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Constraints to Increasing Agricultural Productivity in Nigeria: A Review

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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.

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List of Acronyms

ACGSF	Agricultural Credit Guarantee Scheme Fund
ADP	Agricultural Development Project
AfDB	African Development Bank
APSF	Agricultural Policy Support Facility
BEA	block extension agent
CAADP	Comprehensive Africa Agricultural Development Programme
CBN	Central Bank of Nigeria
CBO	Community-based organization
CEDP	Cassava Enterprise Development Projects in Africa
CIDRAP	Center for Infectious Disease Research and Policy
CMD	Cassava mosaic disease
CRIN	Cocoa Research Institute of Nigeria
DFRRI	Directorate of Food, Roads, and Rural Infrastructure
DRC	Democratic Republic of Congo
FACU	Federal Agricultural Coordinating Unit
FAO	Food and Agriculture Organization
FCT	Federal Capital Territory
FDA	Federal Department of Agriculture
FFB	Fresh fruit bunches
FGN	Federal Government of Nigeria
FMA	Federal Ministry of Agriculture
FMANR	Federal Ministry of Agriculture and Natural Resources
FMARD	Federal Ministry of Agriculture and Rural Development
GDP	gross domestic product
GLASOD	Global Assessment of Human-Induced Soil Degradation
GPS	grandparent stock
ha	hectare
HLR	highest lending rate
HV	hybrid variety
IAR	Institute for Agricultural Research
IAR+T	Institute for Agricultural Research and Training
ICP	integrated cassava project
IFAD	International Fund for Agricultural Development
IFDC	International Fertilizer Development Center
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
kg	kilogram
kg/ha	kilogram per hectare
LUA	Land Use Act
mil ha	million hectares
mm	millimeter
mt	metric ton
MTRM	monthly technology review meeting
NACB	Nigerian Agricultural and Cooperative Bank
NACRDB	Nigerian Agricultural Cooperative and Rural Development Bank
NAIS	Nigerian Agricultural Insurance Scheme
NAPRI	National Animal Production Research Institute
NARIs	National Agricultural Research Institutes
NARP	National Agricultural Research Project
NCA	National Council on Agriculture
NCRI	National Cereals Research Institute

NEPAD	New Partnership for African Development
NERICA	New Rice for Africa
NFDP	National Fadama Development Project
NIFFR	National Institute for Freshwater Fisheries Research
NIFOR	Nigerian Institute for Oil Palm Research
NNPC	Nigerian National Petroleum Corporation
NRCRI	National Root Crops Research Institute
NRICT	National Research Institute for Chemical Technology
NSPFS	National Special Programme for Food Security
NSPRI	Nigerian Stored Products Research Institute
NSS	National Seed Service
NSSP	Nigeria Strategy Support Program
NVRI	National Veterinary Research Institute
OFNL	Obasanjo Farms Nigeria Limited
OGADEP	Ogun State Agricultural Development Programme
OPV	open-pollinated variety
PCOL	Presidential Committee on Livestock
PCU	Projects Coordinating Unit
PIOC	Presidential Initiative on Cassava
PIOR	Presidential Initiative on Rice
PIVODEP	Presidential Initiative on Vegetable Oil Development
PLR	prime lending rate
PQS	Plant Quarantine Service
PRCU	Presidential Research and Communications Unit
PVS	participatory varietal selection
RBDAs	River Basin Development Authorities
R&D	research and development
R-box	rice box
RTEP	Roots and Tubers Expansion Programme
SAP	Structural Adjustment Programme
SDR	savings deposit rate
SFPF	stochastic frontier production function
SGRP	Strategic Grains Reserve Programme
SMEs	small and medium enterprises
SSA	Sub-Saharan Africa
T&V	training and visit system
t/ha	metric ton per hectare
UAES	Unified Agricultural Extension System
VODEP	Presidential Initiative on Vegetable Oil Development
WARDA	Africa Rice Center
WDR	World Development Report
WHO	World Health Organization
ZEA	zonal extension agent

Executive Summary

This paper reviews the constraints hindering growth of agricultural productivity in Nigeria by

- providing an overview of the policy environment that affects agricultural productivity,
- establishing how the policy environment affects productivity improvement, and
- proposing lessons relevant for future research and policymaking to promote productivity growth in Nigeria.

Agricultural Policy in Nigeria

To attain agricultural sector goals, several policies were formulated and implemented during the years following independence. Some macroeconomic and sectoral policies implemented from 1970 to 1985 promoted economic distortions. For example, domestic prices and exchange rates were largely dictated by the government, generating large deviation between them and their market-determined equivalents. Appreciation of exchange rates cheapened imports, hurt exports, implicitly taxed farmers' incomes, and subsidized consumers. Government also directly participated in the provision of many farm inputs and services, and in the production, processing, and marketing of farm commodities. The need to correct the resulting distortions to the Nigerian led to adoption of the Structural Adjustment Programme (SAP) of 1986.

After SAP was introduced, there was general improvement in agricultural production and external trade from 1986 to 1989. Thereafter, growth indices of agricultural production fluctuated between stagnation and decline, a situation blamed mainly on three policy reversals and inconsistencies. First, the devaluation of the naira led to higher domestic prices of imported goods, including farm inputs (principally agrochemicals and fertilizers). Thus, some subsidies were retained on fertilizers, the benefit of which went unintentionally to large-scale farmers. Second, neither the interest-rate nor the exchange-rate liberalization was implemented to its logical conclusion. As a result agriculture could not sustainably derive the inflow of credit that it so badly needed. Third, the agricultural trade reforms were interrupted by import and export restrictions or outright bans or both. All of these factors limited long-term private-investment decisions in agriculture.

Presidential Initiatives on Selected Agricultural Commodities

Presidential initiatives emerged out of government concern that the agricultural sector had diminished capacity to provide the nation's food and industrial raw materials and to generate foreign exchange. Presidential initiatives were announced to encourage the production of cassava, rice, vegetable oil, tree crops, livestock, and aquaculture products. For example, the Presidential Initiative on Cassava (PIOC), introduced in 2002, aimed to move Nigeria from mere dominance in tuber production to a competitive edge in industrial production of starch, chips, and flour. The Presidential Initiative on Rice (PIOR) aimed for national self-sufficiency in rice production by 2005, food security, and the ability to export by 2007.

It is not clear how commodities under the presidential initiatives were selected. However, there are apparent justifications for the commodities selected for presidential emphasis, especially in the cereals group. The three leading cereals in terms of production and area under cultivation are (in descending order) sorghum, millet, and maize. In Nigeria sorghum and millet are produced mainly for subsistence purposes. Significant importation is not required, especially if postharvest activities are efficient. Maize is still imported to some extent whenever its importation is not restricted. However, the amount of maize imported is much smaller than the amount of rice, perhaps justifying the national emphasis on the latter in the cereal group. Thus, it appears that part of the reason for the selection of the

presidential initiative commodities was to preserve or earn foreign exchange by promoting increased production of import-substitute or exportable commodities, as well as to promote value addition (for example, for cassava).

- Implementation of the various presidential commodity initiatives has suffered significant setbacks. For example, the Federal Department of Agriculture (FDA)/Federal Ministry of Agriculture and Rural Development (FMARD) cited (FDA/FMARD 2006) the following constraints to the implementation of the PIOC and PIOR:
- inadequate and untimely fund release by all tiers of government, the lack of funds to procure processing machinery and equipment, and the absence of state and local government implementation committees
- for the PIOC especially, external trade constraints including the absence of storage warehouses for processed cassava products, absence of railway systems for large-volume movement from inland locations to warehouses, and absence of designated and equipped ports for agricultural exports
- for the Presidential Initiative on Vegetable Oil Development (VODEP), aging and inefficient processing equipment, inability to install new processing equipment due to high offshore costs, high costs of production inputs and farm machinery, inability of local vegetable oil to compete with cheaper imported products, inadequate and untimely funding of the program, and delay in the certification of projects.

Constraints to Agricultural Productivity in Nigeria

Agriculture employs nearly three-quarters of Nigeria's work force, as is the case in most of sub-Saharan Africa (SSA). Agriculture is the principal source of food and livelihood in Nigeria, making it a critical component of programs that seek to reduce poverty and attain food security in Nigeria. Interest in changing agricultural productivity stems from the knowledge that income growth comes from productivity growth and savings-supported investment.

Agricultural productivity estimates for Nigeria showed a decline in productivity growth from the 1960s to the 1980s. Nigeria has witnessed strong economic growth in the past few years, averaging 8.8 percent real annual GDP growth from 2000 to 2007. However, the agriculture sector has lagged behind GDP growth, growing at 3.7 percent in 2007. Reviewing the production and postharvest constraints affecting agricultural productivity in Nigeria is an important step in formulating policies to reverse these trends in the future.

Sectorwide Agricultural Productivity Constraints in Nigeria

Poor Agricultural Pricing Policies

Fertilizer use is promoted mainly by the fertilizer subsidy policy in Nigeria. In spite of economic reforms in Nigeria, fertilizer subsidies have remained. There is renewed consideration of input subsidies, at least as a means to reduce attendant effects of market failures. Input subsidies were widely practiced in the 1960s through 1980s. The costs of subsidies became high and unsustainable.

Thus, subsidies have placed a high budgetary burden on the government in Nigeria. Also, the program has been targeted to those who may not need it the most, mainly large-scale farmers. Investments in core public benefits such as research and extension, which also aim to boost productivity, may suffer setbacks under sustained and high-input subsidy programs. However, there are no immediate data from which to draw a firm inference on this assertion for Nigeria. Most subsidies in Nigeria were expected to give way as reforms were embraced in the mid-1980s. However, elements of fertilizer subsidy have persisted within the Nigerian

agricultural economy. Indeed, the National Council on Agriculture (NCA), pronounced a 25 percent fertilizer subsidy for the 2008 production season. How effectively this subsidy was implemented is unclear.

Low Fertilizer Use

Improved crop varieties exist, but realization of yield potential requires a leap in the level of fertilizer use. As elsewhere in SSA, low fertilizer use is a serious constraint to agricultural productivity growth in Nigeria, where fertilizer use averages 10–15 kg/ha.

Between the late 1980s and mid-1990s, domestic fertilizer production as a percentage of the total supply varied from 46 to 60 percent. There has been no domestic production of fertilizers since the early 2000s because NAFCON, the dominant fertilizer producer in Nigeria, has been shut down.

Some issues affecting domestic supply of fertilizers include high transport costs from port to inland destinations, poor distribution infrastructure, absence of capital for private-sector participation in distribution, significant business risks facing fertilizer importers, and inconsistencies in government policies.

Poverty and Women's Limited Access to Inputs

For farmers, poverty can result in food insecurity, low productivity, and inability to afford yield-enhancing inputs. Women have relatively limited rights to farmland in spite of having a significant role in agricultural production in many parts of Nigeria. Women also have less access to extension services and credit. All these constraints limit their agricultural productivity.

In some areas in Nigeria, on-farm activities are left to women. In other places, women engage mainly in cooking and caring for children. To better appreciate women's roles and to estimate their farm labor productivity, diverse roles must be accounted for. Failure to do so may underestimate women's agricultural labor productivity.

Low Access to Agricultural Credit

Access to agricultural credit has been positively linked to agricultural productivity in several studies. Yet this vital input has eluded smallholder farmers in Nigeria. Cooperatives, friends, and family members dominate the sources of farm credit among the rural farmers surveyed in southwest Nigeria.

Banks with large loan funds are generally difficult to access. Issues of collateral and high interest rates screen out most rural smallholders.

Another problem associated with smallholder access to agricultural credit is that agricultural loans are often short term, with fixed repayment periods; this may not suit annual cropping, especially when loan release is not coordinated with growing cycles of crops. Short-term loans are also unsuitable for livestock production. For credit to be most effective, loan terms must flexibly relate to cash flows in the target business, the input demand/supply structure, and quantifiable business risks.

Low and Unstable Investment in Agricultural Research

Private-sector involvement in agricultural research has remained negligible to date. Low public expenditure on agricultural research has been associated with low growth in agricultural productivity elsewhere. Conversely, such investment can help explain eventual agricultural productivity growth.

When research is poorly funded, agricultural technologies cannot be improved, and there will be no downstream farm income increase, rural employment generation, reduction in food prices, establishment of agrobased industries, and economic growth. In short, the absence of new technologies in agriculture will slow the growth of agricultural productivity and the reduction of rural poverty.

Total public research and development (R&D) spending has not been stable since independence. It is believed, however, that the situation has improved since 2000 because of an increase in the salary structure and improvement in the nominal contribution of government to agricultural research.

The budget process for agricultural research funding in Nigeria is neither simple nor wholly transparent. The time between submission of planned budgets by research agencies and approval and release of funds is long and often out of sync with research work plans. Also, approved amounts and disbursement processes by government often fall far short of research agencies' planned budgets. Indeed, since the late 1990s, higher education and research agencies have been receiving both recurrent and capital budgets on a monthly basis, leaving virtually no space for long-term research investment. Apart from making research planning impossible, this has tended to delay or prolong the completion of laboratory-based graduate programs because neither the faculties nor the students have access to adequate and sustained research funds.

Poor Funding and Coordination of Agricultural Extension

Specific constraints identified in the implementation of the training and visit (T&V) system in Nigeria included bureaucratic procedures, and location of crop and livestock extension staff in different departments and ministries, which tended to promote rivalry and duplication of resources. Related to these issues was the fact that the extension system was implemented with a huge bias in favor of cropping activities.

In 1992, the NCA approved the adoption of a Unified Agricultural Extension System (UAES) to ensure a single line of command and delivery of unified extension messages to farmers. The implementation of this laudable extension system remains hampered by poor funding, as most of the state Agricultural Development Projects (ADPs) stopped functioning after the cessation of World Bank funding.

There is some evidence that previous funding of agricultural extension activities had beneficial spillover effects on adoption of farm technologies. Available estimates of adoption rates appear to be satisfactory for a wide array of farm technologies, even after the implementation years of the ADP system. Indeed, adoption may have been constrained more by the inability to purchase improved inputs than by factors related to the extension system itself.

Land Tenure System and Land Degradation

The communal system of land ownership prevails among most ethnic groups in the south, in which individual ownership of land is embedded in group or kinship ownership.

Communal ownership of land in Nigeria has been associated with such problems as limited tenure security, restrictions on farmers' mobility, and the inevitable fragmentation of holdings among future heirs. In addition, group ownership restricts access rights of community members outside the owning group, a situation that limits the use of land as collateral for agricultural credit. But communal ownership has also been credited with preserving traditional land use practices such as bush fallowing, which has helped retard problems of land degradation.

Restrictions on land sales impede the use of land as collateral, thereby hindering development of the rural credit market. Communal land ownership is a disincentive to the improvement of land quality and long-term investment in land management. Inheritance leads to land fragmentation among future heirs, and subsequent uneconomic farm sizes per member.

Subdivision of holdings among household members prevails as a consequence of the inheritance system. But the size of farms per capita depends ultimately on population pressure, the amount of land available to each household, and the specifics of the inheritance law in each community.

An important institutional constraint is absence of clear title to land. This may limit access to formal credit since the farmer cannot use land as collateral. It also reduces incentives to invest in land-quality maintenance and improvement. Because poor farmers cannot afford alternative farmlands, or have no access to lands not inherited, they remain on depleted lands and further degrade resources. Thus, poverty and custom may constrain farmers' ability and willingness to mitigate land degradation, leading to declining productivity.

Poor Market Access and Marketing Efficiency

Limited or poor-quality roads and rail transportation inhibit timely access to inputs, increase costs of inputs, and decrease access to output markets. Thus, investment in infrastructure contributes to agricultural productivity.

The bulky nature of primary produce has discouraged production because rural farmers have limited access to markets and good feeder roads. Economic reforms in Nigeria have led to increased private-sector participation in the supply of most purchased inputs in Nigeria, but most suppliers are based in urban areas. End users of the inputs are in rural areas, which are poorly linked to urban suppliers. Transaction costs of inputs increase delivery costs to rural farmers. However, given the prevailing poor marketing infrastructure and the attendant high transaction costs, fertilizer subsidies in Nigeria may not be effective at this time.

Agricultural marketing efficiency in Nigeria is dismally low. Transportation costs are high. Road conditions are poor, which limits access to purchased inputs, credit, and output markets, and reduces the transmission of market signals. Increased access to output markets would likely generate demand for conventional inputs. High transport costs are significant constraints to agricultural productivity, reflecting the poor state of rural transport infrastructure in the study areas.

Commodity-Specific Constraints

Cassava Constraints

Several production and post-harvest constraints have limited cassava's contribution to agricultural growth overall. A total of 17 cassava varieties have been released in Nigeria (FDA/FMARD 2005). Most of the varieties released have multiplication problems. Outgrowers are often denied good prices for cassava tubers at the end of the growing season, which discourages cultivation. And while some of the varieties are high yielding, they score low on other parameters such as early maturity or resistance to drought, pests, and disease.

On-farm costs of cassava production are still very high at the small-scale level in Nigeria. It is estimated that the cost of managing 1 ha of cassava farm from land preparation to

harvesting is about ₦70,000, if all recommended practices and input levels are followed. This translates into about US$583[1] per ha.

Agrochemicals are important in cassava production for the control of cassava mosaic virus, bacterial blights, and anthracnose, among other diseases. But agrochemicals often must be imported, and at a prohibitive cost. As a result, fertilizers and insecticides are rarely applied to recommended levels. Because cassava is known to respond to a lower application of fertilizers than crops such as maize and rice, farmers are more likely to allocate their limited budgets for costly fertilizers away from cassava and toward more fertilizer-intensive crops. The major variable costs are cassava cuttings and herbicides.

Cassava processors face a number of challenges. Medium- to large-scale processors face problems such as inadequate equipment and fabricators. All processors must routinely deal with unstable market conditions, unstable government trade policies, and difficulty sustaining the supply of cassava.

Maize Constraints

Year-round grain availability is low in Nigeria owing to a combination of low productivity and high post-harvest losses. Efforts to increase maize production through maize seed multiplication are channeled through an outgrower scheme being implemented by state and local extension units, the Agriculture Development Projects (ADPs). The ADPs often assist the outgrowers by providing fertilizers and other production inputs. However, this scheme is constantly threatened by fertilizer shortages and lack of protection for the outgrowers. Fertilizers claim the largest share of maize production costs; this is not surprising given the core role of fertilizers in the yield enhancement of improved varieties of maize.

Increasing the availability of food requires much more than just increasing on-farm production. There must be concerted effort to improve processing, storage, and distribution of maize. Most of the maize processing in Nigeria is still carried out at the cottage level by individual small-scale processors and their cooperative societies. The National Agricultural Research Institutes (NARIs) have made considerable progress in the development of agroprocessing equipment. But progress toward commercialization and multiplication has been slow. The NARIs have no explicit mandate to multiply or commercialize the machines and equipment they develop. The small and medium enterprises (SMEs) that are expected to fulfill these roles are themselves constrained by poor awareness about the existing on-shelf technologies, poor capital base, and low capacity to compete with foreign (imported) substitutes.

Formal credit still eludes many traders who engage in maize storage. Storage is funded either by the traders themselves or, to some extent, by the cooperatives they belong to. The lack of adequate funding for storage activities leads to short-duration maize storage. An estimated 10 percent of the total production of grains are lost or wasted annually through poor storage or lack of storage.

The cost per ton[2] of stored grains has been found to decline with quantity stored. But liquidity constraints may limit traders' ability to achieve the full benefit of scale economies. Because farm-level grain storage may not deliver the benefits of large-scale storage, the government has put in place large storage structures in various parts of the country. Lack of funding has slowed completion of silos and limited the full use of completed ones. Also, farmers have no direct access to government silos.

[1] All dollar figures are US$, unless otherwise noted.
[2] Tons are metric tons throughout the text.

Rice Constraints

Maize and rice seed multiplications are done by the ADPs through outgrower schemes. In one study, seed and fertilizer together accounted for 32 percent of the total variable costs per ha, while labor for fertilizer application, weeding, land clearing, planting, bird scaring, and harvesting accounted for 62 percent of the variable costs.

The rice sector faces several post-harvest constraints. Powered paddy processing is still limited in many producing areas in Nigeria. Due to credit constraints, usually no more than two threshing machines are available in rural producing communities, even in communities with electricity.

Many farmers sell their paddy unprocessed, which results in poor quality and low farm gate prices. Where accessibility is an added problem (for example, in isolated markets), farmers must accept a further cut in the farm gate price from rural assemblers or wholesalers, or both.

Attempts have been made to set up urban rice mills in some northern states. One common feature of these and other large-scale mills is that they are barely operational due to lack of spare parts. This shortage is caused in part by increasingly scarce foreign exchange available to local processors.

Rice storage at the farm level is still small in scale and based on traditional uneconomic methods. Rice storage functions are mainly performed by grain traders within the cereals marketing chain. As with maize, the lack of adequate funding leads to short-duration rice storage.

Major Constraints to Livestock Production

According to a 2003 report of the Presidential Committee on Livestock (PCOL 2003), the constraints to livestock production in Nigeria can be broadly summarized to include "biological limitations of the indigenous breeds of animals; seasonal availability of production inputs such as feed, water, and good quality pasture; and lack of effective veterinary services and availability of vaccines and veterinary drugs at reasonable costs." This review looks specifically at six major livestock constraints: animal feeds and nutrition, animal breeding, processing and marketing, veterinary services, grazing reserves and stock routes, and trade policy.

Animal feeds constitute at least 60 percent of the total variable costs of livestock production in Nigeria. Monogastric animals such as pigs and poultry depend on compound feeds, which are affected by the availability and quality of the constituent raw materials. The ruminants feed mainly on forages and crop residues, which are affected by seasonality. Ruminants experience seasonal weight fluctuation during the wet and dry periods of the year.

About 90 percent of the national livestock herd are under traditional management for breeding. Thus, genetic factors seriously limit livestock productivity in Nigeria. Complete absence of grandparent stock (GPS) affects productivity, especially of the poultry subsector. A related problem is the collapse throughout the entire country of the breeding and multiplication programs for livestock. Furthermore, while the breeding programs were still active, there was little or no recordkeeping as a basis for breed selection.

Livestock marketing in Nigeria has traditionally taken the form of movement of animals (mainly cattle, sheep, and goats) from the livestock-producing areas, mainly in the north, to the southern terminal markets. Livestock marketing and processing constraints in Nigeria include poor packaging facilities for products in the value chains, lack of cold storage

facilities in abattoirs at wholesale and retail markets, and absence of standards for meat and other livestock and poultry products.

Public veterinary services have declined over time in Nigeria. Livestock diseases account for 30 to 40 percent of losses in productivity of animals in Nigeria.

Transhumant pastoralists own over 85 percent of the ruminant population in Nigeria. The pastoral system relies on natural rangeland for ruminant feeding. Increased cropping activities have reduced the available water and grazing resources, leading to conflicts among pastoralists, fishermen, and farmers.

Nigerian livestock trade policies have constrained production. The poultry industry has experienced productivity and marketing problems for years. Until 2001, frozen broiler and turkey meats were imported at no more than half the price of locally produced equivalents. Thus, the industry, facing the problem of high production costs, found it difficult to compete with imported poultry products. Government has intervened since 2002 by selectively banning the importation of poultry products, principally frozen poultry meat. The intervention is partial: hatchable eggs still are imported because the country does not have a local source of GPS. Also, there is no ban on the importation of table eggs, probably because of the risks inherent in transporting eggs. Since the imposition of the import ban in 2002, year-round production has been relatively secured for the poultry industry. The only trace of glut subsequently occurs between late October and the end of November. The experience of poultry farms shows that previous gluts could not be erased even by product price reduction since production cost was already high. The ban has drastically reduced this problem because, in the absence of imported poultry items, a slight price reduction easily erases any glut experienced.

Conclusion

The major constraints to increasing agricultural productivity in Nigeria are as follows:

- direct participation of the government in the provision of many farm inputs and services, and in the production, processing, and marketing of farm commodities
- policy reversals and inconsistencies
- aging and inefficient processing equipment, and the inability to install new processing equipment due to high offshore costs
- high on-farm costs of agrochemicals for small-scale farmers, so these farmers rarely apply fertilizers and insecticides at recommended levels
- constant threats to seed multiplication schemes by fertilizer shortages and lack of protection for the outgrowers
- compounding of feeds, which are affected by the low availability and low quality of the constituent raw materials
- traditional management practices, which seriously limit crop and livestock productivity
- absence of GPS, which limits livestock productivity, especially in the poultry subsector
- collapse of breeding and multiplication programs for livestock
- fertilizer subsidies, which cause a high budgetary burden on the government, while the benefits of the subsidies go to more privileged farmers
- low fertilizer use
- low public expenditure on agricultural research
- negligible private-sector involvement in agricultural research
- inadequate funding of both T&V and UAES

- group ownership of land in Nigeria, which may lead to limited tenure security, restrictions on farmers' mobility, and the inevitable fragmentation of holdings among future heirs

Policy Recommendations

In order to ensure sustained and increased inflow of investment in agriculture, agricultural policies must endure and even outlive the government that formulated them. The practice of changing macroeconomic policies with successive federal governments is inimical to long-term investments in agriculture. The various tiers of government should act in concert with the economic reforms agenda, which entails promotion of greater private-sector roles in agricultural production, processing and marketing of farm commodities, as well as provision of farm inputs.

The common constraint to implementation of presidential initiatives is poor funding. The associated issues are poor planning and poor infrastructural support for the various presidential pronouncements. The key recommendation is institution of adequate and timely release of approved budgets so that projects do not remain mere good intentions on paper. There is a need to promote private-sector participation, especially by attracting foreign investors in local provision and production of needed machinery, equipment, and farm inputs. In the long run, expanded local production of these inputs will likely lead to reduced unit costs through scale economies. This ties to the need for a stable policy environment.

The practice of contract arrangements between outgrowers and private companies needs to be strengthened because it may be difficult to promote and enforce such contract details with any tier of government.

There is a need for government to support the NARIs by promoting awareness of the technology prototypes they have on the shelf. Linkage is needed among private agroprocessing SMEs, NARIs, and financial institutions (especially commercial banks) to develop the prototypes into commercial products.

Private ownership and operation of silos should be promoted alongside those of the federal government. This will help to both expand storage capacity nationally and relax the financial burden on the government. Since most of the community-level agroprocessing occurs through cooperative organizations, these agroprocessing cooperatives must be strengthened to ensure their ability and capacity to attract credit.

Regarding the constraints to increasing livestock productivity in Nigeria, the following recommendations of the PCOL (PCOL 2003) should be emphasized:

- increased capacity utilization in the Nigeria feed industry
- enhancement of feed quality and efficiency
- stronger emphasis on the feed inputs delivery system to smallholders
- improved use of agroindustrial byproducts and crop residues
- accelerated pasture seed production
- pasture improvement and rangeland rehabilitation
- development of the strategic feed reserve
- agroforestry development
- establishment of cattle, sheep, goat, and pig selective breeding centers and multiplication centers
- establishment of poultry breeding centers
- establishment of artificial insemination centers
- provision of market information services

- establishment of a poultry products processing program
- monitoring and enforcement of prescribed standards and laws for livestock and livestock products
- rehabilitation of existing abattoirs and milk processing plants, and establishment of new ones where necessary
- development of appropriate infrastructure at all levels of livestock marketing
- accelerated development of grazing reserves
- accelerated development of stock routes and grazing corridors
- settlement and empowerment of pastoralists

Fertilizer subsidy programs in Nigeria need to be market responsive. Specifically, input subsidy programs should be used to develop competitive private-sector-led input markets, not weaken them. Such programs should be targeted to poor farmers who, without subsidies, would not adopt key inputs. They should complement, not undermine, commercial sale outlets. They should be limited in duration—that is, accompanied from the start with a phase-out schedule.

Agricultural commodities in Nigeria need adequate pricing so that farm income will be high enough to enable farmers to purchase farm inputs. Adequate pricing must be accompanied by farmers' improved knowledge of the use of fertilizers and adequate linkages among traders, suppliers, and farmers. There is need to promote small-scale irrigation to reduce the risk associated with rainfall and to increase the profitability of investment in fertilizer adoption. Related to these is the need to develop domestic capacity for fertilizer production with active private-sector and government partnership.

The current drive toward improved access of women to farmland, extension services, and related farm inputs should be sustained, with the active support of local community-based organizations (CBOs) and international development agencies.

Loan terms must flexibly relate to cash flows in the target business, the input demand/supply structure, and computable business risks. The federal government's agricultural-credit-guarantee scheme, which seeks to guarantee various cadres of loans to farmers, needs to be strengthened in order to reawaken commercial banks' confidence in the scheme.

To achieve the desired impact of research funding on agricultural productivity in Nigeria, private investments in agricultural research and development must be encouraged. Also, greater transparency and timeliness are needed in the budgeting, approval, and fund-release processes of agricultural research. Whatever agricultural extension model is adopted, government's direct promotion and practice of extension delivery in Nigeria must be divested. Larger participation by the private sector will reduce the budgetary burden and improve delivery efficiency.

The Land Use Act of 1978, which was abused through arbitrary seizure of communal lands, should be reviewed. Communal ownership of farmland will be difficult to dismantle in the foreseeable future; however, its elements, which appear to differ among communities, need to be reviewed within the context of each community toward improved title of individuals to farmlands, bearing in mind the need for gender equity.

Finally, there is need for greater government investment in transportation infrastructure, especially rural-urban roads and markets. Improvement in road quality will attract private investment in transportation; improve access to purchased inputs, credits, and output markets; and enhance marketing efficiency.

Introduction

This review provides a broad overview of constraints to agricultural productivity growth in Nigeria as input to the Agricultural Policy Support Facility (APSF) initiative. It is essentially a synthesis of knowledge generated from past research activities in the country.

The review is motivated by the following factors:

- Poverty rates in Nigeria are high, about 54.4 percent in 2004 (NBS 2005), and agriculture remains a viable way to tackle the problem. The literature indicates that improved agricultural productivity is associated with reduced incidence of poverty (Thirtle et al. 2003).
- Agriculture constitutes the single largest contributor to the well-being of the rural poor, sustaining 90 percent and 70 percent of the rural and total labor force, respectively (IFAD 2001).
- The sector has the highest poverty incidence (67 percent) among all occupational groups.
- Food security depends on improved agricultural productivity as this ultimately leads to income growth.

The purpose of the review is to identify the constraints to increasing agricultural productivity in Nigeria. Specifically, the review is to

- provide an overview of the policy environment that affects agricultural productivity,
- establish how the policy environment affects productivity improvement, and
- propose recommendations for future productivity research and policymaking in Nigeria.

Agricultural Productivity Issues In Nigeria

This section is divided into two parts. The first part will provide an overview of the agricultural sector, post-independence agricultural policies, and current government initiatives addressing agricultural productivity constraints. The second part will discuss the constraints hindering agricultural productivity growth in Nigeria.

The Nigerian Agricultural Sector: Overview

Nigeria occupies a total area of 92.4 mil ha, consisting of 91.1 mil ha of land and 1.3 mil ha of water bodies. The agricultural area is 83.6 mil ha, which comprises arable land (33.8 percent), land permanently in crops (2.9 percent), forest or woods (13.0 percent), pasture (47.9 percent), and irrigable land or fadama[3] (2.4 percent) (Adetunji 2006). Average rainfall ranges from 300 mm in the extreme north to about 2,500 mm in the coastal areas. Nigeria's latest population estimate is 140 million, of which 65 percent live in rural areas. Agriculture's contribution to the non-oil gross domestic product (GDP) is stable at about 40 percent in recent years (FDA/FMARD 2005). More than 70 percent of the farming population in Nigeria consists of smallholder farmers, each of whom owns or cultivates less than 5 ha of farmland (NARP 1994). Thus, agriculture should be the focal point of national economic growth agenda and reforms.

The emergence of the petroleum sector in the early 1970s resulted in significant structural changes in the Nigeria economy. In response to the oil boom, public expenditures grew,

[3] "Fadama" is a local Hausa word for low-lying flood plains, usually with easily accessible shallow groundwater. Fadamas are waterlogged during the rainy season but retain moisture during the dry season.

fostering many other economic activities, including infrastructural development, creation of new institutions and expansion of existing ones, and importation of all kinds of consumer goods. The appreciation in the value of the naira (Dutch disease) favored these developments, but tradable agricultural commodities did not experience similar growth.

The share of the oil sector in the total value of exports, which was under 60 percent in 1970, rose to over 90 percent after 1973. The non-oil exports declined from about 30 percent in 1970 to less than 10 percent by 1980 (Ojo 1992). The unprecedented increase in public expenditure placed the Nigerian economy under severe inflationary pressure. The emergence of a dominant oil sector was accompanied by the gradual lessening of international competitiveness of the agricultural export subsector, arising from local currency appreciation, inadequate pricing policies (especially fixed producer prices relative to earnings from the world market), and the general neglect of the rural sector.

Oil export earnings collapsed in the early 1980s from a peak of $24.9 billion in 1980 to $5.2 billion in 1986 (Ojo 1992). The exchange-rate adjustments in many African countries, including Nigeria since the 1980s, were in response to widespread balance of payments problems and the consequent need to correct the seemingly intractable macroeconomic distortions. However, agriculture remained relevant to Nigeria's food and raw materials supplies, rural employment, and general price stability (Phillip 1996).

Agricultural Sector Policies in Nigeria

The roles of the Nigerian agricultural sector, according to the Nigerian Agricultural Policy document (FDA/MANR 1988, FDA/MARD 2001), include provision of food for the growing population, foreign exchange earnings, employing a significant part of the labor force, and providing income for farming households. To attain agricultural-sector goals, several policies were formulated and implemented during the post-independence years. Here we summarize some key policies to better understand their linkages to the productivity constraints identified later in this review.

From 1970–85, capital for agricultural production and post-harvest activities came mainly from the government's budgetary allocations and secondarily from existing lending institutions. However, as observed by Ojo and Akanji (1996), "from the first through the fourth National Development Plans, government spent less than 10 percent of its total capital expenditures on agriculture, which contributed more than 60 percent of the GDP." And, with the poorly developed capital markets, farmers' credit during the period came mostly from informal sources at prohibitive interest rates. Agricultural production, productivity, and post-harvest operations were low and little affected by improved technologies.

The main monetary policy instruments used before 1985 included selective credit controls, credit ceilings, and interest rate controls. Beginning in 1972, commercial and merchant banks were mandated to provide a prescribed minimum percentage of their total loans to agriculture. These mandatory credit allocations to agriculture have received mixed reviews. Babalola and Odoko (1996) noted that mandatory credit allocation was effective only to the extent that it provided some alternative to scarce and poorly developed sources of agricultural funds. The authors also argued that mandatory credit allocation is inconsistent with financial-sector reform and tends to promote credit misallocation. In their study, Balogun and Otu (1991) further noted that "both commercial and merchant banks consistently lent short of the prescribed limits under the credit allocation policy." This policy was abolished in late 1996.

Before the introduction of the Structural Adjustment Programme (SAP) in 1986, agricultural lending rates were largely concessional or subsidized. The 1970s witnessed very low interest rates that could not encourage the development of money or capital markets. No

lender was willing to raise money from existing capital markets and lend under the prevailing low lending rates. Inflation rates during those years were mostly in double digits per annum. Although lending rates for agricultural purposes were deregulated in 1987, the high rates of inflation that accompanied the macroeconomic reforms, in excess of 40 percent per year in the early- to mid-1990s (CBN 1998a), contributed to negative real agricultural lending rates. In short, the concessional lending rates to agriculture before the introduction of SAP and the prevailing high domestic inflation resulting from SAP sent mixed market signals to creditors during this period (CBN 1998b).

Most of Nigeria's non-oil exports historically come from agriculture. Thus, it was necessary to formulate specific policies that would ensure that the sector derived maximum benefit from SAP implementation. Under the rural credit scheme introduced in 1977 by the Central Bank of Nigeria (CBN), commercial banks were required to open rural branches. According to Usman (2000), virtually all the rural branches identified as viable were fully established by commercial banks by 1992.

Under the monetary policy of the 1990s, other guidelines included a loan repayment moratorium, smallholder loan guarantees, uncollateralized smallholder loan schemes, extension of repayment periods for certain export crops, and an increase in both minimum rural deposits and minimum rural credit (FMANR 1997). The fiscal policy guidelines allowed a five-year tax exemption on private-sector profits earned in any agricultural business (production, processing, or marketing). The exchange-rate policy guidelines allowed all voluntarily repatriated foreign-exchange earnings in the agricultural sector to be tariff-exempted (FMANR 1997). Under the trade policy, some agriculture-specific guidelines included the abolition of export prohibition, a ban on importing several agroindustrial raw materials to stimulate local production, and abolition of commodity boards to achieve more competitive pricing and higher farm incomes (FMANR 1997).

Evaluation of Agricultural Sector Policies and Reforms

In this subsection, we assess the presidential initiatives for selected agricultural commodities and the National Special Program on Food Security. The two programs were among government efforts targeted at increasing food production for self-sufficiency, food security and export.

Evaluation of Presidential Initiatives on Selected Agricultural Commodities

Presidential initiatives emerged out of government concern that the agricultural sector's ability to provide the nation's food, produce industrial raw materials, and generate foreign exchange had diminished. Presidential initiatives were announced to stimulate the production of cassava, rice, vegetable oil, tree crops, livestock, fisheries, and aquaculture (FDA/FMARD 2006). Table 1 shows the budgetary commitments to the various commodities under the presidential initiatives, along with the respective targets.

Presidential Initiative on Cassava (PIOC)

The PIOC was implemented in 2002. This initiative was aimed at moving Nigeria from its dominance in tuber production to gaining competitive edge in industrial production of starch, chips, and flour. The Presidential Research and Communications Unit (PRCU) writes, "The goal of the initiative is to promote cassava as a foreign exchange earner in Nigeria as well as satisfy national demand. The challenge of the initiative is to make Nigeria earn $5 billion from value added cassava exports by 2007 (PRCU 2006).

Before the PIOC was announced, more than 90 percent of harvested cassava was locally consumed as food. One key challenge today is to increase labor productivity and yield. The

challenge is to develop and disseminate adequate cassava planters, harvesters, peelers, hydraulic presses, and dryers. Such machines will add value, remove drudgery in production and processing, and make the cassava business more economically attractive. Cassava processing is being promoted to enhance the stability of market prices, add value to primary production, and help farmers earn higher income.

Table 1. Budgetary commitments to policies, strategies, and initiatives, Nigeria

Presidential initiative	Target	Estimated cost (3–5 yrs)	Amount allocated 2004	Amount allocated 2005
Rice	To increase rice production and export with a target of producing 6 million mt by 2005 and surplus for export by 2007	₦182.2 billion	₦100 million	₦31 million
Cassava	To increase cassava production and export with target earnings of $5 billion from cassava export in 3 years; specific target is to produce 150 million mt of cassava per annum by the end of 2006	₦65.5 billion	₦100 million	₦31 million
Vegetable oil development	To bridge the supply and demand shortfall of about 300,000 mt in order to attain self-sufficiency within 5 years. The crop-specific targets are: • Planting 1 million ha of oil palm for 15 million fresh fruit bunches (FFB) • 5 million mt of ground nuts • 678,000 mt of soybeans • 1 million mt of seed cotton from 1.25 million ha • Processing machine fabrication	₦50.8 billion	₦100 million	₦31 million
Tree crops development	To expand tree crop development to increase local production of oil palm, date palm, cocoa, rubber, gum arabic, cashew, coffee, and other horticultural crops in order to meet local consumption and increase export earnings	No data available	₦100 million	₦31 million
Livestock production	To improve animal protein intake by 50% within 3 years; to produce for export within the next 5 years; to expand the development of dairy industry; to develop smallholder poultry scheme and rehabilitation of existing infrastructure	₦60 billion	₦100 million	₦31 million
Fisheries and aquaculture development	To increase domestic fish production to meet the national fish demand of 1.5 million mt from the present production level of 0.5 million mt a year; to focus on implementing aquaculture and inland fisheries production through homestead using fiberglass tanks and reservoirs	No data available		₦31 million

Source: FAO 2006.

The objectives of the PIOC, according to PRCU (2006), are to:

1. expand primary processing and utilization to absorb the national cassava production glut;
2. identify and develop new market opportunities for import substitution and stimulate export;
3. stimulate increased private sector investment in the establishment of export-oriented cassava industries;
4. ensure the availability of clean (disease free) planting materials targeted at the emerging industries;
5. advocate for conducive policy and institutional reforms for the development of the Nigerian cassava sector and integrate the rural poor, especially women and youths, into the mainstream of the national economy.

Presidential Initiative on Rice (PIOR)

The PIOR is aimed at increased rice production for national self-sufficiency, food security, and export. Specifically, projections of the PIOR included self-sufficiency by 2005 and ability to export by 2007. Estimated national demand is 5 million mt milled rice per annum, while the estimated national supply is 3 million mt per annum, leaving a deficit of 2 million mt per annum. It is therefore not surprising that the nation still imports rice. With the outright ban on importing rice replaced by a 50 percent import tariff in 1995, rice importation surged from 300,000 tons ($81 million) in 1995 to 1 million tons ($300 million) in 1998. The PIOR was announced in the wake of rice import bills that topped ₦96 billion by 2002. Policy support for domestic rice production included a 10 percent levy on imported rice, an outright ban on rice import from January 2006, and a 2.5 percent duty incentive on imported agricultural equipment for on-farm or post-harvest uses (Daramola 2005).

The strategies for the PIOR implementation have included (FDA/FMARD 2006):

- intensify of production to increase yield per ha;
- increase in production through increase in crop area;
- improve agronomic practices;
- strengthened extension delivery system;
- provide credit to rice farmers from a revolving loan to be deposited at the Nigerian Agricultural Cooperative and Rural Development Bank (NACRDB);
- supply effective research support;
- rehabilitate existing large- and small-scale irrigation schemes;
- construct small earth dams, particularly using expertise from the South-South Cooperation initiative;
- ensure timely availability of production inputs;
- improve processing and storage techniques;
- strengthen existing cooperative/farmer groups; and
- use of the rice box (R-box)[4] technology, which emphasizes minimum tillage and ensures provision of production inputs.

Presidential Initiative on Vegetable Oil Development (VODEP)

The national deficit in vegetable oil is estimated at 300,000–400,000 tons per annum. Table 2 shows the targets set, the supporting activities, and the institutional framework for the commodities covered by the VODEP.

[4] The R-box technology is an initiative of the Cardel Company Ltd., a private-sector agrochemical company. It is packaged to produce rice on a quarter hectare of land. Piloted in 2003 in the Federal Capital Territory (FCT) and Niger state, it achieved an average yield of 5 mt/ha. The government approved it as a rice production strategy starting in 2004 in at least 25 states (FDA/FMARD 2006).

Table 2. Activities, targets, and institutional framework for the VODEP

Activity	Oil palm	Cocoa	Groundnuts	Soybeans	Cotton
Rehabilitation of existing plantings below 30 years of age	125,000 ha				
Replanting of moribund plantations above 30 years of age	1 million ha	80,000 ha			
New plantings	203,000 ha		6.25 million ha	678,000 ha	1.25 mil ha
Massive production of seedlings	58.5 million	88.5 million			
Production and procurement of breeder/foundation seeds	5 ha seed garden at NIFOR			25 mt by NCRI	13,500 mt seed cotton Breeder and foundation seeds by IAR/ABU
Target outputs	15 million fresh fruit bunches (FFB) 2.25 million mt palm oil	Cocoa butter	5 million mt	678,000 mt	1 million mt seed cotton
Capacity building for	Small farmers and processors	Small farmers and processors	Small farmers and processors	Small farmers and processors	Small farmers and processors
Institutional framework	FDA/FMARD; NIFOR; private producers & processors; network of outgrowers	CRIN; NCDC; FDA/FMARD; private producers & processors; network of outgrowers	NSS; PQS; IAR/ABU; FDA/FMARD; private producers & processors; network of outgrowers	Seed association of Nigeria; NSS; NCRI; private producers & processors; network of outgrowers	Cotton revolving fund management; IAR/ABU; private/ public-sector outgrowers

Source: FDA/FMARD 2006.

Evaluation of Implementation of the Presidential Initiatives

It is not clear how commodities under the presidential initiatives were selected. However, there are apparent justifications for the commodities selected for presidential emphasis, especially in the cereals group. The three leading cereals in terms of national area under cultivation and production are (in descending order) sorghum, millet, and maize. These cereal commodities are produced nationally mainly for subsistence purposes at quantities that do not require significant importation, especially if post-harvest activities are efficient. Maize is still imported to some extent whenever its import is not restricted. However, as shown in Table 3, maize import values are much smaller than those of rice, perhaps justifying the national emphasis on the latter in the cereals group. Thus, it appears that part of the reason for the selection of the presidential initiative commodities was to preserve or earn foreign exchange by promoting increased production of import substitute or exportable commodities, as well as to promote value addition (for example, for cassava).

Table 3. Value of imports of maize and milled rice, Nigeria, 2001–05

Year	Import Values ($ in millions)	
	Maize	**Milled Rice**
2001	not available	366,027.20
2002	78.40	226,914.00
2003	2,527.12	not available
2004	17.92	375,427.36
2005	1,658.72	319,030.88
Source: FAOSTAT <http://faostat.fao.org/site/535/desktopdefault.aspx?pageID=535>.		

The implementation of the various presidential commodity initiatives has suffered significant setbacks. FDA/FMARD (2006) cited the following constraints to the implementation of the PIOC and PIOR:

- inadequate and untimely fund release by all tiers of government
- lack of funds to procure processing machinery and equipment
- lack of state and local government implementation committees
- For the PIOC especially, the PRCU (2006) identified three external trade constraints including the absence of:storage warehouses for processed cassava products
- railway systems for large-volume movement from inland locations to warehouses
- designated and equipped ports for agricultural exports

These VODEP implementation constraints were cited by FDA/FMARD (2006):

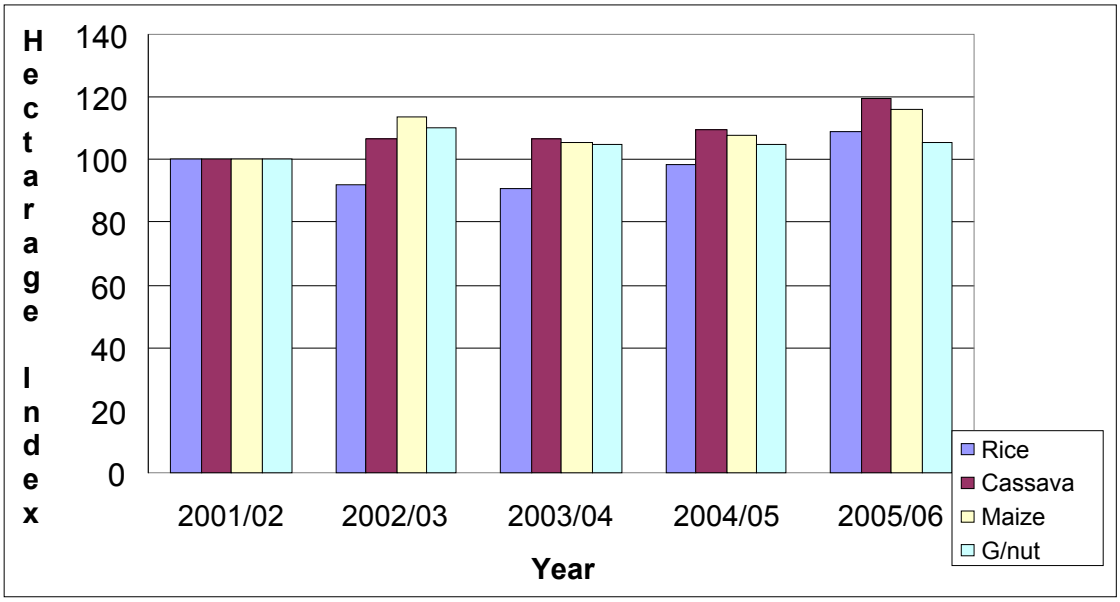
- aging and inefficient processing equipment,
- inability to install new processing equipment due to high offshore costs,
- high costs of production inputs and farm machinery,
- inability of local vegetable oil to compete with cheaper imported products,
- inadequate and untimely funding of the program, and
- delay in the certification of projects.

The recurrence of funding as one of the key implementation constraints of the presidential initiatives is better appreciated in relation to the information in Table 1, in which fund allocations for 2004 and 2005 were dismally low compared to the estimated project cost for each commodity in the package of initiatives.

Figures 1 and 2 show the indices of area planted and national outputs of rice, cassava, groundnuts, and maize from 2001–02 to 2005–06. Relative to the base year (2001–02), the indices for the area planted with rice decreased annually except for the year 2005–06. The cropped area indices for cassava, maize, and groundnuts relative to 2001–02 increased generally but not consistently. The output indices for rice fell in 2002–03 and 2003–04 relative to 2001–02 but rose in 2004–05 and 2005–06. The output indices for cassava rose consistently relative to the base year. That was not the case for maize and groundnuts, for which the output indices showed declines relative to the base year.

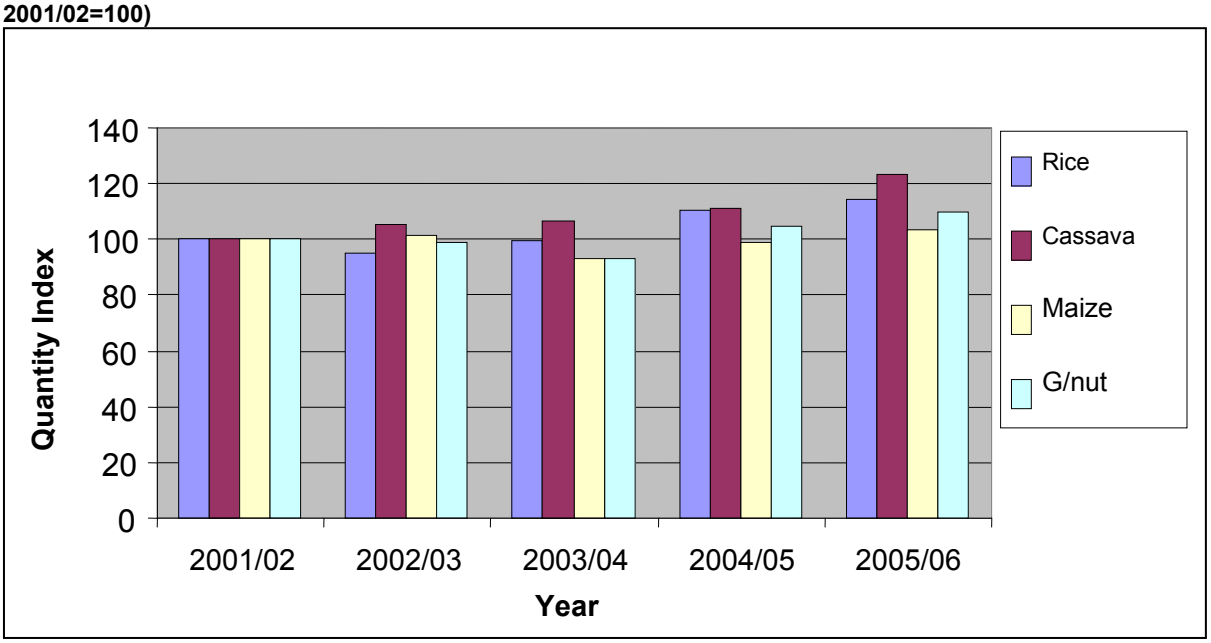
Maize was not among the presidential initiative commodities. But it is significant that the performance of its planted area and outputs relative to the base year is not entirely inferior to those observed for the presidential initiative crops. Thus, the seeming gain in the area planted and outputs of such crops as rice, cassava, and groundnuts cannot be totally attributed to the launch of presidential initiatives for them.

Figure 1. Plot of indices of area planted, selected crops, Nigeria (2001/02-2005/06, 2001/02=100)



Source: computed and plotted based on http://faostat.fao.org/

Figure 2. Plot of Indices of Outputs of Selected Agricultural Commodities Nigeria (2001/02-2005/06, 2001/02=100)



Source: computed and plotted based on http://faostat.fao.org/

Evaluation of the National Special Programme on Food Security (NSPFS)

The NSPFS is another recent agricultural program in Nigeria. It was initiated by the Food and Agriculture Organization (FAO) of the United Nations, with 42 of the participating countries in Africa. The NSPSF was initially piloted in Kano in 1998 and later extended to all 36 Nigerian states (FAO 2006). The initial scope of the NSPFS was broadly defined to include attainment of

food security and poverty reduction. The program was initially funded by the government with $45 million in unilateral trust funds, but was later complemented by $22 million from the Chinese government (Obasanjo 2005). This complementary funding has enabled expansion of the scope of the NSPFS to cover water control, aquaculture, integrated rice-fish culture, poultry-fish culture, small ruminants production, and biogas technology. The government planned to increase participating sites from 109 in 2005 to 327 by March 2007 at an additional cost of $256 million. Government documents claim that the program has doubled crop yields and that 98 communities have potable water as a result of the program.

No doubt, the NSPFS I and II have attracted considerable investment from government. Absence of publicly available detailed financial information about the program continues to make it very difficult to determine whether such investment generated attractive returns or not. While rigorous evaluation of the program has not been carried out, anecdotal evidence suggests that the performance of the NSPFS has been mixed. Some pilot projects have been clearly successful, while others have failed to meet set objectives.

Constraints to Agricultural Productivity in Nigeria

This subsection discusses the conceptual framework for analyzing constraints to the growth of agricultural productivity. It also reviews both constraints general to the sector as well as constraints specific to certain agricultural commodities.

Conceptual Framework

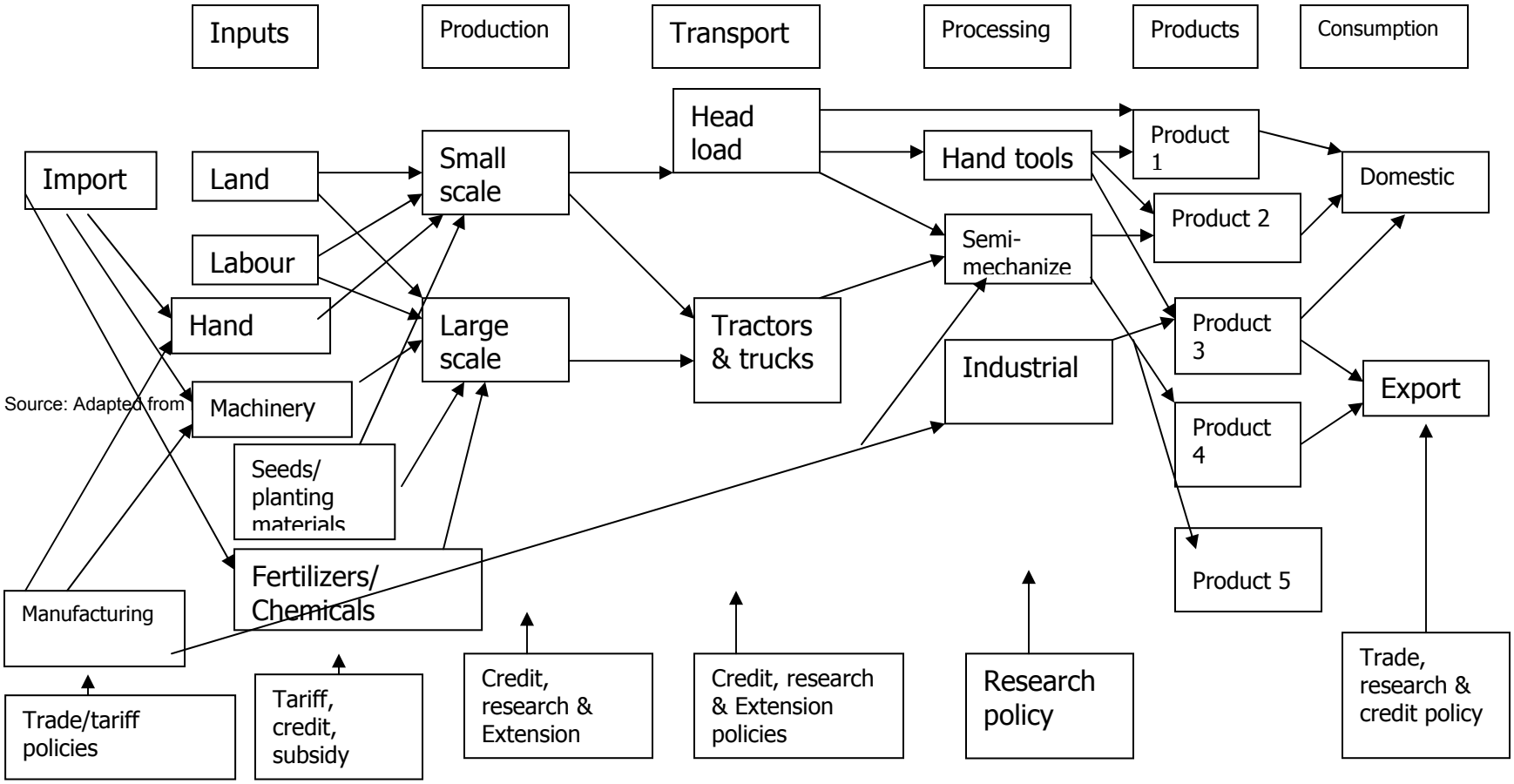
There are alternative approaches to conceptualizing the constraints to increasing agricultural productivity in Nigeria. The approach adopted in this review is to recognize and abstract from the key characteristics of the agricultural production systems, namely, agricultural inputs, outputs, post-harvest activities, and the relevant socioeconomic factors in the commodity value chain. Figure 3 illustrates a generalized value chain for commodity production and consumption.

Figure 3 presents a schematic representation of a typical production-to-consumption system for agricultural commodities in sub-Saharan Africa. Over 90 percent of production takes place on small farms. Inputs cover the whole spectrum for agricultural production in Africa. Imported inputs consist of small hand tools used by small-scale farmers, tractors, machinery, and fertilizer and other agricultural chemicals used mainly by medium- and large-scale farmers.

Large-scale agro-industries, which produce fertilizer, agricultural chemicals, and farm production machinery (tractors, ploughs, etc.), are widespread in sub-Saharan Africa. Small-scale and artisan agro-industries that produce hand tools and processing machinery are more important in the cassava system and provide a link to the industrial sector.

Some agricultural commodities are transported by head load, as well as by trailers and small trucks where the road network allows them to be used. For instance, cassava roots are processed into a wide variety of products for human and industrial

Figure 3. Conceptual Framework: Typical Commodity Production – Consumption System



Source: Adapted from

Source: Adapted from FAO and IFAD (2005)

consumption, ranging from simple boiled roots to fermented products and beverages. Most of the products are consumed domestically within the countries in which they are produced. However, there is a small but growing export trade in dried cassava chips and other industrial products.

Agricultural policies and programs affect the commodity system at different stages and in different ways. Each stage has its unique constraints. However, there are generic constraints that affect the system as a whole. The system contributes significantly to employment creation and income generation. It has an impact on the environment and its development will be affected by infrastructure constraints, especially the state of the rural road network.

Sectorwide Constraints

Most of the following constraints affect virtually every commodity in the sector, although to varying degrees. Commodity and regional distinctions will be highlighted to the extent that evidence allows.

Poor Agricultural Pricing Policies

The history of agricultural prices (inputs and outputs) is expected to affect agricultural technology adoption (Fulginiti and Perrin 1993; Hu and Antle 1993). Tax or subsidy policies or both affect agricultural prices (Fulginiti and Perrin 1993; Hu and Antle 1993). Exchange rate depreciation, a proxy for policy reform (Frisvold and Ingram 1995), affects input and output prices and domestic supply response of farmers.

Fertilizer use is promoted primarily by the fertilizer subsidy policy in Nigeria. The main challenge in this regard is that the fertilizer subsidy has not been pro-poor, nor has it increased market participation of the rural poor (World Development Report 2008). Issues to keep in mind when formulating input subsidy policy include access, which is aimed at improved volume, varieties, and quality of agricultural inputs. Also important is affordability; agricultural inputs must be priced within reach of rural farmers.

In spite of economic reforms in Nigeria, fertilizer subsidies have remained. There is renewed interest in discussing input subsidies, at least as a means to reduce attendant effects of market failures. Input subsidies were widely practiced from the 1960s through the 1980s. The costs of subsidies became high and unsustainable. Between 1978 and 1982, the cost of subsidizing fertilizers as a percentage of the total costs of subsidizing all eligible inputs and services (bush clearing, agricultural machinery and tractor hire services, equipment sale, pesticides, and seeds) in Nigeria varied from 62 to 77 percent (Olufokunbi and Titilola 1993).

Viewed in another related dimension, the share of fertilizer in the agricultural sector budget between 1981 and 1987 varied from 14 percent in 1983 to 71 percent in 1987. The unprecedented jump in the fertilizer percentage share in 1987 may have been due to the naira devaluation as part of the SAP, which began in 1986. This jump may have directly related to the fact that most of the domestic fertilizer demand is met by importation.

Nagy and Edun (2002) provide the following descriptions of the fertilizer-pricing scenario during the 1997–2002 period. FGN discontinued the fertilizer subsidy and distribution programs in 1997 and adopted a complete privatization/liberalization of the fertilizer sector. Subsidies were abolished and the import tariff reduced from 10 percent to 5 percent. However, this policy was

largely ineffective because the groundwork had not been properly laid for the private sector to take over. Fertilizer use declined sharply and the FGN reintroduced a fertilizer subsidy of 25 percent in May 1999 and procured 101,000 tons to be distributed by the states. The fertilizer was to be targeted to poor farmers by the local governments. The FGN then discontinued the subsidy in August 2000 and abolished the import fertilizer tariff. FGN again procured and subsidized a portion of Nigeria's fertilizer in 2001 (164,000 tons). In 2002, 163,700 tons was approved to be procured and subsidized at 25 percent. In 2002, the import tariff was reinstituted at 5 percent. Inconsistent FGN fertilizer policy and the dual fertilizer market precluded the required response from the private sector in the post-1997 period. Problems with fertilizer quality, arbitrage, and timeliness of fertilizer distribution persisted. Table 4 provides a summary of fertilizer subsidy rates from 1990 to 2008.

Table 4. Fertilizer subsidy rates for the 1990-2008 period

Year	Subsidy rate (%)
1990	82
1991	74
1992	86
1993	77
1994	65
1995	87
1996	74
1997	0
1998	0
1999	25
2000	0
2001	25
2002	25
2003	25
2004	25
2005	25
2006	25
2007	25
2008	25

Sources: 1990–2002 data: Nagy and Edun 2002; 2003–2008 data: National Food Reserve Agency (formerly Projects Coordinating Unit [PCU]), Abuja, interpersonal communications.

Note: Subsidy rates for 1990–1996 reflect the total subsidies by federal, state, and local governments; 1997–2008 shows only the federal government subsidy rates.

Thus, subsidies have placed a high budgetary burden on the Nigerian government. Also, the program has been largely hijacked by unintended beneficiaries, mainly large-scale farmers. Still, investments in core public goods (for example, research and extension), which also aim to boost productivity, may suffer setbacks under sustained and high input-subsidy programs. However, there is no immediate data to draw a firm inference on this assertion for Nigeria. Most subsidies in Nigeria were expected to give way as reforms were embraced in the mid-1980s. However, elements of fertilizer subsidy have persisted within the Nigerian agricultural economy. Indeed, the NCA pronounced a 25 percent fertilizer subsidy for the 2008 production season. However, details of how this will be implemented are still unclear. Appendix 3 provides further graphic evidence of the budgetary burden of fertilizer subsidy on the Nigerian economy.

Regarding experiences with fertilizer subsidies in Nigeria, Olufokunbi and Titilola (1993) sum it up as follows: "A large percentage of the demand for fertilizers has not at any time been met. Most of the actual prices paid are as much as, or even higher than what the landed costs

actually are. Unintended beneficiaries are the ones that have been gaining from fertilizer marketing arrangement." The authors therefore concluded that "fertilizer subsidies should be stopped and private entrepreneurs be allowed to enter the market."

One key argument in favor of an input subsidy is that society stands to accrue economic gains if the policy is carefully managed. Specifically, an input subsidy may achieve (WDR 2008):

- of input-market development, which tends to offset initial distribution costs; with market expansion, scale economies may lead to price declines;
- offset of initial risks and costs of learning a new technology, thus increasing adoption;
- insurance, in the absence of farm credit, for poor farmers who may have used fertilizers and seeds sub-optimally;
- reduction in the overall effect on profits where input purchases are taxed or output prices are controlled; and
- increased soil fertility, since land intensification can reduce deforestation often associated with shifting cultivation.

In order for input subsidies not to be counterproductive, they must be market responsive. Specifically, input subsidy programs should be used to develop competitive private-sector-led input markets, not weaken them. Such programs should be targeted at poor farmers who, without subsidies, would not adopt key inputs. They should complement, not undermine, commercial sale outlets. And they should be limited in duration—that is, accompanied from the start with a definite phase-out schedule. As demand for fertilizers or seeds or both expands with subsidies, expanded production of the inputs are expected to reduce their prices, thus nullifying the need for further subsidies. A related incentive, which is presently lacking, is that markets must be readily accessible for output disposal; this will encourage further investments in inputs.

Two preconditions have also been suggested for using subsidies to attain productivity growth in agriculture. One, subsidies must enhance input supplies through elimination of taxes or duties or both, combined with development of transport infrastructure and public/private partnership for procurement and distribution facilities. Two, demand for inputs must be enhanced through promotion of complementary practices such as irrigation, improvement in the knowledge and skills of farmers about the inputs to be used, and promotion of access to product markets and market information.

Finally, some cautions have been raised about input subsidy programs (WDR 2008). For example, misapplication of input subsidies can also lead to environmental damage such as increased pollution of surface and subsurface water systems.

Low Fertilizer Use

New Partnership for African Development (NEPAD) has noted that economic development in Africa must rely on increased and sustainable agricultural production. NEPAD's framework for agricultural growth, food security, and rural development, the Comprehensive Africa Agricultural Development Programme (CAADP), targets a 6 percent annual growth rate for agriculture in order to halve hunger in Africa by 2015 in its member states (Africa Fertilizer Summit 2006).

SSA fertilizer use is estimated to average 8 kg/ha per annum, compared to 100–200 kg/ha in developed agricultural economies. Improved crop varieties exist, but realization of yield potential requires a leap in the level of fertilizer use. As elsewhere in SSA, low fertilizer use is a serious

constraint to agricultural productivity growth in Nigeria, where fertilizer use averages 10–15 kg/ha (IFDC 2006).

Two related issues are noteworthy with regard to improvement of fertilizer use and crop productivity in Nigeria. One, effective demand for fertilizers must be created. This requires conducive commodity prices, farm income that is high enough to enable purchase of farm inputs, farmers' improved knowledge of the use of fertilizers, rural input credit programs to enhance access to inputs, and an efficient network for fertilizer trade. Also, traders, suppliers, and farmers must be efficiently linked. It is also important to encourage small-scale irrigation so that the risk associated with rainfall is reduced and the profitability of investment in fertilizer adoption is increased.

A second condition for the improvement of crop productivity is to develop domestic capacity for fertilizer production. This becomes imperative since virtually all of the fertilizer used in Nigeria has been imported since the early 2000s (Table 5). Thus, domestic sale prices are subject to the vagaries of international supply and demand, and have recently increased dramatically due to rising energy prices.

Table 5. Fertilizer production, import, and consumption, Nigeria, 2002–05, metric tons

Fertilizer type		2002	2003	2004	2005
Nitrogen	Production	0	0	0	0
	Import	94,400	137,603	101,001	115,041
	Consumption	94,400	137,603	101,001	115,041
Phosphate	Production	0	0	0	0
	Import	41,400	49,432	14,028	58,875
	Consumption	41,400	49,432	14,028	58,875
Potash	Production	0	0	0	0
	Import	30,400	42,712	37,141	41,255
	Consumption	30,400	42,712	37,141	41,255

Source: FAOSTAT <http://faostat.fao.org/site/575/DesktopDefault.aspx?PageID=575.

Between the late 1980s and mid-1990s, domestic fertilizer production as percentage of the total supply varied between 46 and 60 percent (Ogunfowora 1993). As shown in Table 5, there has been no domestic production of fertilizers since the early 2000s because NAFCON, the dominant fertilizer producer in Nigeria, has been shut down.

Some of the issues that relate to domestic supply of fertilizers include high transport costs from port to inland destinations, poor distribution infrastructure, absence of capital for private-sector participation in distribution, significant business risks facing fertilizer importers, and inconsistencies in government policies.

Poverty and Women's Limited Input Access

Women have lower access to purchased inputs and natural resources in Nigeria and, to that extent, the aggregate input usage and, indeed, agricultural productivity is affected. Also, because of the domestic roles of women and the lack of freedom to participate in on-farm activities in some communities, there is the tendency to undervalue labor productivity in Nigeria.

Both the incidence and depth of poverty are higher in SSA than in most other regions of the world. Poverty is also a consequence of low access to agricultural technologies, compounded by poor rural infrastructure that blocks easy inflow of inputs and outflow of farm produce (AfDB 2002). Poverty can result in food insecurity, low productivity, and farmers' inability to afford yield-enhancing inputs (Ogunlela and Ogungbile 2006).

Women have relatively limited rights to farmland in spite of having a significant role in agricultural production in many parts of Nigeria. Women have less access to extension services and credit. These constraints, together with lower access to farmlands, limit their agricultural productivity. Table 6 provides evidence concerning the involvement of women in the various activities in the value chains of selected commodities. Although the table does not show the inputs committed by gender groups, there is indication that women play key roles in agriculture in southwest Nigeria, especially in post-harvest activities.

Table 6. Distribution of respondents by commodity, economic activity, and gender, southwest Nigeria

Study	Commodity	Activity	Gender of farmer	No.	%
Adesokan (2007)	Cassava	Production	Male Female Total	66 14 80	82.5 17.5 100
Ajibola (2006)	Cassava	Production	Male Female Total	91 9 100	91 9 100
Osibeluwo (2005)	Cassava	Production	Male Female Total	76 24 100	76 24 100
Murana (2005)	Maize/sorghum	Production	Male Female Total	89 6 95	93.7 6.3 100
Oladele (2006)	Rice	Production	Male Female Total	68 12 80	85 15 100
Erhoyoma (2003)	Cassava	Production	Male Female Total	65 19 84	77.4 22.6 100
Bolarinwa (2006)	Cassava, maize	Production	Male Female Total	129 22 151	85.4 14.6 100
Fade-Aluko (2007)	Rice	Marketing	Male Female Total	6 54 60	10 90 100
Babalola (2003)	Rice, maize, cowpea	Grains storage	Male Female Total	58 62 120	48.33 51.67 100
Alagbe (2007)	Cassava	Processing	Male Female Total	6 54 60	10 90 100

The role of women in agricultural production varies in Nigeria. Among the Muslims in the north, married women mostly live in seclusion (purdah) and are not expected to leave home. The exceptions are the cattle-owning Fulani households, where married women work outside the home primarily to milk the cows and sell the milk, butter, and cheese (NARP 1994). Beyond processing and selling activities, direct on-farm roles are very limited for married Muslim women in the north of Nigeria (Table 7). In the Zonkwa area of Kaduna state, women are substantially involved in on-farm production activities, in addition to their exclusive contributions to marketing, water and firewood fetching, cooking, and caring for the children. By contrast, women in the Funtua community of Katsina state are little involved in most agricultural activities.

There is a growing demand to weigh labor inputs for age and gender groups in Africa since the roles of women in agriculture differ between places on the continent. In some areas in Nigeria, on-farm activities are left to women. In other places, women engage mainly in cooking and caring for children. To better appreciate women's roles and to estimate their farm labor productivity, diverse roles must be accounted for. Differentiation between women who are primarily housewives and women who are primarily farmers will ultimately affect estimation of labor productivity. Failure to account for differing roles may underestimate agricultural labor productivity.

Table 7. Percentage of women performing specific farm activities, Katsina and Kaduna states

Farming activity	Funtua (Katsina state)	Zonkwa (Kaduna state)
Land preparation	17	80
Ridging	0	30
Planting	17	100
Weeding	0	80
Fertilizer application	33	90
Harvesting	0	100
Transporting	33	100

Source: NARP 1994.

Note: Funtua is a Muslim community inhabited largely by the Hausa/Fulani while Zonkwa is a Christian community, dominated by Jarma people.

Of related importance to gender issues in agricultural productivity is level of education. High illiteracy rates among women will limit adoption of improved farm technologies, while high literacy rates for both gender groups is expected to improve farmers' ability to use information from extension services. This would enhance farm recordkeeping for improved cost-and-returns evaluation and better tracking of market opportunities. Thus, education is expected to affect agricultural productivity. However, it is conceivable that with better education, farmers may seek better-paying nonfarm jobs for which they become suited.

Low Access to Agricultural Credit

Access to agricultural credit has been positively linked to agricultural productivity in several studies. Yet this vital input has eluded smallholder farmers in Nigeria. As shown in Table 8, cooperatives, friends, and family members dominate the sources of farm credit among the rural farmers surveyed in southwest Nigeria. However, the total amount of farm credit available from these sources is very limited in relation to the amounts that formal sources like banks would have offered. These results are reinforced by the studies shown in Tables 10 and 11.

Table 8. Available sources of farm credit to sample of farmers, Oyo and Ogun states, southwest Nigeria

Source	% responding *
Cooperatives	75
Informal (friends/family)	75
Banks	0

Source: Phillip and Adetimirin 2001; * Multiple responses allowed.

The banks with larger loan funds were said to be generally difficult to access, as evidenced in Table 9. Issues of collateral and high interest rates appear to screen out most of the rural smallholder beneficiaries. Freeman et al. (1998) agree with this observation by noting that where a smallholder farmer is required to show capital-intensive collateral to qualify for loan, he or she is already screened out in favor of well-off farmers.

Table 9. Distribution of respondents by commodity, economic activity, and sources of credit, southwest Nigeria

Study	Commodity	Activity	Source of credit	No.	%
Adesokan (2007)	Cassava	Production	Bank	8	10.0
			Money lenders	5	6.2
			Cooperatives	40	50.0
			Friends/family	10	12.5
			Personal savings	17	21.3
			Total	80	100.0
Osibeluwo (2005)	Cassava	Production	Bank	1	1.1
			Money lenders	0	0.0
			Cooperatives	29	30.5
			Friends/family	1	1.1
			Personal savings	64	67.4
			Total	95	100.0
Murana (2005)	Maize/sorghum	Production	Bank	1	1.1
			Money lenders	0	0.0
			Cooperatives	29	30.5
			Friends/family	1	1.1
			Personal savings	64	67.4
			Total	95	100.0
Bolarinwa (2006)	Cassava, maize	Production	Bank	17	11.3
			Money lenders	0	0.0
			Cooperatives	48	31.8
			Friends/family	1	0.7
			Personal savings	85	54.3
			Total	151	100.0
Ayeni (2005)	Cassava	Marketing	Bank	4	6.7
			Money lenders	0	0.0
			Cooperatives	5	8.3
			Friends/family	2	3.3
			Personal savings	49	81.7
			Total	60	100.0

Table 10. Distribution of respondents by specific nature of farm credit constraints, Oyo and Ogun states, southwest Nigeria

Nature of farm credit constraints	% responding *
Collateral requirement (bank)	67
High interest rate (bank)	67
High interest rate (informal credit)	16
Inadequate loan amount (coop credit)	58
Inadequate loan amount (informal credit)	25
Late release of loan (bank)	33

Source: Phillip and Adetimirin 2001. * Multiple responses allowed.

One other key problem associated with smallholder access to agricultural credit is that agricultural loans are often short-term with fixed repayment periods; this may not suit annual cropping, especially when loan release is not in tune with growing cycles of crops. Short-term loans are also unsuitable for livestock production; thus, loan terms must flexibly relate to cash flows in the target business, the input demand/supply structure, and computable risks in the business.

It is relevant to add that, from the standpoint of economic rationality, it is quite conceivable that improved access to loan funds could lead some borrowers to invest in nonfarm businesses that yield higher monetary returns than the farm business for which the loan was acquired. Thus, a monotonic positive relationship between access to loan and increased investment in agriculture may not always follow.

Low and Unstable Investment in Agricultural Research

Agricultural research in Nigeria has been primarily funded by the federal government. Funding, however, has become somewhat unstable since the early 1980s. Private-sector involvement in agricultural research has remained negligible to date. Some 59 higher education agencies were involved in some form of agricultural research by 2000 (Beintema and Ayoola 2004). Low private investment in agricultural research in Nigeria can be traced to a few key factors. One, private-sector agricultural agencies gain costless access to the research results generated by the public research agencies, thus leaving little or no desire for private-sector investment in such research. Two, political instability through the years has hampered long-term private investments in agricultural research. Three, the process for varietal release is long, which is a disincentive to private-sector investment in crop varietal research (Beintema and Ayoola 2004).

Low public expenditure on agricultural research has been associated with low growth in agricultural productivity elsewhere. Conversely, such investment can help to explain eventual agricultural productivity growth. However, it is not uncommon to expect some spillover of research impact from other countries or international research centers within a country (or both) even where a country spends little on research.

When research is poorly funded, agricultural technologies cannot be improved, and there will be no downstream farm income increase, rural employment generation, reduction in food prices, establishment of agrobased industries, and economic growth. In short, absence of new technologies in agriculture will slow the growth of agricultural productivity and the reduction of rural poverty.

Public investment in agricultural research in SSA grew at only 1.5 percent per annum in 1976–96, and actually declined into the early 1990s (Pardey and Beintema 2001). Table 11 shows computed indices of instability for funding and actual disbursements for capital and recurrent expenditures from 1984 to 1994 for 11 agricultural research institutes in Nigeria. For ease of comparison, the other institutes that did not have data for the 1984–94 period (for example, NIHORT) were omitted from the table.

As shown in Table 11, eight of the 11 research institutes had capital funding instability while nine of the 11 institutes suffered actual capital disbursement instability during the 1984–94 period. These results are significant because agricultural research in Nigeria is funded from capital funds/disbursements. As expected, only four of the research institutes shown suffered instabilities in recurrent funding and actual recurrent disbursement. The remaining institutes suffered only moderate instability. Idachaba (1998) notes that the trends in agricultural research funding in Nigeria were more on the side of decline than increase during the study period.

Total public R&D spending has been less than stable since independence. Total public agricultural R&D spending declined from about $130 million in the mid-1970s to less than half this amount by the mid-1990s (Beintema and Ayoola 2004). It is believed, however, that the situation might have improved since 2000 because of an increase in the salary structure and some improvement in the nominal contribution of government to agricultural research. Public

spending on R&D per $100 of agricultural output was strongest in 1981 at $0.81. This figure declined to a dismal $0.16 by 1995 and improved only slightly to $0.38 by 2000 (Beintema and Ayoola 2004). The average for Africa by 1995 was $0.85.

Table 11. Instability indices5 in the funding and actual disbursements of capital and recurrent expenditures of agricultural research institutes, Nigeria, 1984–94

Institute	Capital funding index (%)	Capital Disbursement index (%)	Recurrent funding index (%)	Recurrent disbursement index (%)
NIFFR	54.93	50.46	43.15	49.87
NAPRI	61.81	61.81	36.85	82.03
NCRI	RNA	109.86	RNA	35.66
NIFOR	48.06	72.43	36.79	44.32
IAR	70.13	52.39	28.90	28.90
IAR+T	137.07	80.67	74.63	61.64
NRICT	119.16	19.12	62.79	62.79
NRCRI	95.06	RNA	139.30	RNA
CRIN	111.96	72.33	44.82	44.37
NSPRI	39.56	39.56	46.11	46.11
NVRI	54.12	131.68	60.75	60.47

Source: Idachaba 1998.

RNA: Result not available for the period 1984–94.

Note: $0 \leq$ Index < 50 = moderate instability, $50 \leq$ Index < 100 = high instability, Index ≥ 100 = severe instability.

The budget process for agricultural research funding in Nigeria is neither simple nor wholly transparent. The time between submission of planned budget by the research agencies and approval and release of funds is lengthy and often out of tune with research work plans. Also, approved amounts and disbursement processes by government often fall far short of the research agencies' planned budgets. Indeed, since the late 1990s, higher education and research agencies have been receiving both recurrent and capital budgets on a monthly basis, leaving virtually no space for long-term research investment. Apart from making research planning impossible, it has tended to delay or prolong the completion of laboratory-based graduate programs, since neither the faculties nor the students have access to adequate and sustained research funds.

Poor Funding and Coordination of Agricultural Extension

During much of the implementation period of the World Bank-assisted ADPs in Nigeria, T&V was the prevalent agricultural extension system. Due largely to good funding of the ADP system, including staff incentives (such as timely salaries, and provision and maintenance of project vehicles), there were satisfactory contacts between farmers and extension agents. The main concern during the ADP implementation period was that there were insufficient technologies to take to farmers. Thus, the monthly technology review meetings (MTRMs) jointly held by the ADPs and NARIs could not be backed up with sufficient release of farm

[5] Let us define X_{jt} as the fund allocated to research institute j in year t, t =1,2,…..n. We further define S as the standard error of some suitable (linear) regression of X_{jt} on trend t, while M is the sample mean of the X_{jts}. Then, the trend adjusted index of funding instability, I_f, is given by $I_f = S/M$. This can be expressed in percentage terms, as needed. Also, see Idachaba (1998).

technologies, partly because the NARIs were poorly funded and because of the lengthy procedures for certifying the release of improved technologies to farmers.

Specific constraints identified in the implementation of the T&V system in Nigeria included bureaucratic procedures, and location of crop and livestock extension staff in different departments and ministries, which tended to promote rivalry and duplication of resources. Related to these issues was the fact that the extension system was implemented with a huge bias in favor of cropping activities.

In 1992, the NCA approved the adoption of UAES to ensure a single line of command and delivery of unified extension messages to farmers. The implementation of this laudable extension system remains hampered by poor funding, as most of the state ADPs stopped functioning after the cessation of World Bank funding.

The agricultural extension staff is inadequate in number and quality. In the northeast zone, the extension worker:farmer ratio is estimated at 1:1,700 (NARP 1995). This ratio is similar to the average ratio found in the late 1980s for all of Africa (1:1,800), and indicates a low level of extension service to farmers in Africa in general and in Nigeria in particular (Swanson, Farner, and Bahal 1990). Farmers are highly dispersed across large areas of land. This affects the quality of messages as well as the frequency of visits.

The agricultural extension services in Nigeria also suffer from inadequate facilities and input supply. The field workers lack transport facilities. They are not equipped with audiovisual aids. Neither are they supplied with needed technologies that they are supposed to promote among the farmers (NARP 1995).

The agricultural extension staff is poorly paid. Unattractive and untimely paid wages are bound to affect performance. The frequency of visits to the fields by the zonal extension agents (ZEAs) and the block extension agents (BEAs) have been known to be seriously affected by poor wage incentives and poor mobility.

Most agricultural research and the emerging recommendations in Nigeria have targeted programs promoting technology adoption by small-scale farmers. There are various reasons that a study might be designed to estimate adoption rates of components or a package of agricultural technology. An adoption study may be undertaken to evaluate the effectiveness of an agricultural extension system. An adoption study may form part of a larger study to diagnose the constraints to the uptake of some agricultural technologies. Adoption rates may be of interest as part of an agricultural technology impact study, especially where an economic surplus approach is the preferred analytical framework.

Attempts have been made to assess adoption rates of agricultural technologies as a component of evaluating the impact of the T&V system of extension in Nigeria. But such studies have not been carried out in a systemic manner. Thus, trends in the adoption of relevant technologies are difficult to describe. Another design problem in most adoption studies in Nigeria is that they are usually not crop or livestock specific. Where they are crop specific, they are not variety specific. A related problem is that farmers are not trained in the knowledge of the scientific names of crop varieties or animal species. Usually farmers are more comfortable with identifying crop varieties, for example, by using visible physical attributes of the relevant crops.

In a study by Phillip et al. (2000) of maize varietal adoption in three northern Nigerian states, seed color was an acceptable means of identifying maize varieties rather than using scientific

names. In this study, farmers easily identified maize varieties as white local, yellow local, white open-pollinated, yellow open-pollinated, white hybrid, and yellow hybrid varieties, as opposed to using such technical names as TZSR, TZBSR, and TZESR.

In Borno state, a composite technology adoption study evaluated the impact of the T&V extension system. The composite adoption rates obtained were 78 percent (crop varieties), 75 percent (fertilizer application rates), 59 percent (seed dressing chemicals), and 59 percent (planting time/method).

In Adamawa state, the adoption study carried out was crop-specific but less specific for varieties. As shown in Table 12, the adoption rates of the recommended crop varieties, fertilizer rates, and sowing densities were generally higher than the rates for recommended pest and disease control measures. The low adoption rates of chemicals were mainly attributed to the nationwide scarcity and high cost of the inputs.

Table 12. Rates of adoption of recommended practices, Adamawa state

Crop	Rates of adoption (%) of recommended			
	Varieties	Fertilizer rates	Sowing density	Control of pests and diseases
Groundnuts	30	35	40	15
Sorghum	25	30	25	10
Maize	60	65	30	15
Rice	50	60	40	10
Pepper	40	35	30	10

Source: NARP 1995.

In the study by Spencer et al. (2006), the adoption of NERICA (New Rice for Africa) and other upland rice varieties was estimated for Ekiti (southwest) and Kaduna (northwest) states. The samples for the study were drawn in each state from both ”participatory varietal selection” (PVS) and non-PVS villages. The PVS villages participated in the promotion of the relevant rice varieties before the study. The non-PVS villages (otherwise called near-PVS villages) did not directly participate but were immediate neighbors of the PVS villages.

The results in Ekiti state were not disaggregated into PVS and non-PVS villages. In Ekiti state, upland rice adoption rates were obtained for the varieties as follows: 42 percent (NERICA 1), 46 percent (WAB rice variety 189) and 60 percent (ITA rice variety 150). In Kaduna state, the upland rice adoption rates for the PVS villages were 42 percent (NERICA 1), 14 percent (NERICA 2), and 23 percent (WAB 189). The corresponding rice adoption rates in the non-PVS villages in Kaduna state were 9 percent (NERICA 1), 9 percent (NERICA 2), and 36 percent (WAB 189). It is significant to note that because the study was done during the growing season, farmers’ knowledge of the varietal names was aided by showing them the rice plants at survey time.

There is some evidence that previous funding of the agricultural extension activities had spillover effects in terms of technology adoption. The estimated adoption rates appear to be satisfactory for a wide array of farm technologies, even after the implementation years of the ADP system (Table 13). Indeed, adoption may have been constrained more by poverty or the inability to purchase improved inputs than by factors related to the extension system itself. Table 14 provides some indication of this, using evidence from a 1999 nationwide crop-livestock integration study. In the survey, respondents more commonly rated many other factors besides

inadequate extension services as important constraints to crop-livestock integration, although inadequate extension services were also commonly cited in three of the five regions of Nigeria.

Additional evidence is provided by a study of constraints to adoption of recommended cropping practices in maize production. The recommended cropping system for improved maize in Nigeria is sole cropping. However, a study by Phillip et al. (2000) found the adoption rates of sole cropping of the open-pollinated varieties (OPVs) and hybrid varieties (HVs) to be 32.7 percent and 30.5 percent, respectively. These low adoption rates were found to be a direct response by farmers to the scarcity and high cost of fertilizers before the survey period. With little or no fertilizer readily available, mixed cropping became the farmers' rational strategy for avoiding total yield loss. Thus, the low adoption of recommendations here is more a response to market realities than to the quality of extension delivery to the farmers.

Table 13. Adoption rates (%) of selected farm technologies, northwest zone, Nigeria

Crop/Cultural practices	Technology	States			
		Bauchi	Kaduna	Kano	Sokoto
Sorghum	SAMSORG-3	70	NA	30	30
	SAMSORG-17	50	70	20	10
Maize	TZSR	40	70	NA	30
	TZBSR	40	90	NA	30
	TZESR	60	20	10	40
	HYBRID	10	50	NA	NA
Cowpea	SAMPEA-7	40	60	10	20
	SAMPEA-50	50	50	10	40
Groundnut	SAMNUT-10	50	20	70	30
	SAMNUT-18	40	20	60	20
Tomato	Roma VF	80	90	85	60
Cultural practices	Fertilizers	60	70	60	60
	Spacing	50	60	40	40
	Pest control	10	10	10	40
	Seed dressing	40	40	30	10

Source: NARP 1994; NA : not available.

Table 14. Specific constraints to crop-livestock integration and percentage of respondents rating constraint as "Important," Nigeria

S/ No	Constraints	Northwest N=45	Northeast N=45	Central N=45	Southeast N=45	Southwest N=45
1	High fertilizer cost	93.3	100.0	100.0	100.0	71.4
2	High labor cost	0.0	100.0	100.0	100.0	85.7
3	High agrochemical cost	100.0	100.0	100.0	100.0	100.0
4	Improved-seed scarcity	100.0	100.0	100.0	100.0	42.9
5	High improved-seed cost	100.0	100.0	100.0	100.0	100.0
6	Agricultural-credit scarcity	100.0	100.0	100.0	100.0	100.0
7	Limited transport availability	0.0	100.0	100.0	100.0	78.6
8	High transport cost	100.0	100.0	100.0	100.0	100.0
9	Limited crop-storage facilities	0.0	71.4	0.0	100.0	85.7
10	Limited livestock-product preservation	0.0	100.0	0.0	100.0	100.0
11	Crop pests and diseases	100.0	80.9	71.4	100.0	100.0
12	Animal pests and diseases	100.0	38.1	71.4	100.0	100.0
13	High cost of poultry feed	0.0	66.7	0.0	0.0	100.0
14	Insecure land holding	0.0	71.4	0.0	100.0	71.4
15	High cost of animal drugs	100.0	42.9	42.9	100.0	100.0
16	Unsuitable livestock breeds	0.0	100.0	0.0	100.0	57.1

17	Inadequate extension services	100.0	100.0	0.0	100.0	50.0

Source: FACU 1999.

Land Degradation

Land degradation, particularly due to soil fertility depletion and soil erosion, is a serious constraint to agricultural productivity in much of Nigeria. According to the Global Assessment of Soil Degradation (GLASOD), more than one-fourth of the agricultural land in Nigeria is severely degraded, and most of that portion is very severely degraded, meaning it has suffered major and irreversible losses in productivity (Table 15).

Several options for improved management of soil fertility have emerged from on-station research and on individual farms. These include application of organic and inorganic fertilizers, land management practices such as erosion control, and alley farming. Careful application of combinations of these options is key to the maintenance of soil fertility and reversal of land degradation.

In situations where technology is affordable, poor knowledge may lead to overuse of agrochemicals such as fertilizers, which may precipitate environmental problems. But of immediate concern today in Nigeria is underusage of fertilizers as a result of high costs. Fertilizer application rates have decreased in Africa at 1.1 percent per annum since the 1990s (Africa Fertilizer Summit 2006).

Alley farming is based on the principle of nutrient recycling. Annual crops are cultivated continuously within hedgerows of leguminous trees and shrubs (Adesina and Chianu 2002). The latter species are then pruned periodically and turned back into the soil as mulch for soil fertility improvement. The leguminous species maintain soil fertility by fixing soil nitrogen, enhancing nutrient recycling, promoting soil mulching, and providing fodder for livestock feeding (Atta-Krah and Francis 1987; Kang et al. 1990).

The alley technology also reduces soil erosion (Ehui et al. 1990; Kang et al. 1995) and individual farmers have demonstrated that itcan be profitable (Ehui et al. 1990). But several constraints continue to limit its widespread adoption. These constraints include the absence of clear long-term title to land (Francis 1987; Fabiyi et al. 1991), high labor requirements (Dvorak 1996), and long gestation of hedgerows (Carter 1995). Other socioeconomic factors have also slowed the adoption of alley cropping. Hectarage of farmland per capita is low and declining in the face of land fragmentation along family lines (Table 16). And because of increasing land fragmentation, farmers are averse to the idea of sacrificing portions of their land to growing leguminous trees and shrubs merely for the supply of mulch and nitrogen-fertilizer substitutes.

Land-use intensification means shorter fallow periods; this may pose an erosion problem to downstream farmers. Land degradation has been manifested in soil erosion in many parts of the country, especially the southeast zone; desertification as a result of deforestation, mainly in the northeast and northwest zones; and oil spillage, especially in the oil producing states. Low soil fertility has resulted from shorter fallow periods especially around homesteads. Thus, action taken or not taken by farmers to reverse degradation will affect productivity.

Table 15. Parameters for classifying severity of land degradation in Nigeria

Severity	Mapped (km^2)	Population (million)	Population %	Population density	Degraded (km^2)	Degraded %
None	28,185	4.230	3.5	150.09	0	0.00
Light	342,917	23.548	19.2	68.67	8,578	0.94
Moderate	39,440	4.115	3.4	104.33	6,518	0.71
Severe	240,495	30.266	24.7	125.85	64,631	7.07
Very Severe	255,167	59.863	48.8	234.60	176,544	19.31
Unclassified	7,871	0.554	0.5	70.38	0	0.00
TOTALS	914,075	122.576	100.0	134.10	256,271	28.04

Source: <http://www.fao.org/landandwater/agll/glasod/glasodmaps.jsp>.

Land-Tenure System

Land is relatively abundant in Nigeria, but there are limitations to gaining access to land for productive use. The key factor is the land-tenure system prevailing in different parts of the country. The land-tenure system is the body of laws, contracts, and arrangements by which people gain access to land for agriculture and other uses. The land-tenure system in Nigeria varies from one place to another. The communal system of land ownership, in which individual ownership of land is embedded in group or kinship ownership, prevails among most ethnic groups in the south (Onyebinama 2004).

A few significant factors have promoted individual land ownership, especially in southern Nigeria. Increase in population pressure has raised land values and has created incentives to sell portions of lands. Demand for land for nonagricultural uses (especially industrial and residential developments) has also been a factor, and some landowners have disposed of urban and peri-urban lands for fear that government might take over these parcels under the Land Use Act provisions (Onyebinama 2004).

Group ownership of land in Nigeria has been associated with such problems as limited tenure security, restrictions on farmers' mobility, and the inevitable fragmentation of holdings among heirs (Onyebinama 2004; NARP 1994; also see Table 16). In addition, group ownership restricts access rights of community members outside the owning group, a situation that limits the use of land as collateral for agricultural credits. But group ownership has also been credited with such benefits as preserving traditional land-use practices such as bush fallowing, which has helped to retard problems of land degradation.

The Land Use Act (LUA) of 1978 sought to correct some of the inherent weaknesses in the group ownership of land by transferring the custodianship of land to state and local government authorities. In practice, however, these government authorities have often abused the allocation of lands placed in their trust (Onyebinama 2004). In particular, productive lands have been allocated to individuals who have cared little about farming or land conservation.

Under the LUA of 1978, land is owned by the government on behalf of the community. In reality, however, cultivated lands are still occupied by family members under customary laws. The community head acts as the custodian of the land. The individual farmer has virtually complete control over his holding. Thus, the areas mainly under communal control are unallocated land, grazing rights to such land, and access to water (NARP 1994).

An important social factor is the means of access to farmlands in Nigeria. The dominant means of access to farmlands in southwest Nigeria are inheritance, rent, and purchase, in that order, as shown in Table 16.

Table 16. Distribution of farmers by commodity and means of access to farmland, southwest Nigeria

Study	Commodity	Activity	Access to farmland	No.	%
Adesokan (2007)	Cassava	Production	Inheritance	50	62.5
			Rent	8	0
			Purchase	5	6.2
			Gift	16	16
			Other	1	1.3
			Total	80	100
Murana (2005)	Maize/ sorghum	Production	Inheritance	73	76.8
			Rent	2.1	2.1
			Purchase	0	0
			Gift	20	21.1
			Other	0	0
			Total	95	100
Oladele (2006)	Rice	Production	Inheritance	52	65
			Rent	27	33.8
			Purchase	1	1.2
			Gift	0	0
			Other	0	0
			Total	80	100
Erhoyoma (2003)	Cassava	Production	Inheritance	54	64.3
			Rent	14	16.7
			Purchase	5	6
			Gift	2	2.3
			Other	9	10.7
			Total	84	100
Kukoyi (2005)	Maize	Production	Inheritance	55	68.8
			Rent	15	18.8
			Purchase	9	11.3
			Gift	0	0
			Other	1	1.3
			Total	80	100

Restrictions on land sales impede the use of land as collateral, thereby hindering development of the rural credit market. Communal land ownership is a disincentive to the improvement of land quality and long-term investment in land management. Inheritance leads to land fragmentation among heirs, and subsequent uneconomic farm sizes per member (Onyebinama 2004; NARP 1994; also see Table 17). Table 17 illustrates this problem in the southwest of Nigeria.

Table 17. Distribution of farmers by commodity and farm size, southwest Nigeria

Study	Commodity	Activity	Farm size (ha)	NO %	%
Adesokan (2007)	Cassava	Production	0-2.00 2.01-3.00 3.01 or more Total	52 8 20 80	65 10 25 100
Ajibola (2006)	Cassava	Production	0-2.00 2.01-3.00 3.01 or more Total	77 17 6 100	77 17 6 100
Murana (2005)	Maize/ Sorghum	Production	0-3.00 3.01-7.00 7.01 or more Total	69 22 4 95	72.7 23.2 4.2 100
Oladele (2006)	Rice	Production	0-1.00 1.01-2.00 2.01 or more Total	39 24 17 80	48.8 30 21.2 100
Erhoyoma (2003)	Cassava	Production	0-2.00 2.01-4.00 4.01 or more Total	47 25 12 84	56 29.8 14.2 100
Kukoyi (2005)	Maize	Production	0-1.50 1.51-2.00 2.01 or more Total	76 4 0 80	95 5 0 100

Women's access to land is through their household membership as wives, daughters, or sisters. Under Islamic law, which applies in most of the north of Nigeria, women are entitled to inherit half of the share of their male counterparts in the family. Women often end up surrendering such inherited lands when they marry outside their own community (NARP 1994).

Subdivision of holdings among household members prevails as a consequence of the inheritance system. But the size of land per capita depends ultimately on population pressure, the amount of land available to each household, and the specifics of the inheritance law in each community. In the former Kaduna state (now Kaduna and Katsina states), the average farm size was found to be 3.3 ha (NARP 1994). In Bauchi state, the same study found average farm size to be 2.9 ha (Table 18).

Table 18. Distribution of farm size (%) in Kaduna/Katsina, Sokoto/Kebbi, and Bauchi states

Percentage of farms less than	Kaduna/ Katsina (formerly Kaduna state)	Sokoto/ Kebbi (formerly Sokoto state)	Bauchi state
2.0 ha	47.1	41.2	25.0
4.0 ha	76.5	77.7	58.3
6.0 ha	87.1	89.2	80.0

Source: NARP 1994.

An important institutional constraint is absence of clear title to land. This may limit access to formal credit since the farmer cannot use land as collateral, and may reduce incentives to invest in land-quality maintenance and improvement. Because poor farmers cannot afford alternative farmlands, nor do they have customary access to lands not inherited, they remain on depleted lands and further degrade such resources. Thus, poverty and custom may constrain farmers' ability and willingness to mitigate land degradation, leading to declining productivity.

Poor Market Access and Marketing Efficiency

Investment in infrastructure, especially transportation and communication, has been found to indirectly affect agricultural production and productivity (Antle 1983). Examples include investments in roads, utilities, and communications. Public investments in these components will increase agricultural productivity. Inputs will be cheaper at the farm gate because of unhindered movement. Farmers will improve access to market opportunities. Proxies have included paved road density (Craig et al. 1997), and contribution of national transportation and communication to the GDP (Hu and Antle 1993).

Limited or poor-quality roads and rail transportation inhibit timely access to inputs, increase costs of inputs, and decrease access to output markets. Thus, investment in infrastructure contributes to agricultural productivity growth (Shane et al. 1998). However, data has limited inclusion of this variable in African productivity studies.

The bulky nature of primary produce has discouraged production because rural farmers have limited access to markets and good feeder roads. Economic reforms in Nigeria have led to increased private-sector participation in the supply of most purchased inputs in Nigeria, but most suppliers are based in urban areas. End users of inputs are in rural areas, which are poorly linked to urban suppliers. Transaction costs of inputs increase delivery costs to rural farmers. For example, the retail cost of fertilizer at the farm gate is about four to five times its cost to the farmer in developed countries; this is a major disincentive. As noted earlier, some elements of subsidies remain on fertilizer pricing in Nigeria. However, given the prevailing poor marketing infrastructure and the attendant high transactions costs, the computations in Appendix 2 raise doubts about the effectiveness of fertilizer subsidies in Nigeria in recent times.

Agricultural marketing efficiency in Nigeria is dismally low. First, transportation costs are high. In addition, road conditions are poor, which limits access to purchased inputs, credit, and output markets as well as reducing the transmission of key market signals. Increased access to output markets would likely generate demand for conventional inputs. Tables 20 to 23 provide field evidence in terms of specific marketing and infrastructural costs and constraints. High transport costs are particularly evident as a key constraint in Tables 20 to 23, reflecting the poor state of rural transport infrastructure in the study areas.

Table 19. Distribution of respondents by specific nature of agricultural marketing constraints, southwest Nigeria

Nature of agricultural marketing constraints	% responding *
Perishability of produce	100
Lack of/poor market access roads	50
Poor producer prices	83
Poorly developed village market	58
Lack of credit for agro-processing	58
High transport costs	67

Source: Phillip and Adetimirin 2001; * Multiple responses allowed.

Table 20. Components, values, and percentages of marketing costs, rice, Ogun state, 2007

Cost item	Iberekodo market		Lafenwa market		Kuto market	
	₦/100 kg	% of total	₦/100 kg	% of total	₦/100 kg	% of total
Space rent	1,085.71	29.6	672.22	8.4	980.00	12.4
Labor	465.00	12.6	4,322.86	53.4	2,891.43	36.6

Transport Materials (e.g., bags) Association dues	1,263.16 725.00 136.67	34.4 19.7 3.7	2,323.08 602.22 173.33	28.7 7.4 2.1	3,375.00 539.55 119.00	42.7 6.8 1.5
Total	3,675.54	100.0	8,093.71	100.0	7,904.98	100.0

Source: Fade-Aluko 2007.

Table 21. Constraints to marketing of rice, Abeokuta metropolis, Ogun state, 2007

Constraint	Number responding	% of total *
Pricing	6	10.0
Poor processing facilities	32	53.0
Illiteracy	9	15.0
Finance	9	15.0
High transport cost	22	36.7
Low patronage	11	18.3
No problem	5	8.3

Source: Fade-Aluko 2007.

* Multiple responses allowed.

Table 22. Components, values, and percentages of marketing costs, Gari, Ekiti states, 2005

Cost item	Ikole ₦/100 kg % of total		Ayedun ₦/100 kg % of total		Ayebode ₦/100 kg % of total		Ijesa Isu ₦/100 kg % of total	
Transport Rent Storage Association dues Security	375.00 187.50 325.00 206.25 118.75	30.9 15.5 26.8 17.0 9.8	277.50 230.25 262.50 231.25 100.00	25.3 20.9 23.8 20.9 9.1	440.00 244.00 128.88 0.00 122.22	47.1 26.0 13.8 0.0 13.1	255.00 200.00 131.25 500.00 100.00	21.5 16.8 11.2 42.1 8.4
Total	1,212.50	100.0	1,101.25	100.0	935.10	100.0	1,186.25	100.0

Source: Ayeni 2005.

Note: The costs of Gari to the traders were not specified in this study.

The foregoing discussion has shown that variation in agricultural productivity in SSA, including Nigeria, has been mostly attributed to conventional inputs; there is potential for higher growth with increased use of fertilizer, machinery, and livestock inputs. Yet increased use of these inputs is limited by poor infrastructure, a poor policy environment, and lack of cash for input purchase (Byerlee and Heisey 1996; Heisey and Mwangi 1996; Larson and Frisvold 1996). The study by Messer et al. (1998) lists constraints including lack of improved crop varieties, pesticides, policy reforms (in tax and foreign exchange), improved transportation, improved communication, improved education, improved extension services, increased support for research, and improved title to land. These views are largely supported by Pingali and Heisey (1996).

Domestic and External Trade Constraints

The outputs of each agricultural commodity are allocated to domestic or external consumption or both. The quantities of either domestic or external demands for an agricultural output are expected to have an impact on domestic producers' income. Specifically, an increase in the level of domestic or foreign demand or both is expected to translate into an increase in domestic producers' income. Stated differently, low demand (domestic or foreign) for a country's agricultural output could reduce domestic farmers' ability to purchase and use inputs at recommended levels, which in turn could affect agricultural productivity. Related to this is the tendency for domestic consumers to prefer cheaper and better-quality foreign products.

For example, Nigeria had never exported maize or rice. Rather, it had net-imported these commodities, except as interrupted by import restrictions or outright bans or both. For these cereal commodities and for cassava products as well there had been unresolved problems of price competitiveness. Most of the farmers get access to fertilizers, the principal purchased inputs, in the open market. At open market prices, small farmers use less than recommended levels, realizing yields too low to effectively compete internationally. An added problem is the high cost and inefficiency of post-harvest processing. The results are poor retail price competition with imported commodities, as illustrated in Tables 24 and 25.

Table 23. World market prices and local producer prices for maize/metric ton

Year	Imported maize $/metric ton*	Local maize at farmgate N/ton	Exchange rate N/$	$ equivalence of maize local price
2000	88.33	20,175	111.49	180.95
2001	89.57	25,824	120.47	214.36
2002	99.19	28,000	140.33	199.53
2003	104.31	33,000	133.11	247.92

Source: Computations based on FAOSTAT and Central Bank of Nigeria data.

Maize: United States Yellow, f.o.b. Gulf ports

Table 24. World market prices and local producer prices for rice/metric ton

Year	Import price of rice $/ton	Local price of rice at farm gate N/ton	Exchange rate N/$	$/ton equivalence of local rice price
2000	248.64	48,670	103.79	468.93
2001	185.10	73,000	111.49	654.77
2002	205.84	75,000	120.47	622.56

Source: Computations based on FAOSTAT and Central Bank of Nigeria data.

Further comments are probably in order in the case of cassava products, of which the world market prices are shown in Table 25. As was noted for the other arable crops already reviewed, on-farm costs of cassava production is still very high at the dominant small scale level in Nigeria. It is estimated that the cost of managing 1 ha of cassava farm from land preparation to harvesting in 2003 was about N70,000. This translates into about US $507.25 per ha. The critical factors in cassava production are fertilizers, agro-chemicals for the control of cassava mosaic virus, bacterial blights and Anthracnose diseases, among others. The agro-chemicals are largely imported at prohibitive costs to the nation.

Nigeria leads the world in tuber production. But Thailand leads the world in the export of cassava products. Thai export prices must therefore be kept in view to determine the competitiveness of Nigeria's cassava products (Table 25).

Table 25. Prices of Thai cassava product exports, 2002, $/metric ton

Cassava product	Export price
Cassava (pellets)	US $65.84
Cassava starch	US $175.94
Cassava tapioca	US $244.11

Sources: http://faostat.fao.org/

Taking the case of cassava pellets for an illustration, let us adopt the 2003 cassava yield as 10 mt (approximately). One metric tonne of cassava chips can be processed from 4 mt of unpeeled cassava tubers. Using the information provided thus far, it is clear that a tonne of cassava chips will cost at least US $202.90 to produce, which should also be the minimum producer price. Obviously, this amount is way above the Thai price in the above table. Thus, it will be difficult to sell the Nigeria's processed cassava products on the world market if the producer price already is higher than the export price the same commodities from other parts of the world, and more so that the producer price does not yet include marketing costs to the shipment ports.

Commodity-Specific Constraints

This section presents production constraints that are specific to some of the presidential initiative commodities and to maize. And, where relevant, some of the constraints that limit value additions to these commodities are mentioned.

Cassava

Nigeria produces the largest amount of cassava in the world, followed in descending order by Brazil, Thailand, the Democratic Republic of Congo (DRC), Ghana, Tanzania, Mozambique, Uganda, and Madagascar. Available data suggests that Nigeria will continue to expand its output of cassava during the 2000s. The world's demand for cassava in various processed forms has expanded and continues to expand and Nigeria must take maximum advantage of this development. Nigeria's cassava products are still of low value and quality. The export of unprocessed cassava will fetch little international value and place the primary producers at economic disadvantage (Taylor et al. 2004).

There is a continuing debate on how to achieve the government's $5 billion cassava export annual target. A subcommittee's 2002 report estimates that at least 150 million mt must be produced by the end of 2006 to meet the revenue target. This in turn calls for a national cassava area expansion from 3 million to 5 million ha and average yield of 30–32 t/ha.

A more conservative estimate puts national cassava output at 40 million mt by 2005 (Taylor et al. 2004).), based on a linear trend estimate. A similar linear extrapolation of area planted suggests 4 million ha by 2007. Exponential extrapolation suggests 60 million mt of production by 2007. There is a problem here. Cassava yields have stagnated at about 9–11 t/ha since the 1980s, while yield of at least 15 t/ha is required to achieve production of 60 million mt by 2007 (Taylor et al. 2004).).

An important mover toward attaining the target is the availability of high-yielding, cassava-mosaic-resistant varieties. The IITA and NNPC are implementing a four-year action plan in this respect. Most recent attempts to expand cassava production have been done under the Roots and Tubers Expansion Programme (RTEP).

The institutional framework for cassava production in Nigeria includes the National Root Crops Research Institute (NRCRI), Umudike, IITA, Ibadan, and RTEP. RTEP, funded by a loan from IFAD, was established mainly for multiplication and distribution of planting materials. RTEP is an IFAD-assisted project with counterpart contributions from federal and state governments. It was initially conceived as a root and tuber multiplication scheme, but later included a post-harvest component as a result of anticipated production expansion. The program was implemented in 27 cassava-producing states and was recently recommended to include processing and marketing components (PRCU 2006).

Strong collaboration exists between NRCRI and IITA in several cassava projects in Nigeria. NRCRI has a national mandate for root crops research in Nigeria, while IITA has international mandate that covers cassava development. IITA's cassava studies made important inputs into NEPAD's Pan African cassava initiative and the PIOC in 2003. Three cassava projects are being implemented through IITA: the preemptive management of cassava mosaic disease (CMD); the cassava enterprise development projects in Africa (CEDP); and the cassava biofortification project. The CEDP and CMD complement each other and together are referred to as the integrated cassava project (ICP) within IITA.

Cassava Production Constraints

A total of 17 cassava varieties have been released in Nigeria (FDA/FMANR 2005). The dominant varieties are TMS 30572 and TMS 4(2) 1425. Most of the varieties already released have multiplication problems. One problem is that outgrowers are often denied good prices for the resulting cassava tubers at the end of the growing season. And, while some of the varieties are high yielding, they score low on other parameters such as resistance to drought, pests, and disease, or even early maturity.

On-farm costs of cassava production are still very high at the small-scale level in Nigeria. It is estimated that the cost of managing 1 ha of cassava from land preparation to harvesting is about N70,000, if all recommended practices and input levels are followed (Taylor et al. 2004).). This translates into about US$583 per ha (assuming USD1.00= N120.00, March 2008). Agrochemicals are important in cassava production for the control of cassava mosaic virus, bacterial blights, and anthracnose diseases, among others. But agrochemicals are often imported at prohibitive costs to the nation. Thus, fertilizers and insecticides are rarely applied to recommended levels. In Table 26, for example, only 8.8 percent and 4.1 percent of the variable costs are accounted for by fertilizers and insecticides, respectively. Because cassava is known to tolerate a lower dosage of fertilizers than crops such as maize and rice, farmers, because of high purchase costs, are more likely to allocate their limited supplies away from cassava in favor of more fertilizer-dependent crops. The major variable costs were cassava cuttings (35.9 percent) and herbicides (38.3 percent). The high expenditure on herbicides, despite being largely imported and therefore costly, reflects the magnitude of weeds and the scarcity of rural labor.

Table 26. Components of variable costs of production on a representative cassava farm, Ogun State, 2005

Cost items	Amount (₦/ha)	% of total
Fertilizer	1,276.80	8.8
Herbicides	5,569.80	38.3
Planting materials and cuttings	5,220.60	35.9
Insecticides	592.50	4.1
Other variable costs	1,890.00	12.9
Total	14,549.00	100

Source: Osibeluwo 2005.

Cassava Post-Harvest Constraints

Industrial uses as chips, syrup concentrates, and cassava flour accounts for the remaining 10 percent, 5 percent, and 1 percent, respectively. Thus, the role of processing activities in maximizing the uses of cassava in Nigeria cannot be overemphasized (IITA 2007). A cassava

tuber contains 60–70 percent moisture by weight and a shelf life of 2–3 days. And, as large-scale cassava processing in Nigeria is still limited, most farmers still dispose of tubers at very low prices. The bulkiness of cassava tubers increases transport cost to processors. There is therefore no option for increasing the shelf life of cassava products other than processing.

Cassava processors at every level face daily challenges. Medium- to large-scale processors face problems such as inadequate equipment and fabricators. Problems common to all processors include unstable market conditions, unstable government trade policies, and difficulty sustaining the supply of cassava. For example, the Mosaconi cassava factory in Kogi state was established in 1993 for producing packaged gari and laundry starch. It had no cassava farms of its own, and therefore depended solely on tuber supplies from surrounding farms. The company had to close in 1999 due to unreliable supply of cassava roots by its contract growers (Taylor et al. 2004).).

Maize

Maize was not covered by any presidential initiatives. We have included the crop in this discussion, however, because of its importance among the cereal crops in Nigeria, rising world prices for maize, rapid growth in production, and the potential for substantially increased maize production with suitable use of improved technologies and inputs. Maize is now widely accepted as a major source of food and cash income among its predominantly smallholder producers in Nigeria. Maize has evolved in Nigeria from a backyard crop in the 1970s to a commodity that is third since the 1990s to sorghum and millet in terms of output and area cultivated (Phillip 2001).

The expansion of maize production over time may reflect positive domestic supply response since the mid-1980s to selective macroeconomic policies of government, including the import ban on some cereals. Other factors are equally significant. First was the development, through collaborative research, of fertilizer-responsive and early maturing open-pollinated and hybrid varieties (IITA 1990). Second, there was enhanced adoption of maize growing and maize-related technologies through the vigorous extension activities of the World Bank–assisted Agricultural Development Projects (ADPs). Third, there has been prolonged concessional pricing of fertilizers, the critical input class in maize production in most parts of Nigeria. The subsidy on fertilizer procurement, distribution, and pricing averaged over 70 percent per annum during most of the period before the mid-1990s (Phillip et al. 2000). Presently, some of the subsidy elements are still retained. And fourth is the relative ease of transporting and storing maize grains.

Several years of research have been undertaken in Nigeria on maize by IITA and NARIs toward varietal development in relation to fertilizer response, early maturity, and resistance to pests, diseases, and parasites in Nigeria. Much of the research work has occurred in the northern guinea savannah areas, perhaps due to the proven high yield potential in that agro-ecology. The benefits of these and other research programs on maize have diffused slowly but widely through the years and over many smallholders and consumers.

Maize Production Constraints

Table 27 shows a sample of maize varieties that have been developed, released, and sold to farmers since 1989. Seed multiplication is done by the ADPs through outgrower schemes. The ADPs often assist the outgrowers by providing fertilizers and other production inputs. However, this scheme is constantly threatened by fertilizer shortages and lack of protection for the outgrowers. For example, in a 2002 report, the Ogun State Agricultural Development

Programme (OGADEP) noted that "during the (second) quarter, 14.083 mt of excess maize seeds, earlier received above the 25 mt approved by the state seed coordinating committee, were returned to the outgrowers. This was due to the fact that the agro-services corporation only collected 15 mt for distribution out of the intended 25 mt. Moreover, efforts to sell the excess quantity of maize seeds to neighboring ADPs did not materialize."

Table 27. Sample of maize varieties released and sold to farmers since 1989

S/N	Variety code	Variety	Year sale began
1	OBA-SUPER-I	Hybrid	1991
2	OBA-SUPER-II	Hybrid	1989
3	NEW KADUNA	OP	1989
4	P-3236	OP	1990
5	DMR-LSR-W	OP	N.A.
6	SUWAN-1-SR	OP	N.A.
7	DMR-ESR-W	OP	1991
8	PAN-6195	Hybrid	1991
9	PAN-6193	Hybrid	1996
10	DMR-LSR-W	OP	1995
11	DMR-LSR-Y	OP	1997
12	DMR-ESR-W	OP	1997
13	DMR-ESR-Y	OP	1992
14	TZ-PE-SR-W	OP	1997
15	SUWAN-1-Y	OP	1992
16	TZE-COMP-III	OP	1996

Sources: Premier Seeds Company (S/No 1-7), UAC Seeds Company (S/No 8-16)

Note: N.A.: not available OP: open pollinated

Table 28 is presented to place in clearer context the variable costs structure under smallholder maize production. As shown, fertilizers took the largest share of the maize production costs (66.2 percent). This is not surprising given the core role of fertilizers in the yield enhancement of improved varieties of maize. It should be noted that the total variable costs per hectare in Table 28 (N9,556.92) is much less than the levels of input usage recommended by the ADPs. For example, the recommended dosage for NPK fertilizer is about 250–300 kg/ha. This would amount to an expenditure of N10,750 to N12,900/ha for fertilizer alone, at the 2006 open market price of about N2,150/50 kg bag of NPK.

Table 28. Components of variable costs of production on a representative maize farm, Ogun State, 2005

Cost items	Amount (₦/ha)	% of total
Tractor hiring	758.62	8.8
Labor	826.61	9.7
Seed	140.08	1.6
Fertilizer	5,663.31	66.2
Agrochemical	253.89	2.9
Other variable costs	914.41	10.7
Total	**9,556.92**	**100**

Source: Kukoyi (2005)

Maize Post-Harvest Constraints

Making food available goes beyond increasing on-farm production. There must be concerted effort to improve food processing, storage, and distribution.

Most of the maize processing in Nigeria still occurs at the cottage level by individual small-scale processors and their cooperative societies. The NARIs have made considerable progress in the development of agroprocessing equipment. But progress toward commercialization and multiplication has been slow. The NARIs have no explicit mandate to multiply or commercialize the machines and equipment they develop. The small and medium enterprises (SMEs) that are expected to fulfill these roles are themselves constrained by poor awareness about the existing on-shelf technologies, poor capital base, and low capacity to compete with foreign (imported) substitutes.

Year-round grains availability is low in Nigeria due to a combination of low productivity and post-harvest losses. Stored grains are partially lost to storage pests and diseases. An estimated 10 percent of the total production of grains and 20 percent of the total production of tubers are lost or wasted annually to poor storage or lack of storage (Babalola 2003; Adetunji 2006).

Formal credit still eludes many traders who engage in maize storage. Fund sources are either the traders themselves or, to some extent, the cooperatives they belong to. As a direct consequence of the lack of adequate funding for their storage activities, most traders resort to short-duration maize storage, as shown in Table 29.

Table 29. Length of maize grain storage (weeks)

Storage duration (weeks)	Number of farmers	%
< 2 weeks	8	44.45
2–4 weeks	10	55.55
> 4 weeks	0	0
Total	**18**	**100**

Source : Babalola 2003.

The cost per ton of stored grains declines as the stored quantities of maize, rice, and cowpea grow larger. But liquidity constraints may limit storage traders' ability to achieve the full benefit of scale economies (Babalola 2003). Because farm-level grain storage may not deliver the benefits of large-scale storage, the government has put in place capital-intensive storage structures in various parts of the country. Under the National Food Security Programme, the government assigned grain storage responsibilities to the three government tiers as follows (Table 30):

Table 30. Grains storage responsibilities by tiers of government

Program	Minimum grain holding (% of national)	Tier of government
On-farm adaptive storage	75%	Local government and interested foreign organizations
Buffer stock reserve	20%	State
Strategic grain storage reserve	5%	Federal

Source:

Under the Strategic Grains Reserve Programme (SGRP), government acts as the buyer of last resort for farmers. Eight of the planned metal silos have been completed nationwide, with the capacities listed in Table 31.

Table 31. Installed grains storage capacities of completed metal silos under the SGRP

Location	State	Capacity '000 mt
Lafiagi	Kwara	11 000
Minna	Niger	25 000
Gombe	Gombe	25 000
Akure	Ondo	25 000
Ogoja	Cross rivers	25 000
Irrua	Edo	25 000
Makurdi	Benue	25 000
Jahun	Jigawa	25 000
Total installed capacity		186 000

Source: Nigerian Agricultural Magazine (1999), cited in Babalola (2003)

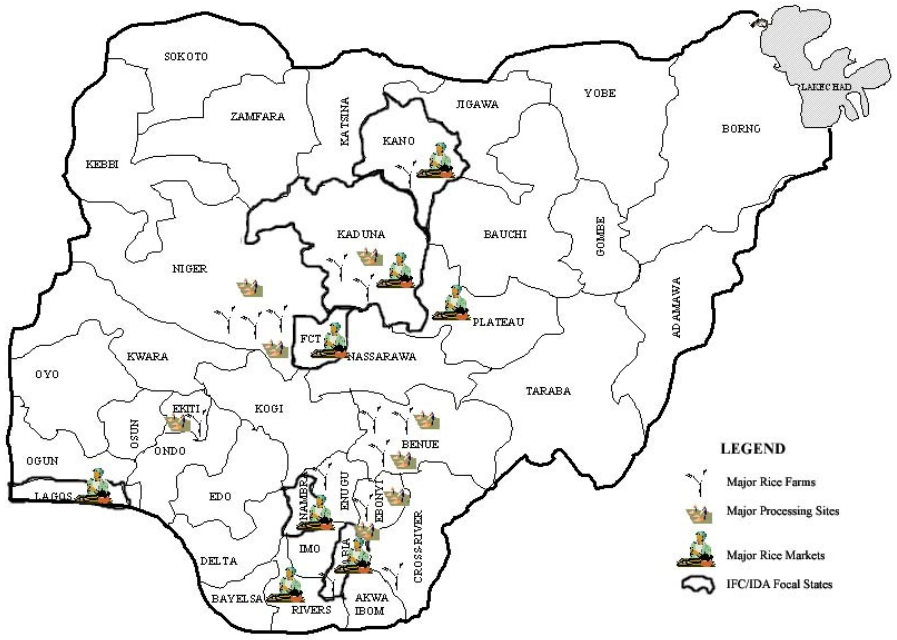
Lack of funding has slowed completion of the other silos and limited the full utilization of completed ones. For example, the eight completed ones held only 3.72 thousand mt of assorted grains in 1999. These storage levels cannot meet a food disaster or encourage more production. Also, farmers have no direct access to government silos.

Rice

Rice is an important food commodity across the West African subregion, including Nigeria. The subregional per capita rice consumption is about 40 kg per annum, while Nigeria's consumption level grew from less than 15 kg in the 1980s to nearly 30 kg in the 2000s. Thus, Nigeria still lags in per capita rice consumption behind the West African average, likely arising from a combination of low domestic production, limits on imports, and low purchasing power of rice consumers (Daramola 2005)

Rice is produced in Nigeria within upland, hydromorphic, and rainfed lowland ecologies, all of which account for at least 70 percent of the total area under rice. In the irrigated systems, rice is the dominant crop, especially in the northern parts of Nigeria. However, in the rainfed production systems, rice is only a part of often complex cropping arrangements, and this complexity tends to vary between ecologies (Ogungbile and Phillip 1996). Figure 4 shows the major rice-producing areas in Nigeria.

Figure 4. Map of Nigeria showing rice-growing areas



Source: Daramola 2005.

Rice Production Constraints

In addition to the local varieties, farmers grow or have adopted over the years several improved varieties of rice within the various production systems already mentioned. Through the research activities of the National Cereals Research Institute (NCRI), Badeggi, and IITA, Ibadan, several rice varieties have been released to farmers, and even improved upon. In recent years, the West African Rice Development Association (WARDA, renamed in 2003 as the Africa Rice Center) has joined in the collaborative rice development effort.

Seed multiplications are done by the ADPs through outgrower schemes. For maize, the ADPs often assist the outgrowers by providing fertilizers and other production inputs. However, these schemes are threatened by fertilizer shortages and lack of protection for the outgrowers.

Table 32 shows that seed and fertilizer together accounted for 32 percent of the total variable costs per hectare, while labor for fertilizer application, weeding, land clearing, planting, bird scaring, and harvesting accounted for 62.2 percent of the variable costs of rice production in this study. Again, as noted earlier for maize, the total variable costs per ha in Table 32 are far less

than they would have been if the farmers surveyed could have afforded the recommended practices and inputs for rice.

Table 32. Components of variable costs of production on a representative rice Farm, Ogun State, 2006

Cost items	Amount (₦/ha)	% of total
Seed	3984.66	20.5
Fertilizer	2223.68	11.5
Pesticide	1125.00	5.8
Fertilizer application	439.58	2.3
Weeding	1703.03	8.8
Land clearing	3013.68	15.5
Planting	2655.56	13.7
Bird scaring	3131.64	16.2
Harvesting	1115.69	5.7
Total	19,392.52	100

Source: Oladele 2006.

Rice Post-Harvest Constraints

Most of the rice processing in Nigeria still occurs at the cottage level by individual small-scale processors and their cooperative societies. Powered paddy processing is still limited in many producing areas in Nigeria. Thus, paddy processing in many rural producing communities still depends mainly on manual options. Due to credit constraints, usually no more than two threshing machines are available, even in rural communities with electricity.

Many farmers sell their paddy unprocessed, which results in poor quality and low farm gate prices. Where accessibility is an added problem (for example, isolated markets), farmers must accept a further cut in the farmgate price from rural assemblers and/or rural wholesalers (FAO 1992).

Attempts have been made to set up urban rice mills in some northern states. Examples include the Atafi rice mill (Jigawa state), the Haske rice mill (Sokoto state), and the Upper Benue rice mill (Adamawa state). One common feature of these and other large-scale mills is that they are barely operational due to lack of spare parts caused in part by the increasingly scarce foreign exchange to local processors.

Rice storage at the farm level is still small in scale and based on traditional uneconomic methods. Rice storage functions are mainly performed by grain traders within the cereals marketing chain. Lack of adequate funding of their storage activities leads to short-duration rice storage, as shown in Table 33.

Table 33. Length of rice storage (weeks)

Storage duration (weeks)	Number of farmers	%
< 2 weeks	37	33.64
2-4 weeks	74	66.36
> 4 weeks	0	0
Total	111	100

Source : Babalola (2003)

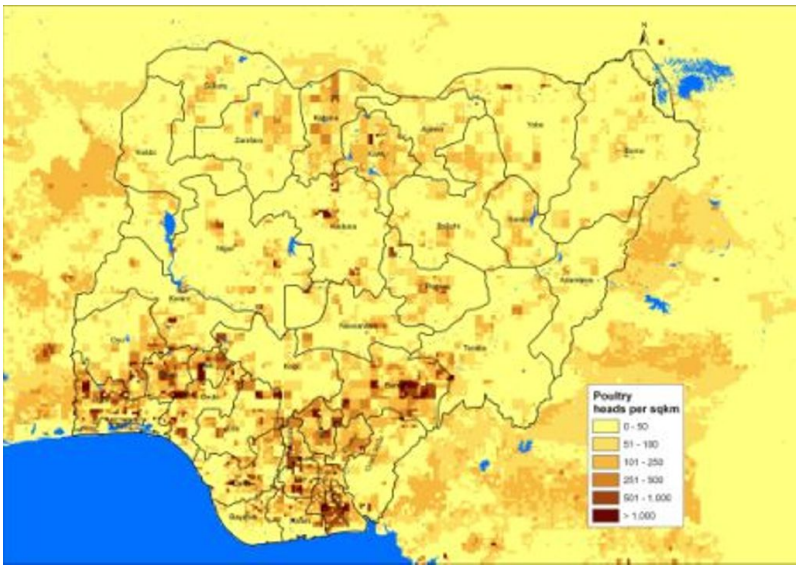
As was noted for maize, the cost per ton of stored rice grains has been found to decline with quantity stored. Thus, profit per ton of stored grains tends to increase with quantity. But lack of funds was found to limit the full benefit of scale economies (Babalola 2003).

Livestock-specific Constraints

The Federal Department of Livestock and Pest Control Services is responsible for initiating national livestock policy and regulatory functions relating to the livestock subsector. Government's role is to facilitate private-sector investment in production, processing, and marketing (PCOL 2003).

The livestock sector plays important roles in the Nigerian economy. The sector's contribution to the agricultural GDP has remained stable between 15–20 percent in the past decade. The Projects Coordinating Unit (PCU 1999) that at least 97 million assorted poultry birds are raised in Nigeria. The estimated poultry population by region includes 17.8 milion birds in the northwest, 15.8 million in the northeast, 22.6 million in the central zone, 16.0 million in the southeast, and 24.3 million in the southwest (Figure 5).

Figure 5. Map of Nigeria's poultry-population densities



Courtesy: Sonder, Kai (IITA, Ibadan), March 2008.

By 2001, Nigerians were rearing about 15.6 million cattle, 28.7 million sheep, 45.3 million goats, 5.3 million pigs, 118.6 million poultry, and 1 million horses, camels, and donkeys. After poultry, goats and sheep are the most widely distributed livestock in Nigeria (PCOL 2003).

There is an acute shortage of animal protein in Nigeria. A minimum intake of 34 gm of protein is recommended per capita per day (NARP 1994). The national estimated daily per capita intake by 1993 was 3.9 gm, allowing for fish and wildlife contributions, and 3.2 gm without. All factors considered, it has been estimated (NARP 1994) that the average daily per capita protein intake by 2010 will be only 5.3 gm, still far below the FAO recommendation (34 gm). Thus, the challenges ahead are still enormous. Expanded production of poultry is one vital way forward for reducing this shortage.

Based on FAO (2004) production estimates, poultry meat production in Nigeria averaged only 179,667 mt during the 1998–2003 period. Egg production during the same period was estimated to average 434,000 mt. During 1998–2003, Nigeria therefore produced, on the average, a total of 613,667 mt of both poultry meat and eggs per annum.

On the basis of the required 34 gm per capita daily consumption of protein, it is estimated that the minimum annual supply of poultry products required is 1,737,400 mt, assuming a national population of about 140 million. It is therefore not surprising that Nigeria has traditionally depended heavily on poultry products importation to meet the supply gap.

Major Constraints to Livestock Production

According to a 2003 report of the Presidential Committee on Livestock (PCOL), the constraints to livestock production in Nigeria can be broadly summarized to include "biological limitations of the indigenous breeds of animals; seasonal availability of production inputs such as feed, water and good quality pasture; and lack of effective veterinary services and availability of vaccines and veterinary drugs at reasonable costs." Following are some of the specific constraints of livestock productivity in Nigeria, as outlined in PCOL (2003).

Feeds and Nutrition Constraints

Feeds constitute at least 60 percent of the total variable costs of livestock production in Nigeria. Monogastric animals such as pigs and poultry depend on compound feeds, which are affected by the availability and quality of the constituent raw materials. The ruminants feed mainly on forages and crop residues, which are also affected by seasonality.

The specific constraints to livestock feed compounding include:

1. severe shortages of grains and oil seeds;
2. low capacity utilization in the agro processing sector, which in turn limits the amount of by-products and wastes available to the feed industry;
3. limited availability of grains for human consumption and industrial processing, which in turn affects availability of grains for feed manufacturing; and
4. capacity utilization in the feed industry is perennially less than 30 percent, due to the above constraints.

The availability of ruminant feeds is specifically constrained by:

1. poorly developed grazing reserves and related infrastructure;
2. poor crop/livestock integration, which still results in high dependency on external inputs for crop and livestock production; and
3. poorly developed agroforestry practices that would have otherwise promoted joint production of crops, livestock, fodder, and crop residues.

Arising from these constraints, ruminants experience seasonal weight gain/loss during the wet/dry periods of the year.

Animal Breeding and Improvement Constraints

About 90 percent of the national livestock herd is under traditional management. Thus, genetic factors seriously limit livestock productivity in Nigeria. Complete absence of grandparent stock

(GPS) affects productivity, especially of the poultry subsector. A related problem is the collapse throughout the entire country of the breeding and multiplication programs for livestock. Furthermore, while the breeding programs were still active, there was little or no recordkeeping as a basis for breed selection (PCOL 2003).

Processing and Marketing Constraints

Livestock marketing in Nigeria has traditionally taken the form of movement of animals from the livestock-producing areas, mainly in the north, to the southern terminal markets. The animals transported are mainly cattle, sheep, and goats. Livestock marketing and processing constraints in Nigeria include poor packaging facilities for products in the value chains, lack of cold storage facilities in abattoirs at wholesale and retail markets, and absence of standards for meat and other livestock and poultry products.

Veterinary Services Constraints

Public veterinary services have declined over time in Nigeria. Livestock diseases account for 30 to 40 percent of the losses in the productivity of animals in Nigeria (PCOL 2003).

Grazing Reserves and Stock Routes Constraints

Transhumant pastoralists own over 85 percent of the ruminant population in Nigeria. The pastoral system relies on natural rangeland for ruminant feeding. The system operates under difficult arid and environmental conditions. Diminishing availability of water and grazing pastures poses a continuing challenge. Increased cropping activities have reduced the available water and grazing resources, leading to conflicts among pastoralists, fishermen, and farmers.

Feeds constitute more than 50 percent of the total costs of poultry production today in Nigeria. Most of the major poultry companies in Nigeria locally source virtually all the constituents of their poultry feeds, in an attempt to conserve foreign exchange. Maize, which constitutes at least 60 percent of the feed components, is either purchased from neighboring farms or sourced from poultry-company-owned farms. Other feed components purchased from farmers include sorghum, soybeans, and dried cassava. This development therefore shows mutual dependency among the livestock and the crop subsectors in the country. The relationship assures benefiting farmers a steady market and price for their crop harvests.

Livestock Trade Policy Constraints

The Nigerian poultry industry has experienced productivity and marketing problems for years. Until 2001, frozen broiler and turkey meats were imported at no more than half the price of locally produced equivalents. Thus, the industry, facing the problem of high production costs, found it difficult to compete with imported poultry products.

Government has intervened since 2002 in by selectively banning on the importation of poultry products, principally frozen poultry meat. The intervention is partial because hatchable eggs still are imported since the country does not have any local source of grandparent stock (GPS). Also, there is no ban on the importation of table eggs, probably because of the risks inherent in transporting eggs.

Top on the list of problems facing the local poultry industry is the instability of the government's policies regarding poultry products and the importation of feed ingredients. Before the ban on

imports of frozen poultry meat, year-round local production was risky because peak demand was associated mainly with the four (Christian and Muslim) festive periods. Outside these periods, glut was the likely consequence of production. Unstable government policies have tended to limit medium-term and especially long-term investments in the industry.

Since the imposition of the import ban in 2002, year-round production has been relatively secured for the poultry industry. The only trace of glut subsequently occurs between late October and the end of November. The experience of poultry farms shows that previous gluts could not be erased even by product price reduction because production cost was already high. The ban has drastically reduced this problem since, in the absence of imported poultry items, a slight price reduction easily erases any glut experienced.

In summary, the constraints to expanded broiler production in Nigeria include high cost of inputs, which tends to make poultry products, especially meat, more costly at the retail end than their imported counterparts; poor-quality feeds, since most small- to medium-scale producers cannot afford to feed poultry at recommended levels or appropriate feed mix ratios; inadequate infrastructure such as electricity, roads, and storage; and poor access to needed capital and funds.

Avian Influenza

Authorities in Nigeria announced the outbreak of deadly H5N1 avian influenza (bird flu) in a Kaduna state commercial firm. While the outbreak was announced February 8, 2006, the initial outbreak was believed to date back to about January 10, 2006. Evidence of the spread of the virus was detected in neighboring states like Kano, Plateau, Katsina, Bauchi, and Abuja (WHO 2006a).

There was fear in the official circles that the virus outbreak could cause human health epidemics, especially because of the close human contact with poultry species in the rural areas where more than 70 percent of the birds are raised as a backyard business. Nigeria is believed to raise an estimated 140 million assorted poultry animals (WHO 2006b). Also, evidence of human fatality has been reported in Asia (UK Clinical Virology Network 2004).

Fortunately, no human fatalities were reported for the period of the virus outbreak in Nigeria. But collateral losses, in the form of culled, burned, and/or buried birds, transitory avoidance of poultry products by consumers, anda temporary ban imposed by other countries on the import of Nigeria's poultry products, were significant (CIDRAP 2006).

Conclusions and Policy Recommendations

This review has identified various categories of constraints to increasing agricultural productivity in Nigeria. These constraints include those arising from agricultural policies that have been formulated over time. Some constraints, such as poor and untimely release of funds and high offshore costs of equipment, limit the implementation of the v presidential initiatives Others, such as aging and inefficient processing equipment and high on-farm costs of agrochemicals, limit the effective functioning of the value chains (production, processing, and marketing) for key agricultural commodities.

Constraints to commercializing agroprocessing R&D results and implementing the Strategic Grains Reserve Programme (SGRP) include poor funding and a lack of effective linkages between researchers and the private sector. Constraints that limit livestock productivity include

those affecting feeds and nutrition, animal breeding and improvement, livestock processing and marketing, and grazing reserve and stock routes. Constraints that limit productivity across the entire agricultural sector include poor agricultural pricing policies, low fertilizer use, gender-specific issues, low access to agricultural credit, low and unstable investments in agricultural research, poor funding and coordination of agricultural extension, insecure land tenure, land degradation, and poor market access and low marketing efficiency.

In conclusion, the major constraints to increasing agricultural productivity in Nigeria are as follows:

- Government direct participation in the provision of many farm inputs and services, and in the production, processing and marketing of farm commodities;
- Policy reversals and inconsistencies;
- Aging and inefficient processing equipment, and the inability to install new processing equipment due to high offshore costs;
- High on-farm costs of agrochemicals for small-scale farmers, resulting in low use by farmers; Constant threats to seed multiplication schemes by fertilizer shortages and lack of protection for outgrowers;
- Compounding of feeds which are affected by the low availability and low quality of the constituent raw materials;
- Traditional management practices which seriously limit crop and livestock productivity;
- Absence of GPS, which limits livestock productivity, especially in the poultry subsector;
- Collapse of the breeding and multiplication programs for livestock;
- Fertilizer subsidies, which cause a high budgetary burden on the government;
- Low fertilizer use;
- Low public expenditure on agricultural research;
- Negligible private sector involvement in agricultural research;
- Poor funding for T&V and UAES; and
- Group ownership of land in Nigeria, which may lead to limited tenure security, restrictions on farmers' mobility and the inevitable fragmentation of holdings among future heirs.

Policy Recommendations

In order to ensure sustained and increased inflow of investment in agriculture, agricultural policies must endure and outlive the government that formulated them. The practice of changing macroeconomic policies with successive federal governments is inimical to long-term investments in agriculture. Therefore, the various tiers of government should act in concert with the economic reform agenda to promote a greater role for the private sector in agricultural production, the processing and marketing of farm commodities, and the provision of farm inputs. There is a need for the government to release approved budgets in an adequate and timely manner so that projects are implemented.

In addition, the government should promote private-sector participation by attracting foreign investors in local provision and production of needed machinery, equipment and farm inputs. In the long-run, expanded local production of these inputs will likely lead to reduced unit costs through scaled economies. Outgrowers and private companies should strengthen their contract arrangements as it may be difficult to promote and enforce such contract details with any tier of government.

Government should support the NARIs by promoting awareness of the technology prototypes they have available. Private agroprocessing SMEs, NARIs, and financial institutions (especially commercial banks) should cooperate to develop these prototypes into commercial products.

Government should also promote private ownership and operation of silos. This will help to both expand storage capacity nationally and relax the financial burden on the government. Since most of the community-level agroprocessing occurs through cooperative organizations, these agroprocessing cooperatives must be strengthened to ensure their ability and capacity to attract credit.

Regarding the various constraints to increasing livestock productivity in Nigeria, these recommendations of the PCOL (2003) should be emphasized, namely the need for

- Increased capacity utilization in Nigeria's feed industry;
- Enhancement of feed quality and efficiency;
- Stronger emphasis on feed inputs delivery system to small holders;
- Improved utilization of agroindustrial by-products and crop residues;
- Accelerated pasture seed production;
- Pasture improvement and rangeland rehabilitation;
- Strategic feed reserves;
- Agroforestry development;
- Establishment of cattle, sheep, goat and pig selective breeding centers and multiplication centers;
- Establishment of poultry breeding centers;
- Establishment of artificial insemination centers;
- Provision of market information services;
- Establishment of a poultry products processing program;
- Monitoring and enforcement of prescribed standards and laws for livestock and livestock products;
- Rehabilitation of existing abattoirs and milk processing plants and establishment of new ones, where necessary;
- Development of appropriate infrastructure at all levels of livestock marketing;
- Accelerated development of grazing reserves;
- Accelerated development of stock routes and grazing corridors; and
- Settlement and empowerment of pastoralists.

Fertilizer subsidy programs in Nigeria need to be market responsive. Specifically, input subsidy programs should be used to develop, not weaken, competitive private sector-led input markets. Such programs should be targeted to poor farmers who, without subsidies, would not adopt key inputs. They should complement, not undermine, commercial sale outlets. They should be limited in duration—that is, accompanied from the start with a phase-out schedule.

Agricultural commodities in Nigeria need adequate pricing, so that farm incomes will be high enough to enable farmers to purchase farm inputs. Adequate pricing must be accompanied by improved knowledge among farmers on the use of fertilizers, and adequate linkages among traders, suppliers, and farmers. There is the need for active private sector and government partnership to promote small-scale irrigation to reduce the risk associated with rainfall and to increase the profitability of adopting fertilizer, and also to develop domestic capacity for fertilizer production.

The government should sustain the current drive toward improved access for women to farmland, extension services, and related farm inputs, with the active support of local CBOs and international development agencies.

Banks must ensure that loan terms flexibly relate to cash flows in the target business, the input demand and supply structure, and computable business risks. The federal government must strengthen its agricultural credit guarantee scheme, in order to reawaken the confidence of commercial banks.

To achieve the desired impact of research funding on agricultural productivity in Nigeria, The government must encourage private investment in agricultural research and development and act with greater transparency and timeliness in the budgeting, approval, and fund release processes of agricultural research. Whatever agricultural extension model is adopted, the government's direct promotion and practice of extension delivery in Nigeria must be divested. Larger participation by the private sector will reduce the budgetary burden and improve delivery efficiency.

The National Assembly should review the Land Use Act of 1978. Communal ownership of farmland will be difficult to dismantle in the foreseeable future; however, the elements which appear to differ among communities need to be reviewed within the context of each community, towards improving individual titles to farmland, bearing in mind the need for gender equity.

Finally, the government must make greater investments in transportation infrastructure, especially rural-urban roads and markets. Improvement in road quality will attract private investment in transportation, improve access to purchased inputs, credits and output markets, and enhance marketing efficiency.

References

Abalu, G.O.I. 1975. Supply response to producer prices: A case study of groundnut supply to the Northern States Marketing Board. *Savanna* 4 (1): 33-40.

Adesina, A.A., and J. Chianu. 2002. Farmers' use and adaptation of alley farming in Nigeria. In *Natural Resources Management in African Agriculture*, eds. C.B. Barrett, F. Place, A.A. Aboud, 51–63 Nairobi, Kenya: ICRAF and CABI.

Adesokan, J.T. 2007. Economic analysis of cassava production in Kajola local government area of Oyo state, Nigeria. Unpublished B. Agric project, Department of Agricultural Economics and Farm Management, University of Agriculture, Abeokuta.

Adetunji, O. 2006. Creating appropriate technology as a means of waste minimization in cassava end products. www.nifst.org/?nifst:articles.

African Development Bank (AfDB). 2002. Gender, poverty and environment indicators on African countries, 2002–2003, vol. III. Tunis, Tunisia: AFDB.

Africa Fertilizer Summit. 2006. http://www.africangreenrevolution.com/en/green_revolution/africas_predicament/fertilizer_summit/index.html.

Aigner, D.J., C.A.K. Lovell, and P. Schmidt. 1977. Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics* 6:21–37.

Ajibola, O.T. 2006. Technical efficiency in cassava production in Ado Ekiti local government, Ekiti state. Unpublished B. Agric project, Department of Agricultural Economics and Farm Management, University of Agriculture, Abeokuta.

Alagbe, D.O. 2007. Economic analysis of small scale Gari production in Odeda local government area of Ogun state. Unpublished B. Agric project, Department of Agricultural Economics and Farm Management, University of Agriculture, Abeokuta.

Antle, J.M. 1983. Infrastructure and aggregate agricultural productivity—international evidence. *Econ. Dev and Cultural Change* 31(3): 609–619.

Atta-Krah, A.N., and P.A. Francis. 1987. The role of on-farm trials in the evaluation of composite technologies: the case of alley farming in southern Nigeria. *Agricultural Systems* 23:133–152.

Ayeni, S.E. 2005. Marketing of cassava products in Ikole local government area, Ekiti state. Unpublished B. Agric project, Department of Agricultural Economics and Farm Management, University of Agriculture, Abeokuta.

Babalola, O.Y. 2003. Economics of commercial storage of grains: A case study of selected markets in Ogun state. Unpublished M. Agric (Agricultural Economics) thesis, University of Agriculture, Abeokuta.

Babalola, J.A. and F.O. Odoko. 1996. The Performance and future of mandatory allocation of credit to selected sectors in the Nigerian Economy, Central Bank of Nigeria Economic and Financial Review 34 (3): 675-690.

Balogun, E.B., and M.F. Otu. 1991. Credit policies and agricultural development in Nigeria. *CBN Economic and Financial Review* 29 (2): 138–155.

Battese, G.E., and T.J. Coelli. 1995. A model for technical inefficiency effects in a stochastic frontier production function for panel data. *Empirical Economics* 20:325–332.

Beintema, N.M., and G.B. Ayoola. 2004. Agricultural Science and Technology Indicators, Nigeria, ASTI Country Brief No. 10.

Bolarinwa, O.D. 2006. Relationship between cropping pattern and farm productivity in cassava based production system in Ogun state, Nigeria. Unpublished B. Agric project, Department of Agricultural Economics and Farm Management, University of Agriculture, Abeokuta.

Byerlee, D., and P.W. Heisey. 1996. Past and potential impacts of maize research in Sub-Saharan Africa: A critical assessment. *Food Policy* 21 (3): 255–277.

Carter, J. 1995. Alley cropping: Have resource poor farmers benefited? ODI Natural Resource Perspectives No. 3. London: Overseas Development Institute.

Central Bank of Nigeria (CBN). 1998a. Central Bank of Nigeria Statistical Bulletin, vol. 9, no. 2.

_____. 1998b. Central Bank of Nigeria Annual Report and Statements of Accounts.

Craig, B.J., P.G. Pardey, and J. Roseboom. 1997. International productivity patterns: Accounting for input quality, infrastructure and research. *American Journal of Agricultural Economics* 79 (November): 1064–1076.

Center for Infectious Disease Research & Policy (CIDRAP). 2006. Avian flu reported in two more Nigerian states. www.cidrapbusiness.net/cidrap/content/influenza/avianflu/news/feb0906nigeria.html.

Crosson, P., and J.R. Anderson. 1995. Achieving a sustainable agricultural system in Sub-Saharan Africa. World Bank, Building Blocks for Africa 2025 Paper No. 2. March.

Daramola, B. 2005. Government policies and competitiveness of Nigerian rice economy. Paper presented at the workshop on rice policy and food security in Sub-Saharan Africa, organized by WARDA, Cotonou, Republic of Benin, November 7–9, 2005.

Dvorak, K.A. 1996. Adoption potential of alley cropping, Final Project Report, RCMD Research Monograph #23. Ibadan, Nigeria: IITA.

Ehui, S.K., B.T. Kang, and S.C. Dunstan. 1990. Economic analysis of soil erosion effects in alley cropping, no tillage and bush fallow systems in southwestern Nigeria. *Agricultural Systems* 34:349–368.

Erhoyoma, O. 2003. Socioeconomic constraints in cassava based production system in Odeda local government of Ogun state. Unpublished B. Agric project, Department of Agricultural Economics and Farm Management, University of Agriculture, Abeokuta.

Ezeugoh, S.C. 1991. Financing the rural economy: The role of insurance. Paper presented at NAIC's 1991 Management Conference, Owerri, Imo state.

Fabiyi Y.L, E.O. Idowu, and A.E. Oguntade. 1991. Land tenure and management constraints to the adoption of alley farming by women in Oyo state of Nigeria. *The Nigerian Journal of Agricultural Extension* 6 (1&2): 40–46.

Federal Agricultural Coordinating Unit (FACU). 1999. Evaluation of crop-livestock integration at the small-scale level in Nigeria, final report, May 1999.

Fade-Aluko, T. O. 2007. Marketing of ofada rice in Abeokuta Metropolis of Ogun state. Unpublished B. Agric project, Department of Agricultural Economics and Farm Management, University of Agriculture, Abeokuta.

Federal Department of Agriculture/Federal Ministry of Agriculture and Natural Resources (FDA/FMANR). 1988. The Nigerian Agricultural Policy.

Federal Department of Agriculture/Federal Ministry of Agriculture and Rural Development (FDA/FMARD). 2006. Progress in implementation of Presidential Initiative on Rice, Cassava and Vegetable Oil Development Programme. www.mistowa.org/files/CASTON/presidential%20Initiative%20-%20FDA.pdf.

_____. 2001. The Nigerian Agricultural Policy.

_____ 2005. Cassava development in Nigeria—A country case study towards a global strategy for cassava development.

Federal Ministry of Agriculture and Natural Resources (FMANR). 1997. Federal Ministry of Agriculture and Natural Resources, Vision 2010 Final report of the Subcommittee on Agriculture (Economic sector).

FAO, FAOSTAT <http://faostat.fao.org/site/535/desktopdefault.aspx?pageID=535>.

FAO. 1992. Nigeria: Rural roads and marketing—Identification report no. 32/92 CP-NIR 48.

_____. 2004. Food and Agriculture Organization Year Book.

_____. 2006. Follow up of the implementation of the World Food Summit Plan of Action. National report. ftp://ftp.fao.org/docrep/fao/meeting/010/ag368e.pdf.

FAO and IFAD. 2005. A review of cassava in Africa, with country case studies on Nigeria, Ghana, the United Republic of Tanzania, Uganda, and Benin. www.fao.org/docrep/009/a0154e/A0154E01.htm.

Francis, P. 1987. Land tenure systems and the adoption of alley farming in Nigeria. In *Land, trees and tenure: Proceedings of an international workshop on tenure issues in agroforestry*, 175–180. 27–31 May 1985, International Centre for Research in Agroforestry, Nairobi.

Freeman, H.A., M.A Jabbar, and S. Ehui, 1998. The role of credit in the uptake and productivity of improved dairy technologies in SSA. Livestock Policy Analysis Brief No. 10. www.ilri.org/infoserv/webpub/fulldocs/LPA10/LPA10.htm.

Frisvold, G., and K. Ingram. 1995. Sources of agricultural productivity growth and stagnation in sub-Saharan Africa. *Agricultural Economics* 13:51–61.

Fulginiti, L.E., and R.K. Perrin. 1993. Prices and productivity in agriculture. *The Review of Economics and Statistics* 75 (August, no. 3): 471–482.

Fulginiti, L.E., and R.K. Perrin. 1998. Agricultural productivity in developing countries. *Agric Econ* 19 (1&2): 45–51.

Heisey, P.W., and W. Mwangi. 1996. Fertilizer use and maize production in Sub-Saharan Africa. CIMMYT Economics Working Paper 96-01. Mexico, D.F., International Maize and Wheat Improvement Center (CIMMYT).

Hu, F., and J.M. Antle. 1993. Agricultural policy and productivity: International evidence. Review of Agricultural Economics 15 (September, no. 3): 495–505.

Idachaba, F.S. 1998. Instability of national agricultural research systems in Sub-Saharan Africa: Lessons from Nigeria. The International Service for National Agricultural Research (ISNAR) Research Report 13.

Taylor,S., T. Phillips,L.Sanni and M. Akoroda. 2004. A cassava industrial revolution in Nigeria: The potential for a new industrial crop. Rome. International Fund for Agricultural Development (IFAD) and Food and Agricultural Organization (FAO).

International Fund for Agricultural Development (IFAD). 2006. *Rural poverty report 2001: the challenge of ending rural poverty*. Oxford University Press Inc., New York

International Fertilizer Development Corporation (IFDC). 2006. Nigerian company re-opens only urea fertilizer plant In Sub-Saharan Africa to meet summit call for African Green Revolution.www.ifdc.org/New_Design/Whats_New/Notore%20Release%20Final%206%2013%202006.pdf.

International Institute of Tropical Agriculture (IITA). 1990. International Institute of Tropical Agriculture, Annual Report.

International Institute of Tropical Agriculture (IITA). 2007. Cassava market bonanza. www.cgiar.org/enews/june2007/story_14.html.

Kang, B.T., L. Reynolds, and A.N. Atta-Krah. 1990. Alley farming. *Advances in Agronomy* 43: 315–359.

Kang, B.T., S. Hauser, B. Vanlauwe, N. Sanginga, and A.N. Atta-Krah. 1995. Alley farming research on high base status soils. In *Alley farming research and development:*

Proceedings of an international conference on alley farming, 25-39. Ibadan, Nigeria: IITA.

Kukoyi, T.A. 2005. Economic analysis of fertilizer use in maize production among farmers in Odeda local government area of Ogun state. Unpublished B. Agric project, Department of Agricultural Economics and Farm Management, University of Agriculture, Abeokuta.

Larson, B.A., and G.B. Frisvold. 1996. Fertilizers to support agricultural development in Sub-Saharan Africa: What is needed and why*. Food Policy* 21:509–525.

Lusigi, A., and C. Thirtle. 1997. Total factor productivity and the effects of R&D in African agriculture*. Journal of International Development,* 9 (4): 529-538.

Meeusen, W., and J. van den Broeck. 1977. Efficiency estimation from Cobb-Douglas production functions with composed error. *International Economic Review* 18:435–444.

Messer, E., M.J. Cohen, and J. D'Costa. 1998. Food from peace: Breaking the links between conflict and hunger. 2020 Brief 50. Washington, D.C.: The International Food Policy Research Institute.

Murana, S.B. 2005. Economic analysis of maize-sorghum inter cropping in ATISBO local government area of Oyo state. Unpublished B. Agric project, Department of Agricultural Economics and Farm Management, University of Agriculture, Abeokuta.

Nagy, J.G., and O. Edun. 2002. Assessment of Nigerian government fertilizer policy and suggested alternative market-friendly policies. http://www.usaid.gov/downloads/reforms/assessmentoffertilizerpolicy.pdf.

National Agricultural Research Project (NARP). 1994. National Agricultural Research Strategy Plan, Draft Report on North West Zone.

_____. 1995. National Agricultural Research Strategy Plan, Draft Report on North East Zone.

National Bureau of Statistics (NBS). 2005. Poverty profile for Nigeria. Federal Republic of Nigeria.

Obasanjo, O. 2005. Address of His Excellency, President Olusegun Obasanjo, to the high-level round table on agricultural trade reform and food security, hosted by FAO, Rome, April 13, 2005. ftp://ftp.fao.org/docrep/fao/meeting/010/ag075e.pdf.

OGADEP. 2002. Ogun State Agricultural Development Programme. Unpublished Project monitoring Report.

Ogunfowora, B. 1993. Analysis of fertilizer supply and demand in Nigeria. In *Alternative pricing and distribution systems for fertilizers in Nigeria: Proceedings of a symposium organized by the Federal Agricultural Coordinating Unit*, eds. N.B. Mijindadi, D.O.A Phillip, and P. Jayaraman. April 21, 1993. Ibadan. Nigeria.

Ogungbile, A.O., and D.O.A. Phillip. 1996. A review of rice commodity systems in northern Nigeria. Report prepared for the West African Rice Development Association (WARDA).

Ogunlela V.B., and A.O. Ogungbile. 2006. Alleviating rural poverty in Nigeria: A challenge for the national agricultural research system. www.tropentag.de/2006/abstracts/full/614.pdf.

Ojo, M.O. 1992. Monetary policy in Nigeria in the 1980s and prospects in the 1990s. *CBN Economic and Financial Review* 30 (1): 1–31.

Ojo, M.O., and O.O. Akanji. 1996. The impact of macroeconomic policy reforms on Nigerian agriculture. *CBN Economic and Financial Review* 34 (2): 549–570.

Oladele, A.F. 2006. Economic analysis of ofada rice production in Obafemi Owode local government area, Abeokuta, Ogun state. Unpublished B. Agric project, Department of Agricultural Economics and Farm Management, University of Agriculture, Abeokuta.

Olufokunbi, B., and T. Titilola. 1993. Fertilizer pricing and subsidies in Nigeria: Issues and implications. In *Alternative pricing and distribution systems for fertilizers in Nigeria: Proceedings of a symposium organized by the Federal Agricultural Coordinating Unit*, eds. N.B. Mijindadi, D.O.A Phillip, and P. Jayaraman. April 21, 1993. Ibadan, Nigeria.

Onyebinama, U.A.U. 2004. Land reform, security of tenure and environmental conservation in Nigeria*. Int. J. Agric. Rural Dev*. 5:86–90.

Osibeluwo, D.O. 2005. Economic analysis of cassava production systems in Abeokuta local government area, Ogun state. Unpublished B. Agric project, Department of Agricultural Economics and Farm Management, University of Agriculture, Abeokuta.

Ousmane Badiane. 2008. Sustaining and Accelerating Africa's Agricultural Growth Recovery in the Context of Changing Global Food Prices, IFPRI Policy Brief #6.

Owonubi, J.J., V. Kumar, J.K. Adewumi, and D.O.A. Phillip. 1989. Management of large scale irrigation farms in Nigeria. Paper presented at the seminar on applied agricultural research in mechanized farming in tropical areas, sponsored by CIRAD and Federal Ministry of Science and Technology, Lagos, November 8–9, 1989.

Pardey, P., and N. Beintema. 2001. Slow magic: Agricultural R & D a century after Mendel, IFPRI Food Policy Report. Washington D.C.: IFPRI.

Presidential Committee on Livestock (PCOL). 2003. Report of the Presidential Committee on Livestock, vol. 1, consolidated report.

Phillip, D. 2001. Analysis of formal lending to the agricultural sector in Nigeria: 1978–98, Central Bank of Nigeria Economic and Financial Review 40 (3).

Phillip, D., and V. O. Adetimirin. 2001. Enhancing the transfer and commercialization of agricultural technologies in Nigeria. PRA Survey Report on the South West Zone of Nigeria, prepared for OAU/SAFGRAD-STRC.

Phillip, D., M. Maiangwa, and B. Phillip. 2000. Adoption of maize and related technologies in the north-west zone of Nigeria. *Moor Journal of Agricultural Research* 1 (1): 98–105.

Phillip, D.O.A. 1996. Responsiveness of selected agricultural export commodities to exchange rate devaluation in Nigeria: An econometric analysis. *Central Bank of Nigeria Economic and Financial Review* 34 (2): 571–578.

Pingali, P.L., and P.W. Heisey. 1996. Cereal crop productivity in developing countries: Past trends and future prospects. Conference Proceedings, Global Agricultural Science Policy for the Twenty-First Century, Melbourne, Australia, 26–28 August.

Presidential Research and Communications Unit (PRCU). 2006. Presidential Research and Communications Unit: Cassava initiatives in Nigeria. www.nigeriafirst.org/article_4301.shtml. accessed on May 16, 2008.

Shane, M., T. Roe, and M. Gopinath. 1998. U.S. agricultural growth and productivity: An economywide perspective. Market and Trade Economics Division, Economic Research Service, U.S. Department of Agriculture, Washington, DC. Agricultural Economic Report No. 758.

Spencer, D., A. Doward, G. Abalu, D. Phillip, and A.O. Ogungbile. 2006. Evaluation of adoption of NERICA and other improved upland rice varieties following varietal promotion activities in Nigeria. A study for GATSBY and Rockefeller Foundations, final report.

Swanson, B. E., B. J. Farner, and R. Bahal. 1990. *The current status of agricultural extension worldwide*. Report of the Global Consultation on Agricultural Extension, Rome, Italy, 4-8 December 1989, Food and Agriculture Organization. Rome: FAO.

Thirtle, C., L. Lin, and J. Piesse. 2003.The impact of research-led agricultural productivity growth on poverty reduction in Africa, Asia and Latin America, *World Development*, 31(12): 1959-1975

Thrupp, L.A. 1997. Linking biodiversity and agriculture: Challenges and opportunities for sustainable food security. Washington, D.C.: World Resources Institute.

UK Clinical Virology Network. 2004. Avian influenza - Current evaluation of risks to humans from H5N1 following recent reports**.** www.clinical-virology.org/pages/cvn/sp_vr/cvn_news.html.

Usman, S. 2000. The Central Bank of Nigeria: Rural finance policies and the Agricultural Credit Guarantee Fund. In *After the reforms: Which way forward for Central Banks in rural finance*, 56–61. AFRACA Rural Finance Series vol. 1.

World Bank. 1989. Nigeria: Public expenditure review, agricultural sector. Washington, D.C.: The World Bank.

_____. 1998. World development indicators 1998. Washington, DC.: The World Bank.

_____. 2008. World development report 2008: Agriculture for development. New approaches to input subsidies. http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTWDRS/EXTWDR2008/0,,contentMDK:21498650~pagePK:64167689~piPK:64167673~theSitePK:2795143,00.html.

World Development Report (WDR). 2008. New approaches to input subsidies. www.econ.worldbank.org/EXTRESEARCH/EXTWDRS/EXTWRD2008/

World Health Organization (WHO). 2006a. Avian influenza - situation (birds) in Nigeria. www.who.int/csr/don/2006_02_08/en/index.html.

_____. 2006b. Avian influenza - situation in Nigeria – update. www.who.int/csr/don/2006_02_22/en/index.html.

Appendix 1: Agricultural Institutions in Nigeria

In this appendix we profile some key agricultural institutions in Nigeria to provide understanding on the extent to which productivity constraints identified can be linked to various institutions. The Federal Ministry of Agriculture and Water Resources (FMAWR) is the top rural development institution, and is primarily responsible for agricultural policy formulation in Nigeria. State ministries of agriculture have the responsibility for agricultural policy implementation in their respective states, except agricultural research, which the federal government also funds (FMANR 1997).

Introduced on a pilot basis in 1975, Agricultural Development Projects (ADPs) were established in Nigeria through World Bank assistance to promote crop production and farm incomes through the modernization of extension services. Planned activities included rural road construction, rural water supply, small-scale irrigation, and distribution of farm inputs.

The ADPs were implemented with considerable emphasis on crop production, agricultural extension services, and input delivery. But, perhaps because of initial project design, not much was done on rural water supply, irrigation facilities, agricultural marketing, and post-harvest activities.

To complement some functions of the ADPs, especially in irrigation, the government of Nigeria established a total of 11 River Basin Development Authorities (RBDAs) under Act No. 25 of 1976. The functions of the RBDAs were to include development of both surface and subsurface water resources for multipurpose uses; control of flood and erosion; forestry and watershed management; construction and maintenance of dams, dykes, wells, boreholes, irrigation, and drainage systems; provision of water from reservoirs and lakes for irrigation to farmers; mechanized clearing and cultivation of land for the production of crops, livestock, and forestry; development of fisheries; and processing of crops, livestock, and fish products (Owonubi et al. 1989).

The Directorate of Food, Roads and Rural Infrastructure (DFRRI) was established in 1986 to speed up the pace of rural development. Its activities specifically included rural road construction and maintenance, seed multiplication, and fish and livestock breeding.

The RBDAs and DFRRI suffered from poor and unsustained funding, and overlapped functions with the ADPs and other national and state agricultural organizations. Also, these agencies engaged directly in agricultural production rather than concentrating their resources on providing enabling platforms for the activities of farmers.

The large-scale irrigation approach under the RBDAs was capital intensive. Dams were built across Nigeria. While the total irrigation potential in Nigeria is about 2 million ha (about 70 percent in Nigeria's north), the nationally irrigated area by the RBDAs declined from 45,000 ha (early 1990s) to about 26,000 ha (early 2000s). The failure of the large irrigation structures led to the small-scale initiatives promoted by the first and second National Fadama Development Projects (Fadama I and Fadama II) between 1992 and 2004.

The estimated national area of *fadama* (a Hausa word meaning low-lying floodplains) resources is about 0.94 million ha, but the area developed under Fadama I was far smaller than this. Design problems under Fadama I included post-harvest losses resulting from poor transportation infrastructure and the non-inclusion of processing, storage, and other downstream activities. The results were poor producer prices and storage losses. The desire for

the realization of the full potential of fadama resources led to Fadama II, a joint effort of the World Bank and the federal, state, and local governments of Nigeria. The strategy under Fadama II was a shift from public domination to a community-driven development approach. Production, marketing, processing, financial, and advisory services to project clients were private sector-led.

Agricultural marketing boards, later restructured into crop-specific commodity boards, were established during the 1970–85 period, to serve as buyers of last resort for farm commodities. The commodity boards were hampered by several operational problems. One, administrative overheads grew so large that the various commodity boards became indebted; the debts had to be written off at various times by the federal government's budgetary provisions. Two, the domestic prices paid to export farmers relative to the external prices received by the commodity boards were dismally low, virtually amounting to implicit taxation or negative protection of the farmers (Abalu, 1975; Phillip, 1996).

As part of the effort to improve farmers' access to credit, the Nigerian Agricultural and Cooperative Bank (NACB) was established in 1972 primarily for direct and on-lending of funds to agriculture. This function distinguished NACB from the commercial and merchant banks that provided credit to agriculture mainly in line with prescribed policy guidelines. Several studies have reviewed the performance of NACB since its inception, with the dominant conclusion that loan disbursements by NACB were less than satisfactory. Balogun and Otu (1991) noted that NACB's credit administration was characterized by wide divergence between loan approvals and actual disbursements. Also, most of the funds allocated by NACB came from the federal government, meaning that the long-term survival of this institution had always rested squarely on loan recovery. The NACB, following its merger with the Peoples Bank of Nigeria, was renamed as the Nigerian Agricultural Credit and Rural Development Bank (NACRDB).

Established in 1977 and managed by the CBN, the Agricultural Credit Guarantee Scheme Fund (ACGSF) was expected to operate through commercial and merchant banks to enhance credit supply to the rural sector. While agricultural loans as a percentage of all sector loans grew during much of the 1978-98 period, the total amount of agricultural loans guaranteed as a percentage of the total loan to agriculture stayed generally below 5 percent and steadily declined. Thus, the allocation of loans to the agricultural sector during the period under review was likely sustained by guidelines mandating that banks allocate a prescribed percentage of their total loans to agriculture (Phillip 2001).

The Nigerian Agricultural Insurance Scheme (NAIS) was launched in December 1987, with the expectation that prospective loan beneficiaries would first obtain insurance cover (Ezeugoh 1991). This was to encourage lenders to fund agriculture without fear of losses in the event of a crisis, while ensuring protection under the ACGSF guidelines. In practice, however, the expected linkage between the ACGSF and NAIS was not achieved satisfactorily. The absence of an active linkage between lending to agriculture, agricultural insurance, and default claims compensation by the parties concerned did immense harm to agricultural credit lending in Nigeria. Participation in the ACGSF, which peaked at 29 banks in 1989, declined to five banks in 1998 (Usman 2000).

Appendix 2: CIF Prices of Fertilizers Based on a Sample of 39 Importers' Records, Nigeria, 2006

S/No	Fertilizer	CIF US$/ ton	CIF Naira/Ton	Retail Price Naira/ Ton	Retail Price US$ Equivalence/ Ton
1	NPK	265	37100	43000	307.14
2	NPK	245	34300	43000	307.14
3	NPK	250	35000	43000	307.14
4	NPK	250	35000	43000	307.14
5	NPK	255	35700	43000	307.14
6	NPK	250	35000	43000	307.14
7	NPK	265	37100	43000	307.14
8	NPK	265	37100	43000	307.14
9	NPK	270	37800	43000	307.14
10	NPK	265	37100	43000	307.14
11	NPK	260	36400	43000	307.14
12	NPK	265	37100	43000	307.14
13	NPK	270	37800	43000	307.14
14	NPK	285	39900	43000	307.14
15	NPK	265	37100	43000	307.14
16	NPK	250	35000	43000	307.14
17	Urea	305	42700	45000	321.42
18	Urea	270	37800	45000	321.42
19	Urea	280	39200	45000	321.42
20	Urea	280	39200	45000	321.42
21	Urea	285	39900	45000	321.42
22	Urea	285	39900	45000	321.42
23	Urea	290	40600	45000	321.42
24	Urea	290	40600	45000	321.42
25	Urea	310	43400	45000	321.42
26	Urea	305	42700	45000	321.42
27	Urea	310	43400	45000	321.42
28	Urea	310	43400	45000	321.42
29	Urea	310	43400	45000	321.42
30	Urea	310	43400	45000	321.42
31	Urea	305	42700	45000	321.42
32	Urea	310	43400	45000	321.42
33	Urea	310	43400	45000	321.42
34	Urea	310	43400	45000	321.42
35	Urea	310	43400	45000	321.42
36	Urea	305	42700	45000	321.42
37	Urea	310	43400	45000	321.42
38	Urea	310	43400	45000	321.42
39	Urea	305	42700	45000	321.42

Source: CIF prices from IFDC 2006.

***Authors' computation based on NPK retail price of N2,150/50kg, and urea retail price of ₦2,250/kg in 2006, Ogun state.

**Authors' computation, assuming US$ 1.00 = ₦ 40.00 in the year 2006.

*As provided by IFDC 2006.

Appendix 3: Nigerian National and Agricultural Budgets and Fertilizer Subsidy Costs, 1990–2001

Year	National budget	Agric. budget	Fertilizer subsidy cost	Agric. budget as % of national budget	Fertilizer subsidy as % of national budget	Fertilizer subsidy as % of agric. budget
	At 2001 constant ₦ billion					
1990	164.333	23.022	30.416	14.0	18.5	132.0
1991	152.492	6.428	25.662	4.2	16.8	399.0
1992	127.074	6.069	54.294	4.8	42.7	895.0
1993	93.689	9.168	36.371	9.8	38.8	397.0
1994	106.389	9.609	30.606	9.0	28.8	319.0
1995	89.023	9.374	28.979	10.5	32.6	309.0
1996	73.552	5.965	17.711	8.1	24.1	297.0
1997	162.823	8.793	0	5.4	-	-
1998	245.456	11.754	0	4.8	-	-
1999	179.599	9.064	0.968	5.0	0.5	10.7
2000	348.854	11.269	0	3.2	-	0.0
2001	496.659	10.595	0.890	2.1	0.2	8.4

Source: Nagy and Edun 2002.

Note: The fertilizer budget came from the President of Nigeria's special account, and was not part of the budget of the FMARD.