizers which happens to be significant in Kaduna State where farmers receive an additional 17 percent from the state government in addition to the 25 percent national subsidy.

Figure 21. Maize production cost shares in Kaduna State, Nigeria



Source: Generated by author from PAM model.

The issue of fertilizer subsidy is an important one in Nigeria because while a wide discrepancy was seen in the price data in our sample, revealing farmers who were beneficiaries of the subsidy and those who were not, it is generally accepted that only about 10 percent of farmers actually get the subsidized fertilizer. Given that the focus of the analysis is on comparative advantage and thus social values, the existence of comparative advantage is evident showing that maize production would still be profitable without the current 25 percent fertilizer subsidy. However, given the significant proportion of production costs that are attributed to chemical fertilizers and the value of the subsidy of about 42 percent, the effect on private profitability and rural household welfare relative to the cost of the subsidy borne by the government, while beyond the scope of this study, is important for welfare implications of removing the subsidy or increasing the number of beneficiaries.

Though similar to the case where Fadama rice farmers had higher yields than non-fadama rice producers, yields of Fadama farmers in Kaduna State are about double those of the non-fadama farmers at 5.23 tons/ha and 2.58, respectively. Interestingly, input use is also much higher for fadama farmers. While fadama farmers on average use about 8 bags of NPK per hectare of land, non-fadama farmers only use about 4 bags. This reveals that not only is higher fertilizer use associated with higher yields but having access to productive assets and extension as provided to fadama participants is positively associated with both of these (that is input use and yields).

As with rice, the PAM analysis traces back the farm gate price for maize grain for farmers in Kaduna from the import price of maize in Lagos. Reconciling these prices indicates an appropriate accounting of the different parts of the maize value chain. It starts with the CIF[26] price of maize imported into Nigeria at Lagos[27.] It then incorporates the necessary transportation costs to get the maize from the port to the domestic market, which in our case is Abuja, about 880km away.

Our PAM analysis shows that for the representative farmer in Kaduna State, who is not a participant in fadama, the unit cost of production is about N28/kg28. For fadama farmers, their higher yields translates to a per unit cost of only about N17/kg. In either case, farmers can cover their production costs with a price around N30/kg. However, the average price being received by farmers in our sample is about N50 at the local market and the NAMIS price in Kaduna urban market in Kaduna city is between N75 and N80. While this N30 (N50) difference in price between farm gate price (production cost) reflects trader margins and transportation costs (farm gate to market), it also reflects demand pressure for grain to meet its various national uses and the higher price of imported maize whose value after transportation from Lagos to Abuja cannot be less than about N81, by our PAM analysis and confirmed by the urban market price of between N75 and N80.

Divergences in Maize Production

The sources of divergence in maize production are the same as those discussed under cassava and maize. These are the import subsidy on chemical fertilizer, the slightly over valued, and the incorporation of the distinction between the private and social interest rates indicating credit constraints farmers face. The distinguishing factor about maize is that while it does not enjoy the export subsidy available to cassava chip exporters nor an import duty on competing maize imported into the country, the divergence between social and private profits is significantly larger than in the case of cassava for domestic production because of the large proportion of production costs accounted for by imported chemical fertilizers.

Policy Options

Though farmers in Kaduna State do not completely reflect the plight of the diverse group of maize producers in the entire nation, maize production in Kaduna State is quite impressive with farmers on average already exhibiting double the often cited national yield of about 1.5 tons/hectare. The main issue in the maize production system relates to harnessing the sector's full potential and bringing farmers across the nation to the productivity levels of the Kaduna farmers and possibly beyond. However, even within the Kaduna farmers, we can see that there is still room for improvement. This is evident when we disaggregate input use, yields, and consequent social profitability of fadama and non-fadama farmers as well as when we disaggregate farmers along improved seed usage.

While the positive social profits shown in Tables 19 reveal that Nigerian farmers have the comparative advantage in the production of maize, the yield gap between Fadama farmers and non-fadama farmers and consequent profitability shown in Tables 20 and 21 reveal that farmers who have access to various inputs and complementary productive assets are able to enjoy much higher private and social profits. The social profits of fadama farmers are almost three times larger than their non-fadama counterparts at about N296,000 versus N102,000 per hectare. This is also shown by the much lower SCB for fadama farmers relative to non-

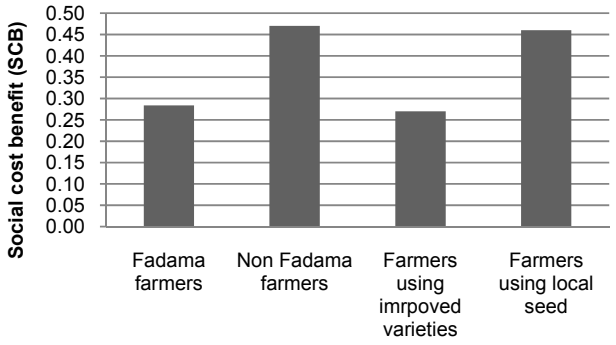
[26] CIF refers to the cost insurance freight price which is basically the import price.

[27] The Nigeria export promotion council world commodity list for June 2009 puts the import price at between $164 and $184 while recognizing local price in Jos as N63,000 which amounts to about $425 dollars.

[28] This is gotten by dividing the total production cost by the yield of 2.5 tons.

fadama farmers in Figure 22. Similarly Table 28 shows that farmers using improved maize varieties have about double the yield of those who do not use improved seed. While there is not much difference between labor days used, there is some difference in the amount of complementary inputs used by these farmers. Farmers using improved seed tend to use about 120Kg more NPK than their counterparts who use local seeds. Tables 27 and 28 reveal that farmers using improved varieties have more than twice the social profits than those who use local varieties. Figure 22 shows the difference in SCB ratios for different groups of farmers, clearly revealing that fadama farmers and farmers using improved varieties[29] have lower SCB ratios than non-fadama farmers and those using local varieties. Thus we can see that by increasing farmer access to and proper use of inputs like chemical fertilizers and other complementary productive assets (tractors, pumps, and credit) there is a clear opportunity to increase the nation's self-sufficiency in maize production in a manner that benefits all participants including farmers, local consumers, and the government. This is especially important with the general rise in cereal prices due to increased global demand fueled in part by increased demand for meat in parts of Asia and the competition for cereals like corn in the current 'fuel for food crisis.'

Figure 22. Social cost benefit ratio of maize producers in Kaduna State



Source: Generated by author from PAM model.

Another significant cost associated with the production and marketing of maize, as with rice and cassava in Nigeria, is high transaction costs largely due to poor road networks and an inefficient transportation system generally. Poor road infrastructure in Nigeria is a well known problem and improving market access for farmers as well as general movement across the nation would significantly reduce transportation costs and increase the efficiency of the maize production and marketing systems.

Conclusions

The PAM analysis suggests that Nigerian cassava growers with yield of about 15.7 tons/ha do not have comparative advantage in the production of cassava chips for export. This is partially due to the low world price of cassava chips, but also driven by inefficiencies in the cassava production and distribution system. However, local and regional demand for cassava for the production of cassava-based products creates a current viable market for cassava tubers to feed mills and other agro-allied industries with cassava as a major input. Major hindrances to the profitability of cassava to small-scale farmers include high transportation costs, high labor costs, and higher per unit costs due to lower yields. For Nigerian farmers to enjoy comparative advantage in the production of cassava, efforts are

[29] We acknowledge that there is an overlap in these two groups (Fadama farmers and those using improved seeds) further strengthening the argument that access to inputs, productive assets, and training partially explain this gap yield.

necessary to increase yields as well as lower production costs. This will increase the efficiency of cassava production and processing to chips, as even with the current government policy to subsidize the export of cassava products, farmers with average production of 15.7 tons/ha do not have comparative advantage in production of cassava for chips for export. There is a wide variety in cassava chip price due to variability in quality. If Nigerian cassava chips can attract a higher export price or if the current going price of $200/ton increases due to rising global demand for cassava chips, Nigerian farmers near Lagos will have comparative advantage in the production of cassava for chip export. Addressing transportation cost issues would be another way to expand the pool of farmers that can take advantage of higher global prices or with higher yields enjoy comparative advantage in cassava production.

For rice production in Nigeria, the PAM analysis finds positive social profits for farmers with an average yield of 2.5 tons/ha who apply average (but not the most efficient) input use and other agronomic practices. These farmers are assumed to have minimal amount of mixed grains in their paddy and there rice to have been parboiled appropriately with about 0.25 quality differential with the imported rice. The PAM analysis finds that there is immense potential in the Nigerian rice production system which can be harnessed through increasing farmer use of improved varieties, chemical fertilizers, and herbicides. Training farmers on appropriate practices associated with the production of high quality paddy that can produce milled rice competitive with imported rice is a major need identified. The PAM analysis finds that farmers with guaranteed input and output markets, as well as the necessary training, produced paddy rice with minimum mixed grain, generated much higher yields (more than 2 times the national average yield), and are socially profitable. The potential for rice to contribute to national growth is clearly evident from the PAM results. Even if current high rice prices are not maintained, Nigeria still has much to gain from higher productivity in rice production, given its large rice importation costs as well as the costs to consumers from higher rice prices due to government policy.

While Nigeria does not have comparative advantage in the production of maize for export at the current world price due to low farmer yields and particularly due to the high transportation costs, its role as an import substitute or good for national sufficiency and food security is clearly revealed. Importing maize only leads to higher local prices of the commodity, increasing production costs for the industries to which it serves as an input and also for local maize consumers. The PAM analysis reveals that consumers could benefit from lower prices that would be possible if maize yields could be increased and in the absence of higher priced imports competing with locally produced maize.

Generally, increased input use and proper management practices appear to be key bottlenecks faced by cassava, rice, and maize farmers in Nigeria. Proper extension services for management practices associated with new varieties could significantly increase yields and minimize wastage. It should be noted that while this analysis indicates that more intensive use of inputs such as fertilizer and chemicals might enhance the rice and maize systems, it does not identify fully the current constraints to fertilizer use. Cost, timely use, application, and timely availability are issues to be considered further. The PAM results imply that further research to understand and correct bottlenecks in the fertilizer distribution system could be very useful. The results also point strongly to the importance of addressing issues associated with grain quality in the rice system, as well as transportation and extension services for all systems. Simply improving the transportation infrastructure and effectiveness of extension would have multiplier effects across all crop systems. Findings indicate that further research on the harvesting and post-harvesting activities of cassava are very necessary to understand ways in which cassava can be efficiently harvested and converted into other forms, at minimum cost, in order to enable Nigerian farmers to be able to capture some of this added value and to be competitive in the production of cassava chips and other cassava based products.

References

Africa Research Bulletin (ARB). 2006. *Nigeria-South Africa: Trade Imbalance: Economic, Financial and Technical Series* 43 (10): 17139B–17140C.

Ahmed, Tahari. 9/6/2009.The death of cassava dream: Nasarawa lost millions of naira due to government induced cassava glut. *Sunday Trust Newspaper*. Retrieved from http://sunday.dailytrust.com/index.php?option=com_content&view=article&id=1169&catid=28&Itemid=29. Accessed November 13, 2009.

Akande, T. 2003. *An Overview of the Nigerian Rice Economy*. Unpublished Paper: The Nigerian Institute of Social and Economic Research (NISER) United States Department of Agriculture: International Database (USPSD), 2008.

Awoyemi,Taiwo and Adetola I. Adeoti. 2006. Gender inequalities and economic efficiency: New evidence from cassava-based farm holdings in rural south-western Nigeria. *African Development Review* 18(3): 428-443.

Anyanwu and Oyefusi. 1997. *The Structure of the Nigerian Economy (1960-1994)*. Onitsha, Nigeria: Joanee Educational Publishers Ltd.

Ayoola, J.B. 1999. *Economic Analysis of Women Entrepreneurship in Low-Income Households of Benue State, Nigeria.* Abubakar Tafawa Balewa University of Science and Technology Bauchi (PhD Thesis).

Ayoola, J.B. and G.B. Ayoola. 2000. Demand For Women Entrepreneurship in Low-income Households: Evidence from Benue State of Nigeria. *The Nigerian Journal of Economic and Social Studies* 42 (1): 113-120.

CIA Factbook. 2008. *Nigerian Economy.* Accessed at https://www.cia.gov/library/publications/the-world-factbook/index.html . Accessed September 13, 2010.

Ekpo, A.H. and O.J. Umoh. 2008. An Overview of the Nigerian Economic Growth and Development. Accessed at http://www.onlinenigeria.com/economics/?blurb=488. Accessed April 4, 2009.

Ezedinma et al. 2007. *Trends in Cassava production and Commercialization in Nigeria: A Baseline Report* (Preliminary draft, not for distribution).

FAOstat. 2008. Accessed at http://faostat.fao.org/default.aspx. Accessed April 5th, 2009.

FAO and World Bank. 2001. *Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World.* Rome: Food and Agriculture Organization.

Federal Ministry of Agricultural and Water Resources (FMAWR). 2008. *National Food Security Programme.*

Hawkins, K. E. 1958. Marketing Boards and Economic Global Insight. 2008. *IMF Review Finds Nigeria Surpassing Original Programme Goals Same Day Analysis.* Global Insight incorporated. Accessed at http://www.globalinsight.com/SDA/SDADetail10863.htm. Accessed September 5, 2009.

Development in Nigeria and Ghana. *The Review of Economic Studies* 26 (1): 51-62.

IITA 2007. *Doubling maize production in Nigeria in two years: Project description.* < http://www.iita.org/cms/details/agric_health_project_details.aspx?newsid=266&rid=66511&pg=o&activity=Agriculture%20and%20health&mainzoneid=64>. Accessed September 5, 2009.

International Monetary Fund. 2007. *Nigeria: Poverty Reduction Strategy Paper–Progress Report*. IMF Country Report No. 07/270.

Kwanashie, M., I. Ajilima, and A. Garba. 1998. *The Nigerian economy: Response of agriculture to adjustment policies.* AERC Research Paper 78 . Nairobi. African Economic Research Consortium.

NCEMA. 2008. *Structural Adjustment Programme in Nigeria: Causes, Processes and Outcomes.* Revised Technical Proposal.

Nigeria First. 2005. *Cassava initiatives in Nigeria. June 24, 2005*. < http://www.nigeriafirst.org/article_4301.shtml>. Accessed April 4, 2009.

Okonjo-Iweala , N. and K. Osafo. 2007. *Nigeria's Economic Reforms: Progress and Challenges*. Working paper Series # 6. Washington DC: The Brookings Institution .

Okoruwa V. O., A. M. Rahji and O. Ajani. 2007. *Rice and Maize Stratification Project in Nigeria: Draft Report.*

Oladapo, Olagoke. 2007. *Getting Agriculture Going in Nigeria: Commercial Agriculture in Nigeria: Prospects and Challenges*. African Development Bank. Annex 11.

Olaf Erenstein, Frederic Lançon, S.O. Akande, S.O. Titilola, G. Akpokodje, and O. Ogundele. 2003. *The Nigerian Rice Economy in a Competitive World: Constraints, Opportunities and Strategic Choices: A Report of the Final Technical Workshop Rice production systems in Nigeria. Abidjan. The West Africa Rice Development Association (WARDA)*.

Olusi, Janet. 1997. Enhancing Female Participation in African Agricultural Transformation: The Nigerian Experience, African Women in the Age of Transformation: Women's voices. *The Continent: A Journal of Opinion* 25(2). 12-15

Reuters. 2007. *Nigeria failed 2006 rice production target–growers*. Thursday July 12, 2007.

Ronchi, L. 2007. *Getting Agriculture Going in Nigeria: Statistical Overview of Nigeria's Agricultural Sector*. Washington, D.C.:World Bank.

Sasakawa Africa Association. 2006. *Country Profile: Nigeria*. < http://www.saa-tokyo.org/english/country/nigeria.shtml>. Accessed September 21, 2009.

Ukeje, E. 2006. Modernizing Small Holder Agriculture to Ensure Food Security and Gender Empowerment: Issues and Policy. Unpublished work of Emmanuel U. Ukeje, Central Bank, Nigeria.

USAID, FewsNet. 2006. *Trip Report: Northern Nigeria: Joint Food Supply Assessment Mission*. <http://www.fews.net/resources/gcontent/pdf/1001220.pdf>. Accessed April 4, 2009.

_____. 2007. *Bumper harvest leaves markets supplied, prices low*. Monthly Report for Nigeria covering the period Dec 2006 to 09 Apr 2007. <

http://www.alertnet.org/thenews/newsdesk/FEWS/18f8458475a7a22928d8632fbec0dc0a.htm>. Accessed April 4, 2009.

US Department of State (USDOS). 2009. *Background Note: Nigeria*. < http://www.state.gov/r/pa/ei/bgn/2836.htm>. Accessed September 6, 2009.

Walabai, E. 2005. *Gender Dimensions of Nigerian Agriculture*. Washington, D.C.: World Bank:

Walkenhorst, P. 2006. *Distortions to Agricultural Incentives in Nigeria. Agricultural*. Distortions Research Projec.t Munich Personal RePEc Archive Working Paper.Munich. Munich Personal RePEc Library

World Bank. 2006. *World Development Report 2006. Agricultural Inputs* <Table at http://devdata.worldbank.org/wdi2006/contents/Table3_2.htm>. Accessed April 9, 2008

_____. 2009. World Development Indicators Online (WDI) database. Accessed June 13, 2008. <http://devdata.worldbank.org/dataonline>.

_____. 2009. World Development Indicators Online (WDI) database. Accessed November 20, 2009. <http://devdata.worldbank.org/dataonline>.

Appendix 1. Tables

Table 1. Illustrative Policy Analysis Matrix

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	A	B	C	D
Social Prices	E	F	G	H
Divergences	I	J	K	L

Source: Generated by author.

Table 2. Summary of PAM results for cassava tuber production for local market—base scenario (yield of 15.7 tons/ha)

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	176,275.94	2,919.85	79,250.30	94,105.79
Social Prices	176,275.94	2,949.36	78,896.66	94,429.91
Divergences	0.00	-29.52	353.64	-324.12

Source: Generated by author.

Table 3. Summary of PAM results for cassava tuber production for local market for female-headed households

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	141,382.08	3,074.44	61,577.56	76,730.07
Social Prices	141,382.08	3,095.74	61,195.91	77,090.43
Divergences	0.00	-21.30	381.65	-360.35

Source: Generated by author.

Table 4. Summary of PAM results for cassava tuber production for domestic cassava chip market—base acenario (yield of about 15.7 tons/ha)

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	205,732.87	2,919.85	79,250.30	123,562.73
Social Prices	205,732.87	2,939.24	78,896.66	123,896.97
Divergences	0.00	-19.40	353.64	-334.24

Source: Generated by author.

Table 5. Summary of PAM results for cassava tuber production for domestic cassava chip market—with increased yield of about 30tons/ha

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	389,894.61	2,919.85	79,250.30	307,724.46
Social Prices	389,894.61	2,939.24	78,896.66	308,058.70
Divergences	0.00	-19.40	353.64	-334.24

Source: Generated by author.

Table 6. Summary of PAM results for cassava production for cassava chip export market—base scenario (yield of 15.7 tons/ha) and an export price of $200

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	61,451.40	2,919.85	79,250.30	-20,718.74
Social Prices	27,354.43	2,949.36	78,896.66	-54,491.59
Divergences	34,096.97	-29.52	353.64	33,772.85

Source: Generated by author.

Table 7. Summary PAM results for cassava production for cassava chip export market at and an export price of $200 for female-headed households

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	50,554.95	3,074.44	61,577.56	-14,097.05
Social Prices	22,792.63	3,095.74	61,195.91	-41,499.02
Divergences	27,762.32	-21.30	381.65	27,401.97

Source: Generated by author.

Table 8. Summary of PAM results for cassava production for cassava chip export market—base scenario (yield of 15.7 tons/ha) and an export price of $300

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	137,074.57	2,919.85	79,250.30	54,904.43
Social Prices	85,929.11	2,949.36	78,896.66	4,083.09
Divergences	51,145.46	-29.52	353.64	50,821.34

Source: Generated by author.

Table 9. Summary of PAM results for cassava production for cassava chip export market for an export price of $300 for female-headed households

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	235,275.89	3,074.44	61,577.56	170,623.89
Social Prices	165,870.08	3,095.74	61,195.91	101,578.43
Divergences	69,405.81	-21.30	381.65	69,045.46

Source: Generated by author.

Table 10. Summary of PAM results for cassava production for cassava chip export market—base scenario (yield of 15.7 tons/ha), an export price of $200, and based in Benue not Ogun State

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	0.00	2,919.85	79,250.30	-82,170.14
Social Prices	0.00	2,949.36	78,896.66	-81,846.02
Divergences	0.00	-29.52	353.64	-324.12

Source: Generated by author.

Note: At current global price, accounting for export price and transportation costs to the port, it would not be possible for farmers to charge a positive price

Table 11. Summary of PAM results for cassava production for cassava chip export market—base scenario (yield of 15.7 tons/ha), an export price of $500, and based in Benue not Ogun State

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	88,531.96	2,919.85	79,250.30	6,361.82
Social Prices	91,151.56	2,949.36	78,896.66	9,305.53
Divergences	-2,619.59	-29.52	353.64	-2,943.71

Source: Generated by author.

Table 12. Summary of PAM results for cassava production for cassava chip export market—base scenario (yield of 15.7 tons/ha), based in Benue with a 30 percent reduction in transportation costs with an export price of $350 and increased yield to 30 tons

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	87,152.03	2,919.85	79,250.30	4,981.89
Social Prices	-26,667.97	3,378.97	78,896.66	-108,943.60
Divergences	113,820.00	-459.13	353.64	113,925.49

Source: Generated by author.

Table 13. Summary of PAM results for cassava production for cassava chip export market—base scenario (yield of 15.7 tons/ha), based in Benue with a 90 percent reduced TP with an export price of $200 and increased yield to 35 tons

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	168,892.96	2,919.85	79,250.30	86,722.82
Social Prices	93,012.96	2,949.36	78,896.66	11,166.94
Divergences	75,880.00	-29.52	353.64	75,555.88

Source: Generated by author.

Table 14. PAM results for cassava production for cassava chip export with 25 percent reduction in labor costs at FOB price $200

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	61,451.40	2,919.85	65,348.24	-6,816.68
Social Prices	27,354.43	2,949.36	65,000.23	-40,595.16
Divergences	34,096.97	-29.52	348.01	33,778.48

Source: Generated by author.

Table 15. PAM results for cassava production for cassava chip export with 25 percent reduction in labor costs at FOB price $200

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	116,816.91	2,919.85	65,348.24	48,548.83
Social Prices	82,719.94	2,949.36	65,000.23	14,770.35
Divergences	34,096.97	-29.52	348.01	33,778.48

Source: Generated by author.

Table 16. PAM results for cassava production for cassava chip export in Ogun State with 25 percent reduction in labor costs at FOB price $300

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	137,074.57	13,233.35	67,965.75	55,875.47
Social Prices	85,929.11	13,334.32	67,562.40	5,032.39
Divergences	51,145.46	-100.97	403.35	50,843.08

Source: Generated by author.

Table 17. PAM Results for representative rice farmers in Niger State with average yield of about 2.3 tons/ha

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	140,772.80	27,695.28	33,298.73	79,778.79
Social Prices	78,213.18	40,999.41	33,132.59	4,081.18
Divergences	62,559.62	-13,304.13	166.15	75,697.61

Source: Generated by author.

Table 18. PAM results for rice farmers in Niger State who do not participate in the Fadama Project with average yield of about 2 tons/ha

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	125,211.10	18,533.60	30,603.08	76,074.42
Social Prices	69,567.12	25,388.98	30,444.25	13,733.89
Divergences	55,643.98	-6,855.38	158.83	62,340.53

Source: Generated by author.

Table 19. PAM results for rice farmers in Niger State who participate in the Fadama Project with average yield of about 2.5 tons/ha

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	156,334.50	22,830.57	36,293.83	97,210.10
Social Prices	86,859.24	31,028.67	36,127.92	19,702.65
Divergences	69,475.26	-8,198.09	165.91	77,507.44

Source: Generated by author.

Table 20. PAM results for rice production by OLAM farmers

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	223,164.00	30,894.97	37,131.37	155,137.66
Social Prices	123,989.63	43,695.02	37,103.84	43,190.77
Divergences	99,174.38	-12,800.05	27.54	111,946.89

Source: Generated by author.

Table 21. PAM results for rice production for farmers using improved variety

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	158,994.43	18,416.60	28,676.91	111,900.92
Social Prices	88,337.10	25,522.04	28,510.01	34,305.05
Divergences	70,657.33	-7,105.44	166.90	77,595.87

Source: Generated by author.

Table 22. PAM results for rice production for farmers not using improved variety

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	131,396.70	21,035.70	36,286.86	74,074.14
Social Prices	73,003.84	29,197.02	36,113.64	7,693.18
Divergences	58,392.87	-8,161.32	173.22	66,380.96

Source: Generated by author.

Table 23. Mean crop yield by farmer type (kg/hectare)

Farmer type	Maize	Rice
Fadama	5,226.47	2,521.93
Non Fadama	2,327.63	2,019.86
Local Variety	2,875.23	2,119.64
Improved variety	5,203.38	2,564.84

Source: Generated by author.

Table 24. PAM results for representative maize farmer in Kaduna State for domestic market

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	204,230.25	34,283.95	43,891.79	126,054.51
Social Prices	204,784.06	53,815.47	43,528.61	107,439.99
Divergences	-553.82	-19,531.52	363.19	18,614.52

Source: Generated by author.

Table 25. PAM results for fadama maize farmers with about 5.2 tons/ha

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	407,664.71	42,265.85	46,798.89	318,599.97
Social Prices	408,559.35	66,545.58	46,502.87	295,510.90
Divergences	-894.64	-24,279.73	296.03	23,089.07

Source: Generated by author.

Table 26. PAM results for non-fadama maize farmers with about 2.5 tons/ha

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	187,816.20	28,257.30	43,449.47	116,109.42
Social Prices	188,236.33	43,232.29	43,088.90	101,915.14
Divergences	-420.13	-14,974.99	360.57	14,194.29

Source: Generated by author.

Table 27. PAM results for maize farmers using improved varieties

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	406,087.74	39,161.15	47,296.89	319,629.69
Social Prices	406,978.43	61,982.04	46,921.05	298,075.33
Divergences	-890.69	-22,820.89	375.85	21,554.36

Source: Generated by author.

Table 28. PAM results for maize farmers using local varieties

Naira /Hectare	Revenue	Costs of tradable inputs	Cost of domestic factors	Profits
Private Prices	209,017.16	28,612.94	38,240.83	142,163.39
Social Prices	209,484.72	45,479.79	37,965.98	126,038.96
Divergences	-467.56	-16,866.85	274.85	16,124.43

Source: Generated by author.

Appendix 2. Sample budget of cassava production for domestic market in Ogun State

Commodity:	Cassava
Production System:	Mixed cropping
Location:	Ogun State
Condition: using recommended inputs	Average fertility soil with adequate agronomic

INPUTS	Units of Measure/HA	Quantity (in units/HA)	Market Price N Per Unit	Market Value N Per Unit	Market Value N Per Unit
TRADABLES					
				0.00	
FERTILIZER				0.00	
NPK (15,15,15)	(Kg/Ha)	0.45	62.00	27.68	
Urea	(Kg/Ha)	0.00	80.00	0.00	
Chemicals (Pre emergence)	(Liters/HA)				
Chemicals (Post emergence)	(Liters/HA)	0.10	1,199.22	121.35	
Other (specify)	(Liters/HA)	0.00		0.00	
Other (specify)				0.00	
	Sub-Total (Tradables)				149.03
NON-TRADABLE FACTORS :					
LOCALLY SOURCED INPUTS					
Cassava root stems	(bundles per hectare)	41.49	258.93	10,742.60	
LABOR					

Land Clearing	(Mandays / Ha)	86.3	484.77	41,841.67	
Land Preparation	(Mandays / Ha)			0.00	
Planting	(Mandays / Ha)			0.00	
Applic. Manure	(Mandays / Ha)			0.00	
Fertilizer	(Mandays / Ha)			0.00	
Pesticide	(Mandays / Ha)			0.00	
Weeding/Hoeing	(Mandays / Ha)			0.00	
Irrigation	(Mandays / Ha)			0.00	
Harvest and processing	(Mandays / Ha)	25	400.00	9,964.29	
Threshing	(Mandays / Ha)			0.00	
Bagging	(Mandays / Ha)			0.00	
Other	(Mandays / Ha)			0.00	
Sub-total			111.22	0.00	62,548.56
Service type/cost-input procurement TP Costs	Per HA	1.00	6,550.51	6,550.51	
of which:					
Capital depreciation cost share		0.50			3,275.26
Labor cost share		0.30			1,965.15
Tradable (fuel and spares) cost share		0.20			1,310.10
sub-total (shares must add to one)		1.00			6,550.51
Others (harvesting implement and transport - LS) K	Per HA	1.00	7,303.57	7,303.57	
of which:					
Capital depreciation cost share		0.50			3,651.79
Labor cost share		0.30			2,191.07
Tradable (fuel and spares) cost share		0.20			1,460.71

Sub-total (shares must add to one)		1.00			7,303.57
TOTAL COSTS (excluding direct taxes)					82,170.14
TRADABLE COSTS					2,919.85
DOMESTIC FACTOR COSTS					79,250.30
OUTPUT :					
Cassava root tuber	(Kg/Ha)	15,727.39	11.000	173,475.94	
Stems	(No/Ha)	400.00	7.00	2,800.00	
TOTAL REVENUE PER HA					176,275.94
NET REVENUE PER HA					94,105.79