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NIGERIA EARLY GENERATION SEED STUDY

COUNTRY REPORT

August 2016

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FOREWORD

The United States Agency for International Development (USAID) Bureau for Food Security (BFS) Early Generation Seeds (EGS) program, acting through Development Alternatives, Inc.'s (DAI) Africa Lead II project, will facilitate existing USAID Mission, BFS, and Bill & Melinda Gates Foundation (BMGF) partnerships to make significant seed system changes to break the bottlenecks on breeder and foundation seed, primarily in Africa. These include an insufficient and unsustainable supply of EGS; poorly functioning national variety release systems; policies, regulations, and misplaced subsidies that limit access to publicly-developed improved varieties by private seed companies; and the continuing presence of obsolete varieties, as well as counterfeit seeds in markets.

The overall EGS effort, which began in 2014 and which will continue through 2017, is carried out in a complex, dynamic environment involving the USAID and BMGF partnership, several international and bilateral donors, as many as 12 African governments, several African regional organizations, and a plethora of public and private stakeholders. Over the past two years, the USAID and BMGF partnership has explored, with a large number of noted US, African, and international technical experts, how to address constraints in EGS systems. This exploration led to the Partnership's development of a methodology to analyze seed value chains according to specific market, crop, and economic dimensions. Applying this methodology leads to the identification of actors and actions along the seed value chain that are required in order to produce an adequate supply of EGS on a sustainable basis. The methodology was vetted by technical experts from African regional organizations, research and technical agencies, and development partners.

USAID asked DAI through its Africa Lead Cooperative Agreement II to take this analytical methodology to the country level in selected Feed the Future countries, particularly in ways to change seed systems as they affect smallholders in the informal agriculture sectors. The lack of readily available and reasonably priced quality seed is the number one cause of poor agricultural productivity across much of the continent, particularly among smallholders. Africa Lead II selected and contracted with Context Network to execute EGS studies in Rwanda, Zambia, Kenya, and Nigeria as well as to lead a one-day EGS technical training with researchers from 11 countries on how to implement the study methodology. The training session was held in Addis Ababa, Ethiopia, on February 27, 2016.

With Africa Lead's guidance, the Context Network's work (both the technical training and the four country studies) ensures careful consideration of appropriate private, public, donor, NGO, and informal sector roles in seed distribution to end users. In each country situation, the Context Network identifies an inclusive set of stakeholders extending beyond a short "seed only" value chain (i.e., from breeder to foundation seed producers to producers of certified and Quality Declared seed) to end users (e.g., farmers in both the formal and informal agriculture sectors). Each study recognizes that needs and utilization will be shaped by gender-differentiated roles in both crop production and trade (both formal and cross border). The Context Network's country studies aim to better understand farmer requirements (i.e., demand), independent of the policy and technical parameters affecting EGS supplies.

The resulting EGS country studies are expected to have two additional medium-term impacts beyond the life of Africa Lead's contract with the Context Network. First, the studies will create incentives for greater government and private investment in the respective seed

sectors, establishing the basis for increased scale-up and adoption of more productive technologies. Second, with some short-term increase in the supply and quality of EGS, a number of policy or investment constraints will come into focus, coalescing stakeholders around the changes required to address those constraints.

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This report was developed by teams at the Context Network and Sahel Capital, led by Mark Nelson, a principal at the Context Network, and Ndidi Nwuneli, a director at Sahel Capital. Field research activities were conducted by Solomon Afuape, Shola Aribido, and Millicent Lafe.

The team is grateful for the support of DAI, including David Tardif-Douglin, Charles Johnson, and Sonja Lichtenstein, as well as guidance from BFS Senior Food Policy Advisors David Atwood and Mark Huisenga, and USAID Nigeria's Tor (Melanie) Edwards.

The team would also like to thank all key stakeholders in Nigeria who participated in interviews for this study. Through the course of the study, a number of challenges have been identified. The report research team recognizes the Federal Government of Nigeria (FGN) is committed to improving EGS systems and addressing many of these recommendations. In interviews with FGN officials, the team repeatedly heard of the FGN's desire and focus to address many of these issues and recommendations, and thus the team looks forward to the FGN's continuing efforts.

ACRONYMS

Acronym	Name
ADP	Agricultural Development Program
AGRA	Alliance for Green Revolution in Africa
ATA	Agricultural Transformation Agenda
BFS	Bureau for Food Security (USAID)
BMGF	Bill and Melinda Gates Foundation
CACS	Commercial Agricultural Credit Scheme
CBN	Central Bank of Nigeria
CGIAR	Consultative Group on International Agricultural Research
CVRRC	Crop Variety Registration and Release Committee
DAI	Development Alternatives, Inc.
DFID	Department for International Development (U.K.)
ECOWAS	Economic Community of Western States
EGS	Early Generation Seed
EGS-PPP	Early Generation Seed Public-Private Partnership
FAFIN	Fund for Agricultural Finance in Nigeria
FAO	Food and Agriculture Organization of the United Nations
FARO	Federal Agriculture Research Oryza
FGN	Federal Government of Nigeria
FMARD	Federal Ministry of Agricultural and Rural Development
FTF	Feed the Future
GDP	Gross Domestic Product
GES	Growth Enhancement Support
IAR&T	Institute for Agricultural Research & Training
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IITA	International Institute of Tropical Agriculture
IP	Intellectual Property
LCRI	Lake Chad Research Institute
MARKETS II	Maximizing Agricultural Revenue and Key Enterprise in Targeted Sites
MFI	Microfinance Institution
MSME	Micro, Small and Medium Enterprises
NAERLS	National Agricultural Extension and Research Liaison Services
NARI	National Agricultural Research Institute
NASC	National Agricultural Seeds Council
NCRI	National Cereals Research Institute
NGO	Non-Governmental Organization
NIRSAL	Nigeria Incentive-based Risk-sharing System for Agricultural Lending
NRCRI	National Root Crops Research Institute
NSS	National Seed Service
OPV	Open Pollinated Variety
PPP	Public-Private Partnership
QDS	Quality Declared Seed
RTEP	Root and Tubers Expansion Program
SCPZ	Staple Crops Processing Zones
TIB	Temporary Immersion Bioreactors
USAID	United States Agency for International Development

WAAPP	West African Agricultural Productivity Program
WASP	West Africa Seed Program
YIIFSWA	Yam Improvement for Income and Food Security in West Africa

TERMINOLOGY

Breeder seed: Breeder seed is produced by or under the direction of the plant breeder who selected the variety. During breeder seed production, the breeder or an official representative of the breeder selects individual plants to harvest, based on the phenotype of the plants. Breeder seed is produced under the highest level of genetic control to ensure the seed is genetically pure and accurately represents the variety characteristics identified by the breeder during variety selection.

Pre-basic seed: Pre-basic seed is a step of seed multiplication between breeder and foundation seed that is used to produce sufficient quantities of seed for foundation seed production. It is the responsibility of the breeder to produce pre-basic seed, and production should occur under very high levels of genetic control.

Foundation seed: Foundation seed is the descendent of breeder or pre-basic seed and is produced under conditions that ensure maintaining genetic purity and identity. When foundation seed is produced by an individual or organization other than the plant breeder, there must be a detailed and accurate description of the variety the foundation seed producer can use as a guide for eliminating impurities (“off types”) during production.

Certified seed: Certified seed is the descendent of breeder, pre-basic, or foundation seed produced under conditions that ensure maintaining genetic purity and identity of the variety and that meet certain minimum standards for purity defined by law and certified by the designated seed certification agency.

Quality Declared seed: In 1993 the Food and Agriculture Organization of the United Nations (FAO) produced and published specific crop guidelines as Plant Production and Protection Paper No. 117 Quality Declared seed – Technical guidelines on standards and procedures. The Quality Declared Seed (QDS) system is a seed-producer implemented system for the production of seed that meets at least a minimum standard of quality but does not entail a formal inspection by the official seed certification system. The intent behind the QDS system is to provide farmers with an assurance of seed quality while reducing the burden on government agencies responsible for seed certification. The QDS system is considered by FAO to be part of the informal seed system.

Quality seed: In this report, the phrase quality seed is at times used in place of certified seed or QDS to describe a quality-assured seed source without specifying certified or QDS.

Commercial seed: Any class of seed acquired through purchase and used to plant farmers’ fields.

Formal seed system: The formal seed system is a deliberately constructed system that involves a chain of activities leading to genetically improved products: certified seed of verified varieties. The chain starts with plant breeding or variety development program that includes a formal release and maintenance system. Guiding principles in the formal system are to maintain varietal identity and purity and to produce seed of optimal physical, physiological, and sanitary quality. Certified seed marketing and distribution take place through a limited number of officially recognized seed outlets, usually for cash sale. The central premise of the formal system is that there is a clear distinction between "seed" and "grain." This distinction is less clear in the informal system.

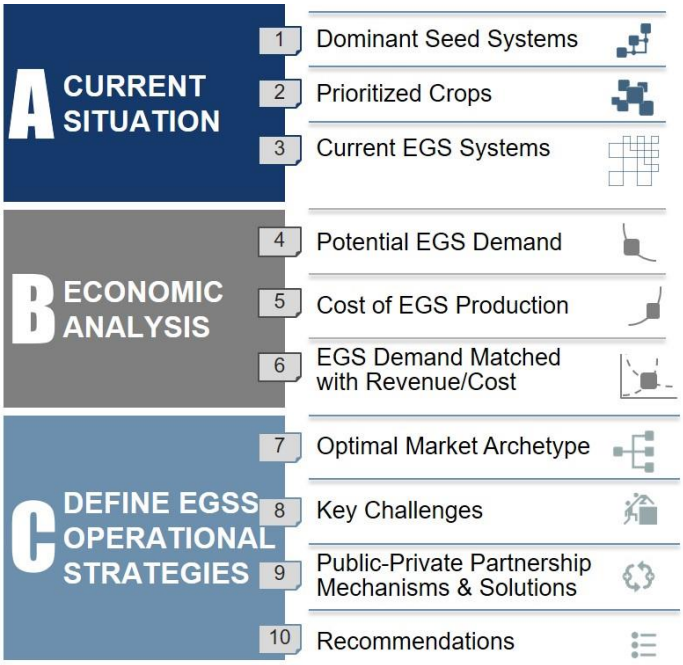
Informal seed system: The informal system also referred to as a local seed system, is based on farmer-saved seed or QDS. Varieties in the informal system may be variants of improved varieties originally sourced from the formal system, or they may be landrace varieties developed over time through farmer selection. There is less emphasis on variety identity, genetic purity, or quality seed. The same general steps or processes take place in the informal system as in the formal system (variety choice, variety testing, introduction, seed multiplication, selection, dissemination, and storage), but they take place as integral parts of farmers' production systems rather than as discrete activities. While some farmers treat "seed" as special, there is not always a distinction between "seed" and "grain." The steps do not flow in a linear sequence and are not always monitored or controlled by government policies and regulations. Rather, they are guided by local technical knowledge and standards and by local social structures and norms.

Improved versus landrace and local varieties: Improved varieties are the product of formal breeding programs that have gone through testing and a formal release process. A landrace is a local variety of a domesticated plant species which has developed over time largely through adaptation to the natural and cultural environment in which it is found. It differs from an improved variety which has been selectively bred to conform to a particular standard of characteristics.

METHODOLOGY

Building on previous studies and consultations with governments, private sector organizations, and partners, the USAID and BMGF partnership developed, tested, and widely vetted a methodology to identify country-specific and crop-specific options to overcome constraints in EGS supply (Monitor-Deloitte EGS Study sponsored by USAID and BMGF in 2015). As illustrated in Figure 1, this methodology includes ten-steps to define EGS systems, perform economic analysis, and develop EGS operational strategies.

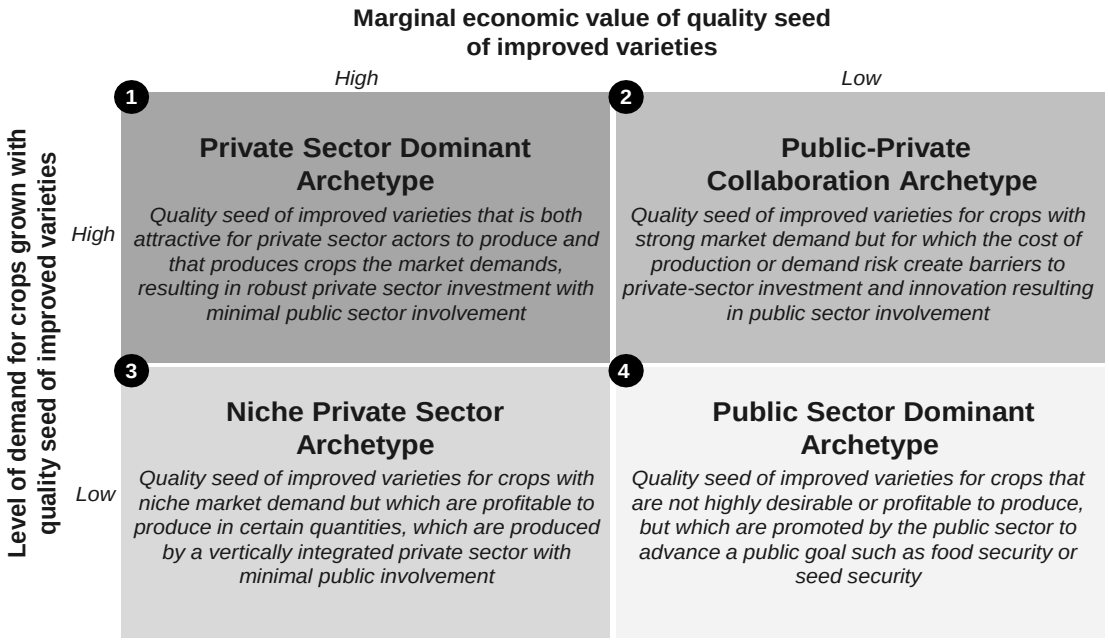
Figure 1: **EGS system ten-step process.**



Source: Ten steps based on process developed by Monitor Deloitte for EGS study prepared for USAID and BMGF (2015).

The first six steps of this ten-step process were used to analyze specific crops within Nigeria in order to inform step seven, development of the optimal market archetype. The study commissioned by the USAID and BMFG partnership utilized a common economic framework to define public and private goods and applied it to EGS systems, as shown in Figure 2. Once the optimal market archetype for each crop was developed, steps eight through ten identified the key challenges to achieving the optimal market archetype, possible public-private partnership (PPP) mechanisms and solutions, and final recommendations.

Figure 2: **Market archetype framework.**



Source: Framework developed by Monitor-Deloitte EGS Study sponsored by USAID and BMGF (2015).

This framework categorizes EGS systems of crops and crop segments within a specific country, based on marginal economic value of the quality of improved varieties and the level of demand for crops grown with quality seed of improved varieties. Several variables, as represented in Table 1, inform these two factors.

Table 1: **Variables that inform market archetype framework.**

Key Variable	Description	Examples
MARGINAL ECONOMIC VALUE OF IMPROVED VARIETIES		
Differential performance of improved varieties	Level with which improved varieties in the market have differential performance versus local varieties	Yield, quality, traits such as disease and drought tolerance
Frequency of seed replacement	Frequency with which quality seed must be replaced to maintain performance and vigor of an improved variety	Yield degeneration, disease pressure, pipeline of new varieties being commercialized regularly
Differentiating characteristics	Existence of differentiating characteristics that command a price increase for improved varieties	Price premiums for processing, nutritional characteristics
Fragility of seed	Ability of seed to withstand storage and/or transport without significant performance loss	Hardiness or fragility of seed
Cost of quality seed production	Cost of producing quality seed	Multiplication rates, input costs, labor requirements for field production, mechanization, rapid propagation technology
MARKET DEMAND FOR QUALITY SEED OF IMPROVED VARIETIES		
Total demand for seed	How much seed is required to meet the planting needs of a given crop	Area of crop planted in country
Requirement for quality assurance	Requirement for quality assurance to realize variety benefits	Certified, Quality Declared, farm-saved seed
Farmer demand for specific varieties	Level of farmer demand for specific varieties	Agronomic traits of improved varieties (i.e., disease tolerance, drought tolerance)
Market demand for specific varieties	Level of downstream demand for specific characteristics	Color, cooking quality, processing quality

Source: Based on variables developed by Monitor-Deloitte EGS Study sponsored by USAID and BMGF (2015).

STAKEHOLDER CONSULTATION

The selected crops for in-depth EGS system analysis were identified during a consultative process with key seed system and agricultural stakeholders from the public and private sectors during three roundtable meetings convened in Kaduna, Abuja and Abia, Nigeria on

March 17th, 18th and 21st, 2016 respectively. These are locations representing North, Central and South Nigeria. Attendees included representatives from USAID, Federal Ministry of Agriculture and Rural Development (FMARD), National Agricultural Seeds Council (NASC), National Cereals Research Institute (NCRI), International Institute of Tropical Agriculture (IITA), National Root Crops Research Institute (NRCRI), State Ministries of Agriculture, Seed Entrepreneurs Association of Nigeria and private seed companies. The final stakeholder consultation on June 29, 2016 was convoked in Abuja where the participants reviewed and discussed the work of the Context field research team and their findings. See Annex D for the participants in each roundtable.

PRIORITY CROPS

Within Nigeria, four crops were selected for analysis: rice, yam, maize, and soybean.

EXECUTIVE SUMMARY

SEED SYSTEMS IN NIGERIA

There are four identified seed systems in Nigeria. These include 1) farmer-saved, 2) public-private composed of the National Agriculture Research Institutes (NARIs) with private seed company involvement in certified seed production, 3) public led systems, and 4) private-led systems dominated by local seed companies. The farmer-saved seed systems represent the majority of seed volume. The largest proportion of the EGS volume is produced by the public and private systems, while farmer-saved seeds and farmer-to-farmer seed exchange dominate the informal seed sector.

While smallholder farmers in Nigeria are aware of improved varieties, the rate of adoption is low across most agro-ecological zones, as the majority of smallholder farmers recycle seeds of improved varieties. However, some fraction of farmers buys improved seeds while others depend upon free seeds acquired from donor- or NGO-funded input intervention programs. Adoption of improved varieties is higher for some crops than others, with smallholder farmers tending to adopt improved varieties of grains more than improved varieties of root and tuber crops, because root and tuber planting material is easily recyclable. Accordingly, there has been little demand for, or development of, root and tuber varieties. Among grain crops, improved varieties of maize, specifically hybrid maize, are adopted more than other grain cereals or legumes. This is because the maize value chain and seed system attract more development initiatives from NGOs and donors than other grain value chains.

EARLY GENERATION SEED SYSTEMS BY CROP

Nigeria has a three-tier system of seed production and multiplication: breeder seed, foundation seed, and commercial or certified seed under the seed certification scheme. While EGS systems and specific roles and responsibilities vary across the four selected crops for this study, some general themes resonate across crops. The NARIs are responsible for breeder seed production. Depending on the crop, private seed companies and seed production units of the NARIs also produce foundation seed. ADPs and private seed companies are the key actors involved in commercial seed production, but private companies willing to produce both foundation and certified seeds must do so under separate trade names. Historically, the NSS under NASC was responsible for foundation seed production, but under the current National Seed Policy, foundation and certified seed production is led by the private sector. NASC is now responsible for supervision, monitoring, coordination, assurance of quality, and certification, including licensing private seed companies to produce foundation and certified seeds.

Rice: It is estimated that only 10% of rice planted area is supported by the formal seed system, while 90% is planted with seeds sourced by farmers through informal means such as local open markets and farmer exchanges. The primary reasons for the dominance of the informal system are limited production capacity and often-changing government policies that weaken demand for quality seeds.

Yam: Currently the formal seed system for yam is very small, contributing ~2% of the total yam planted area. The informal seed system for yam contributes ~98% of yam planted area and is dominated by the public sector, with very little private sector participation. There are promising developments underway to integrate new technologies and quality management protocols into the yam value chain approach to produce and deliver improved varieties.

However, these efforts are in their early stages and thus, significant supply bottlenecks and demand problems currently prevail.

Maize: 50% of maize planted area is supported by the formal seed system, while the remaining 50% is planted with seed sourced by farmers through informal means. Hybrid seeds, which are planted on more than one-half of the area served by the formal system, are a key factor in the growth of the formal system. The formal system for maize has historically been dominated by the public sector, but there is growing private sector participation by seed companies and agro-dealers. Although more open pollinated variety (OPV) seeds are currently planted than hybrid seeds, it is expected that the hybrid market will continue to grow, gradually replacing the OPV market.

Soybean: The formal seed system serves an estimated 20% of soybean planted area, with the informal seed system claiming a greater share through farmer-saved seed, seed obtained from neighboring farmers, and open markets. Within the formal system, public (i.e., the NARIs, universities) and private (i.e., seed companies) actors are both active. Current EGS demand is estimated to exceed supply, due to several supply capacity bottlenecks.

EARLY GENERATION SEED SYSTEM BOTTLENECKS AND CONSTRAINTS BY CROP

Rice: Rice EGS supply bottlenecks stem from production and certification capacity problems as well as weak demand. These include:

Supply bottlenecks

- Low technical capacities and inadequate infrastructure of breeder seed and foundation seed producers.
- Absence of an adequate EGS demand forecasting system needed to orient the future EGS supply.
- Lack of credit and working capital for private seed producers of foundation and certified seed.
- Inadequate storage and seed processing facilities which would be necessary to maintain inventory.
- Commercial seed distribution networks which fail to reach smallholder farmers with sufficient quantities of seed while maintaining quality.
- Lack of trained NASC personnel to inspect and certify seed production fields.

Demand constraints

- Unpredictable and often-changing government policies create market uncertainty which discourages demand.
- Lack of demonstration trials to educate farmers about the benefits of improved varieties.

Yam: Significant supply bottlenecks and demand problems continue to stymie development of the EGS system for yam. These include:

Supply bottlenecks

- Lack of private sector interest in yam EGS production due to high production costs.
- Low multiplication rates and inadequate technical know-how for high throughput foundation seed yam production.

- Ineffective public distribution system of commercial yam seed due to insufficient funding.

Demand constraints

- EGS producers' poor quality seed.
- Low private sector interest in value chain development limits the dissemination of improved varieties to farmers.
- Low demand for improved varieties resulting from a lack of on-farm demonstration trials.
- Slow pace of varietal improvement due to limited funding for yam breeding activities.

Maize: Because of several supply bottlenecks, EGS demand is currently estimated to exceed supply. There are also critical demand problems that, if addressed, would further increase EGS demand. These include:

Supply bottlenecks

- Inadequate supply of breeder seed due to government policy mandating the free dissemination of breeder seed to commercial producers which strains the already severely underfunded NARI budgets.
- Absence of an adequate EGS demand forecasting system required to provide future consistent EGS supplies.
- Breaches of agreements by seed companies and out growers which leads to unfulfilled production commitments, resulting in a reduced supply of certified hybrid seed.
- Lack of trained NASC personnel to inspect and certify production fields.
- Lack of Intellectual Property (IP) protection and incentives for breeder seed production.

Demand constraints

- High cost of hybrid seed, and the lack of yield benefits from hybrids when companion inputs are underutilized.
- Lack of access to credit for smallholder farmers to purchase higher cost seed and the recommended inputs to fully realize yield benefits.
- Presence of counterfeit seeds results in farmers' skepticism about improved seeds.
- Poor adaptation of hybrids for agro-ecological conditions in the south.

Soybean: Despite farmers' limited awareness of the benefits of improved soybean varieties, demand for EGS is strong. However, EGS producers lack the capital, operating credit, and capacity to increase their supply. While demand for EGS exceeds supply, there are demand constraints that limit the further growth of demand. These include:

Supply bottlenecks

- Lack of public funding for the NARIs to produce sufficient quantities of breeder seed.
- Limited private sector technical know-how to produce foundation seed.
- Lack of trained NASC personnel to inspect and certify production fields.

Demand constraints

- Farmers' lack of awareness of the benefits of improved varieties and continuing to grow varieties with high rust susceptibility.
- Sale of counterfeit seeds results in farmers being skeptical about "improved" seeds.

PUBLIC-PRIVATE PARTNERSHIP

The most common problem facing the EGS systems in Nigeria is insufficient financial and technical support from the government to the NARIs, as well as Government's failure to educate farmers about improved varieties. Supply and demand issues also affect the availability, quality, and best practices necessary to produce and deliver EGS. To resolve these problems, significant human, technical and financial resources need to be deployed. A key objective of the FGN's Agricultural Transformation Agenda (ATA) is increasing the adoption of improved varieties, but investments will be necessary to build well-developed and sustainable EGS systems.

Two of the four crops analyzed in this study—maize and soybean—would benefit from having public-private partnerships (PPP) aimed at improving their current EGS systems. Due to the similarities in the end use segments such as animal feed, and the actors involved in soybean and maize, an EGS public- private partnership (EGS-PPP) focused on both crops is recommended. Following the successful creation and implementation of an EGS-PPP for maize and soybean, the government would be able to redirect resources away from EGS production to further develop the national research program as well as to strengthen seed certification and farmer extension services. These programs would help to ensure a sustainable supply of improved varieties for Nigerian farmers in the future.

The EGS-PPP would need to accomplish three key purposes:

- Produce enough EGS to meet current and future demand.
- Produce seed at the lowest possible cost while continuing to meet quality standards.
- Stimulate demand for quality seed at the farm level.

Due to the similarities in their end use segments, the maize and soybean EGS-PPP would have a joint public and private production system for foundation seed. The EGS-PPP's primary focus would be on producing foundation seed for hybrid maize, with a secondary focus on producing foundation seed for soybean. This would reduce the overall cost of production, as well as bridging the current supply-demand gap to make foundation seed of both crops more available to seed companies.

RECOMMENDATIONS

Full and detailed recommendations for each crop can be found in section 5.4. A number of cross-cutting recommendations have been developed which include: establishing a National Seed Fund; implementing and enforcing clear Intellectual Property (IP) policies; improving the quality assurance system; and the FMARD pushing for the early enactment of the New Seed Law to suppress the counterfeit seed trade.

The FMARD should support the establishment of a National Seed Fund focused on enabling Nigerian seed companies to produce and distribute new varieties of foundation and certified rice, maize, and soybean seeds and to actively promote these seeds in remote areas. Additionally, NASC and FMARD should support the implementation and enforcement of clear and strong IP policies that enable licensing agreements and support appropriate royalty sharing.

To ensure quality across all classes of seeds and increase the rate of adoption of improved seeds among farmers, FMARD and NASC would need to sponsor an initiative to 1) improve the quality assurance system and 2) implement a certification protocol for Quality Declared seeds in the informal system. FMARD should also work with the National House of Assembly to complete the review process, thereby accelerating the passage of the New Seed Law. The new seed law will bring credibility to the seed system by placing more stringent and punitive sanctions on seed counterfeiters in both the formal and informal systems.

RICE

Rice demand is expected to remain high because of strong, growing consumer demand, currently fulfilled by imports. Given the crop's appreciable marginal economical value, it should be attractive for full private sector participation. The priority objective for rice should be to stimulate sustainable private sector growth by removing barriers to their participation in foundation seed production. By allowing market forces to dictate which varieties are sold and at what prices, smallholder farmers will have more access to improved seeds, and Nigeria could become self-sufficient in rice production.

Specific recommendations include establishing a private processor-oriented rice seed system; and promoting policies to increase local paddy production through support of integrated rice processors that process locally produced paddy at a competitive quality and price.

YAM

The yam value chain in Nigeria is underdeveloped, receiving little attention from the government and development organizations. While it isn't exactly clear why this is the case, the lack of industrial opportunities as compared to cassava could be the main reason why the FGN has not focused more on yam to date. Furthermore, while yam is an important crop in Nigeria, it is not widely grown outside of Nigeria. This could explain why donors have focused more on cassava as it is a key crop in many countries around the world.

Although the yam seed system falls under the public sector dominant archetype due to the crop's low demand and marginal economic value, it has the potential to be attractive to the private sector. The Yam Improvement for Income and Food Security in West Africa (YIIFSWA) program led by IITA has already initiated the formation of a formal yam seed system through collaboration with private sector entities such as Biocrops Biotechnology Limited, a private laboratory committed to developing seed systems in Nigeria through the use of improved technologies, and other local seed companies. Once these technologies and business models are validated and demonstrate value to the private sector, an EGS-PPP could be recommended. However, at this stage, recommendations focus on establishing a strong National Yam Value Chain Association, demonstrating the benefits of adopting improved varieties at farm level, and supporting the distribution of improved seed yam.

MAIZE

The major barriers to further development in hybrid maize are insufficient breeder seed quantities, breaches in hybrid seed production agreements between seed companies and out-growers, and the limited availability of credit necessary for farmers to purchase in higher cost hybrid seed and the necessary inputs to optimize yield.

A PPP focused on producing foundation seed from existing germplasm from IITA and the NARIs presents an opportunity to develop a sustainable and economically attractive hybrid maize seed system in Nigeria. The PPP would supply foundation seeds to existing and emerging domestic and regional seed companies. Given the high cost of producing foundation seed of hybrid maize and soybean, as well as the complementarity of the two crops in the downstream processing sector, the PPP would concentrate on improving the foundation seed production system for hybrid maize, and include soybean to reduce the overall cost of production. This would help to bridge the sizeable supply-demand gap currently existing for both crops.

Specific recommendations include establishing an EGS-PPP for both maize and soybean and accelerating the production and distribution of maize hybrids in the Humid Rain Forest agro-ecological zone.

SOYBEAN

The priority objective for soybean is to expand EGS production capabilities to meet current and future demand through an EGS-PPP with maize. A strong EGS system would help resolve the significant local supply deficit stemming from increased demand in the poultry and aquaculture sectors, and position Nigeria to become self-sufficient in soybean production.

Specific recommendations include establishing an EGS-PPP for soybean and maize; increasing the capacity of the National Cereals Research Institute (NCRI) substations to increase breeder seed production; and improving the knowledge of the benefits of improved varieties among agro-dealers, who will, in turn, educate farmers.

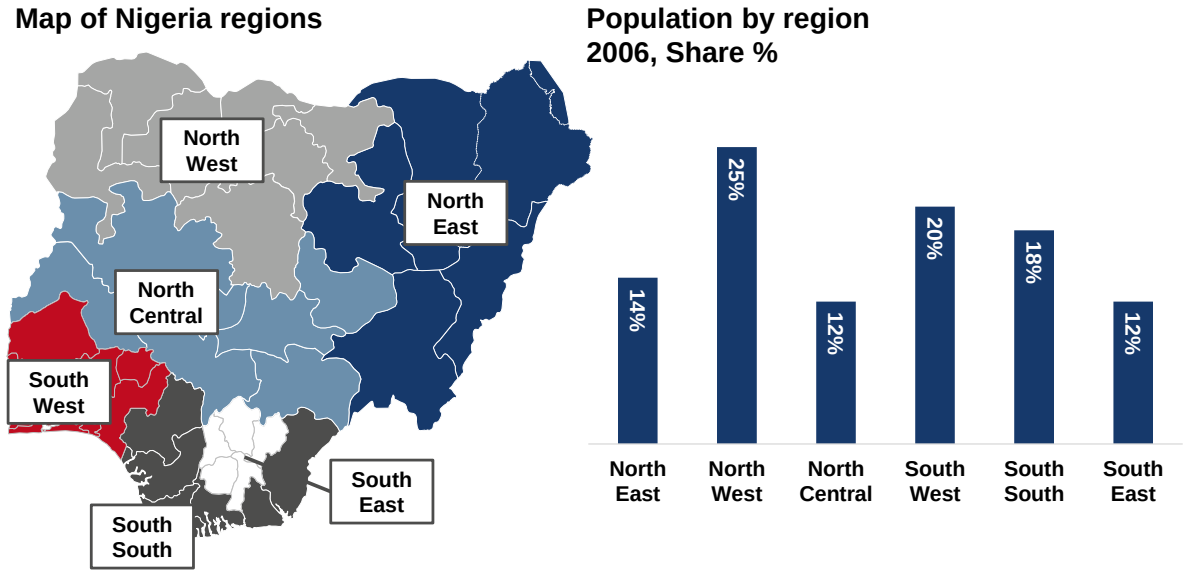
CHAPTER 1: CURRENT SITUATION – DOMINANT SEED SYSTEMS

1.1. COUNTRY OVERVIEW

Nigeria is often referred to as the "Giant of Africa" because of its large population and economy. With 177.5 million inhabitants (World Bank, 2015), of which 51% are men, Nigeria is the most populous country in Africa and hosts more than 500 ethnic groups, the three largest being Hausa, Igbo, and Yoruba. While the official language of Nigeria is English, more than 500 languages are spoken by the different ethnic groups, reflecting the wide variety of cultures.

As illustrated in Figure 3, Nigeria is divided into 36 states across six regions, namely the North East, North West, North Central, South West, South East, and South South. Approximately 70% of the Nigerian population is rural, with the populace concentrated in the North East and North West regions. Approximately 48% of Nigerians are illiterate, with the lowest literacy rates concentrated in the North East and North West. Due to very low levels of development in these regions, many youth (ages 15-24) are migrating to the urban hubs of Lagos (South West) and Abuja (North Central) in search of employment. A recent United Nations survey estimates that 1,200 people migrate to Lagos every day.

Figure 3: **Map of Nigeria regions and % population share.**

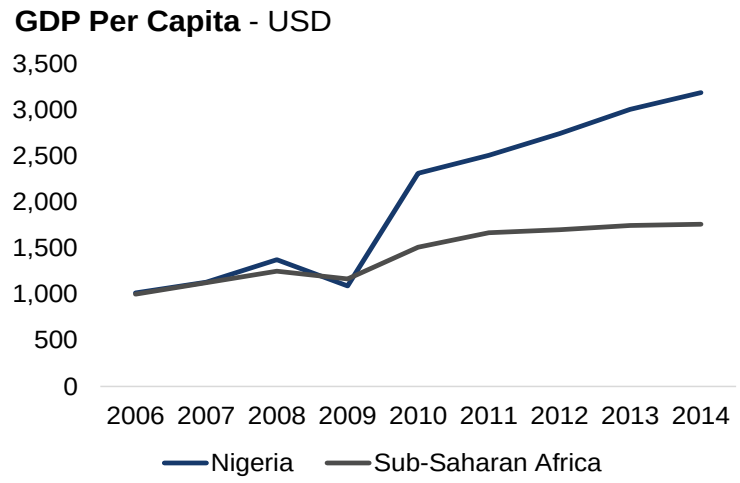


Source: Nigerian Population Commission (2006).

In 2014, Nigeria overtook South Africa to become Africa's largest economy and the world's 20th largest economy. Nominal gross domestic product (GDP) is $568 billion and purchasing power parity is $1 trillion (World Bank, 2015).

In 2012, real per capita GDP was $3,202, well above the Sub-Saharan Africa average of $1,522 (World Bank, 2015). Between 2005 and 2014, real GDP growth averaged about 5.3% per year (National Bureau of Statistics, 2015). Despite these recent positive trends, the International Monetary Fund downgraded Nigeria's GDP growth forecast from 3.3% to 2.3% for 2016 because of the drastic reduction in the country's foreign exchange earnings due to low oil prices and exchange rate volatility leading to rising inflation, shortfalls in non-oil revenues, and security concerns. Nonetheless, the International Monetary Fund predicts the overall impact on the non-oil sector, which represents about 67% of GDP (of which the agricultural sector accounts for 35%), will be relatively muted. In light of the aforementioned macroeconomic problems, the FGN intends to implement a strategy to boost agriculture, retail and wholesale trade, real estate, information technology, and communication. With this new government orientation and a greater focus on food security and increased domestic production, agriculture may become a larger contributor to the country's medium-term economic growth.

Figure 4: **Per capita GDP Nigeria compared to Sub-Saharan Africa.**



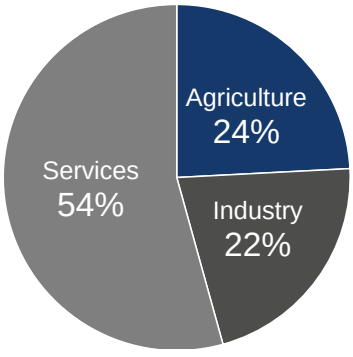
Source: World Bank (2015).

1.2 AGRICULTURE SECTOR

OVERVIEW

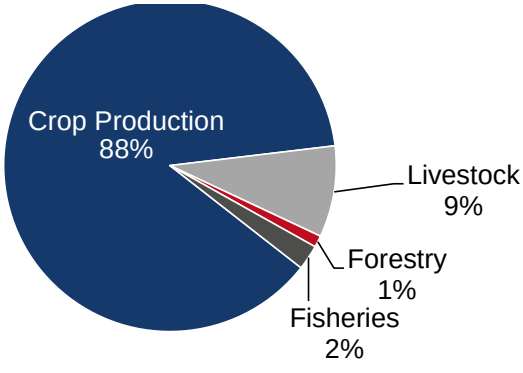
Currently, agriculture makes up only 24% of real GDP, despite the fact that more than 60% of the labor force is involved in this sector. Services and industry are the other two sectors significantly contributing to GDP, as shown in Figure 5. Agricultural GDP is mainly a function of crop production, with much smaller contributions by fisheries, livestock, and forestry, as shown in Figure 6.

Figure 5: **Nigeria GDP composition (4th Quarter, 2015).**



Source: Nigerian Bureau of Statistics (2015).

Figure 6: **Nigeria agriculture GDP composition (2015).**



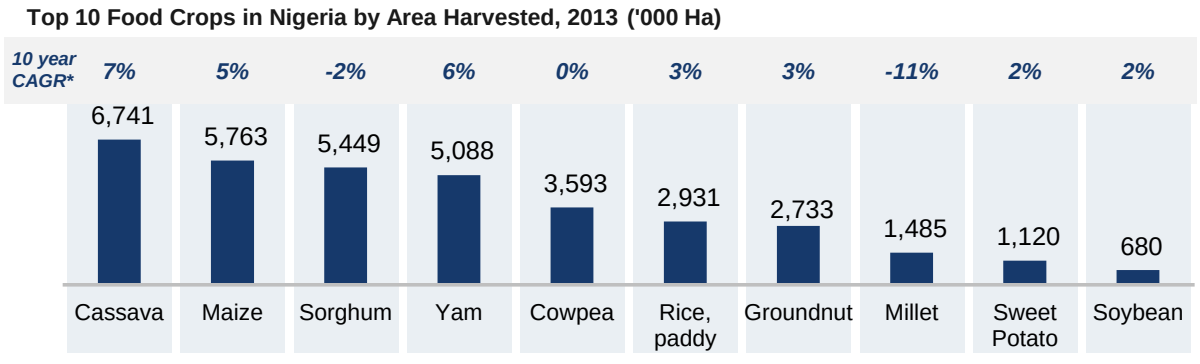
Source: Nigerian Bureau of Statistics (2015).

In the 1960s, agriculture contributed 60% of GDP (Omorogiuwa et al., 2014), with groundnut alone representing about 70% of export earnings. However, after the oil boom in the 1970s, petroleum exports dramatically grew (now accounting for more than 90% of export earnings), while agricultural exports plunged. Today, sesame seeds and cashew nuts are Nigeria's leading agricultural exports. Destination markets for sesame seeds are Japan, Korea, China, Turkey, and the Middle East, while cashew nuts go to Vietnam and India. A 2015 European Union ban on food crops including beans, melon seeds, dried fish and meat, peanut chips, and palm oil has prevented the already diminished agricultural export sector from developing. The ban resulted from cowpea exports that, upon analysis, had at least three times the acceptable limit of dichlorvos pesticide, which is considered dangerous to human health. The FGN recently agreed to implement recommendations from a 17-member committee set up to address this export ban and to ensure zero rejection of food exports. Recommendations are focused on limiting the usage and concentration of this pesticide on farm, as well as the timing of usage, especially while being stored. To date the ban has not been lifted and will last until the FGN implements a robust food safety and traceability system.

KEY CROPS

The top ten food crops in Nigeria, based on area harvested and production, are shown in Figures 7 and 8, respectively. Cassava represents the largest crop by area and production, and is an important crop for smallholder farmers, with more than 90% of Nigeria's cassava production sourced from five million-plus smallholder farmers. Yam is the second largest crop in production terms in Nigeria and is also a key crop for smallholder farmers (~80% of production from smallholder farmers) and food security. While Nigeria is the global leader in production of both cassava and yam, cassava production has grown faster, receiving more attention from the government and private sector due to its versatile uses which include food, starch, ethanol, and animal feed. High-quality cassava flour can also serve to lessen Nigeria's reliance on wheat imports, which were more than 4.5 million MT in 2013. Maize and rice production are Nigeria's fastest-growing grain crops, partially a function of the government's efforts to decrease grain imports. With respect to legumes, groundnut and cowpea are the two largest crops in Nigeria, but soybean has emerged as a crop targeted by the government to double in production, given its nutritional importance as a source of high protein for food and animal feed.

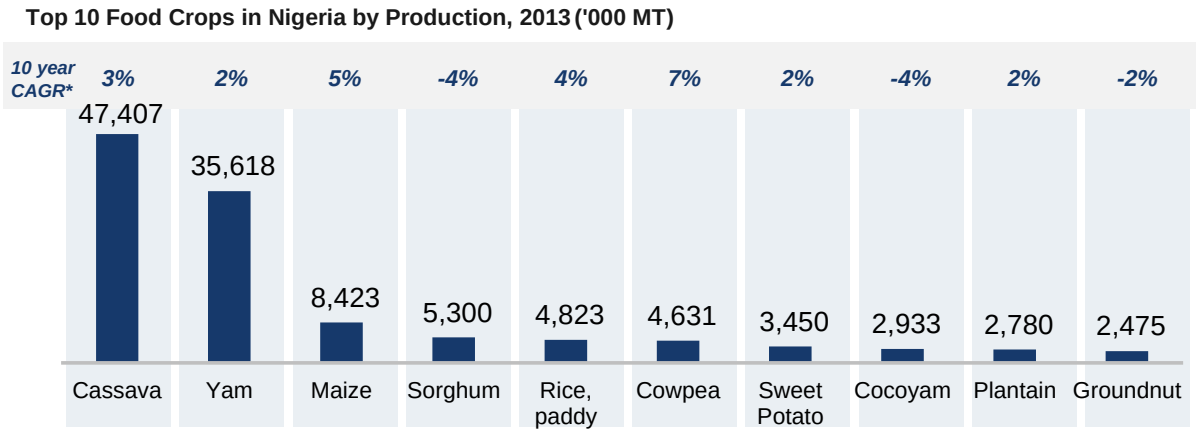
Figure 7: **Top ten crops by area (2013).**



**Compound Annual Growth Rate*

Source: FAOSTAT (viewed in February 2016).

Figure 8: **Top ten crops by production (2013).**



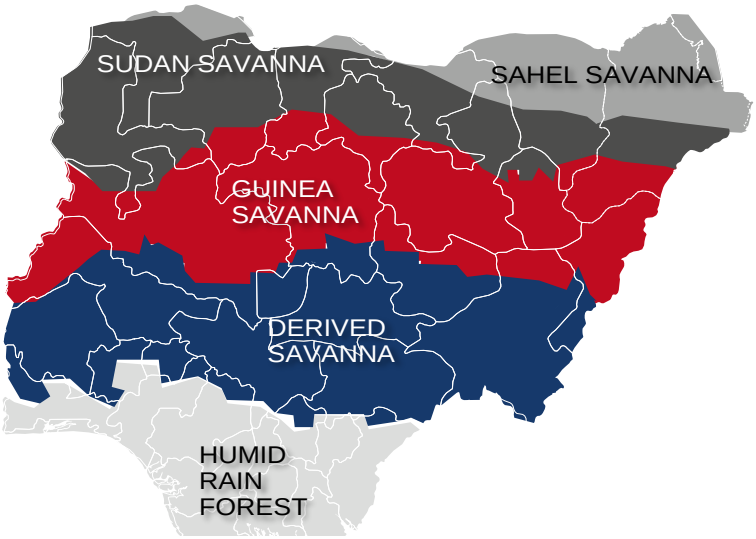
**Compound Annual Growth Rate*

Source: FAOSTAT (viewed in February 2016).

GROWING CONDITIONS

Nigeria has five agro-ecological zones suitable for growing a wide range of crops, leading to diverse cropping systems across regions (Figure 9). Zones include the Sahel and Sudan Savannahs in the north; the Guinea and Derived Savannahs in the middle belt; and the Humid Rainforest in the south. The climate conditions in these zones largely reflect the presence of rainfall, with the wet southern zones bordered by the Atlantic Ocean, and dry northern zones bordered by the republic of Niger on the edge of the Sahara Desert.

Figure 9: **Agro-ecological zones.**

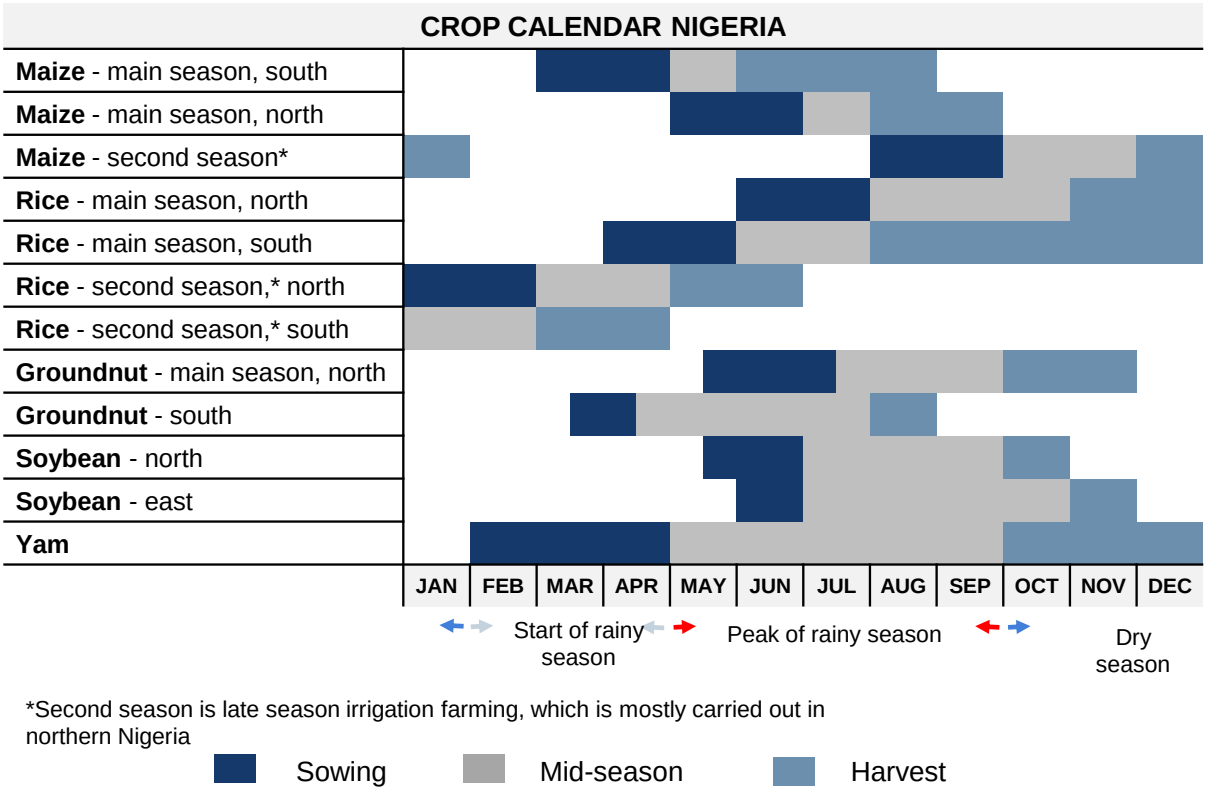


Source: Context Network Multi-Crop Value Chain Analysis (2015).

The bulk of farming activity occurs during the rainy season, which lasts from May to November in the south and July to September in the north (Figure 10). Little farming takes place during the dry season, as it is labor intensive and costly for smallholder farmers to irrigate.

The rainy season in Nigeria varies across the agro-ecological zones. In the south, rain begins in March/April, with the peak of rainfall occurring in June/July, and peak dry season occurs between November and January. In the north, the rainy season starts in April, with a peak in June/July, and the dry season occurs between early to mid-October and mid-April.

Figure 10: **Typical year cropping season calendar.**



Source: USDA Production Estimates and Crop Assessment Division (PECAD).

REGIONAL CROP PRODUCTION

Most states in Nigeria grow staple crops. While northern areas (particularly the Sudan, Sahel Savannah, and Guinea Savannah) produce the most volume due to the large arable land area, southern regions generally have better yields. The yield performance of the crops under study as shown in Table 2, is largely determined by climate and traditional farming practices specific to each crop.

***Table 2*: Regional crop yields across Nigeria (MT/Ha) (2013).**

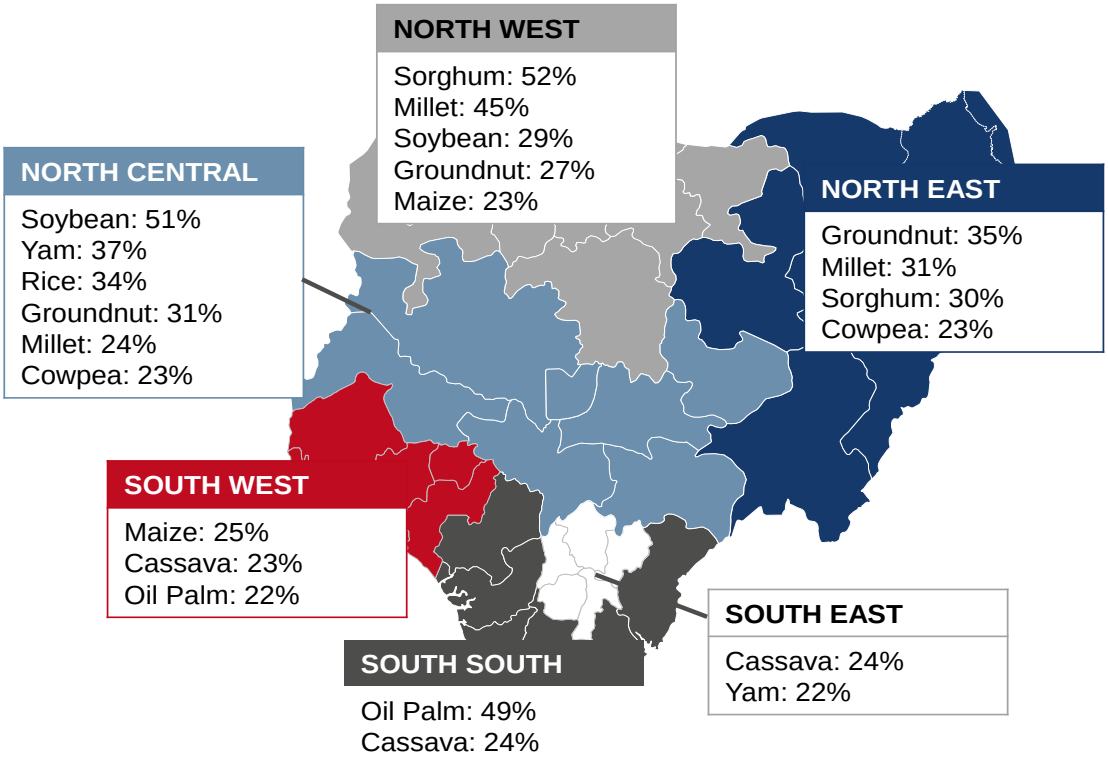
	YAM	SOYBEAN	MAIZE	RICE
North East	N/A	**1.5**	1.9	1.6
North West	N/A	0.9	1.9	1.8
North Central	**12.2**	1.4	1.3	2.3
South West	6.6	1.0	**2.0**	1.8
South East	10.5	N/A	1.6	**2.5**
South South	8.0	1.3	1.7	2.0

**N/A=Not available*

Source: Agricultural Performance Survey of 2013 Wet Season in Nigeria, National Agricultural Extension and Research Liaison Services (NAERLS).

Although farm sizes vary across the country, the majority of farmers can be classified as smallholder farmers, as the average farm size is about 2 Ha. Figure 11 presents the top ten crops by region. Cassava is grown across the country, while production of other key crops such as maize, soybean, and rice is more focused in the north and middle belt. Oil palm, a top export crop, is predominantly grown in the south. Yam is grown across the country, while sorghum is produced exclusively in the north.

Figure 11: **Key crops by region.**



*Crops listed as % of National production. Only crops representing at least 20% of National production are listed.

Source: Agricultural Performance Survey of 2013 Wet Season in Nigeria, NAERLS.

As shown in Table 3, the division of labor in Nigeria varies by task and by region. Women actively participate in all aspects of production, but men own the majority of farmland and are also dominant in decision-making. A male farmer in Nigeria is five times more likely to own land than a female farmer (Africa Region Gender Practice, 2012). Across the country, women are most active in local processing of food security crops, such as rice, maize, cowpea, and vegetables, but this processing is often at a subsistence level on farm, rather than for commercial purposes. Female-headed households are very few and often very poor, with limited access to funds and suitable equipment such as tractors.

In general, men are more involved in the production of cash crops such yam, maize, soybean, cotton, and sesame seeds. They are more open to taking risks in order to optimize payouts.

In regard to trade, Nigerian women play an important role in both informal and formal cross-border trade. An estimated 52% (Adeyinka, 2014) of cross-border trade between Nigeria and Benin Republic is carried out by women.

Table 3: **Gender roles in crop production by region.**

		Maize		Rice		Soybean		Yam	
									
North	Production	**98%**	2%	**90%**	10%	**95%**	5%	*N/A*	*N/A*
	Processing	10%	**90%**	20%	80%	10%	**90%**	*N/A*	*N/A*
	Marketing	**85%**	15%	**90%**	10%	**90%**	10%	*N/A*	*N/A*
South	Production	**70%**	30%	**60%**	40%	86%	14%	**80%**	20%
	Processing	10%	**90%**	20%	**80%**	*N/A*	*N/A*	50%	50%
	Marketing	**90%**	10%	**60%**	40%	*N/A*	*N/A*	**80%**	20%

N/A=Not applicable

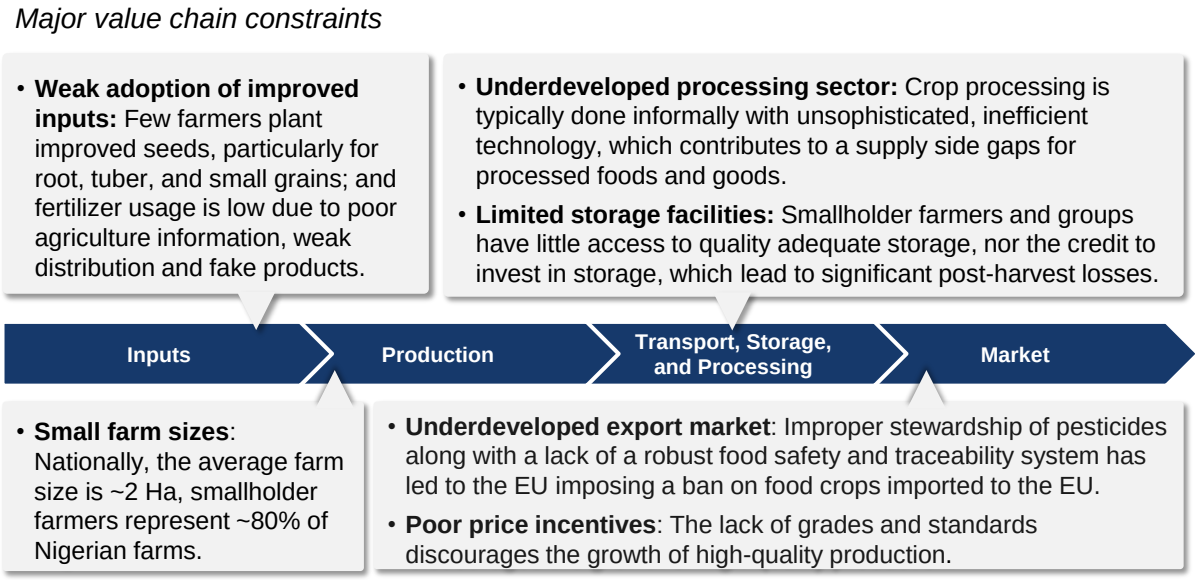
Source: Estimating Gender Differentials in Agricultural Production in Nigeria (2012).

AGRICULTURE AND ENABLING ENVIRONMENT CONSTRAINTS

While this study focuses primarily on constraints specific to seed systems, it's critical to review a broader set of constraints across multiple crop value chains that impact the seed situation. Figures 12 and 13 provide a high-level but not exhaustive list of key constraints in Nigeria, the most pertinent being weak adoption of improved inputs, limited use of agronomic best practices by smallholder farmers, lack of on-farm storage facilities, and limited use of mechanization, which together lead to low yields and high post-harvest loss.[1]. Limited access to credit is the root cause of the underdeveloped value chains, as it hinders agribusinesses' ability to operate at optimum capacity and smallholder farmers' ability to buy high-quality inputs.

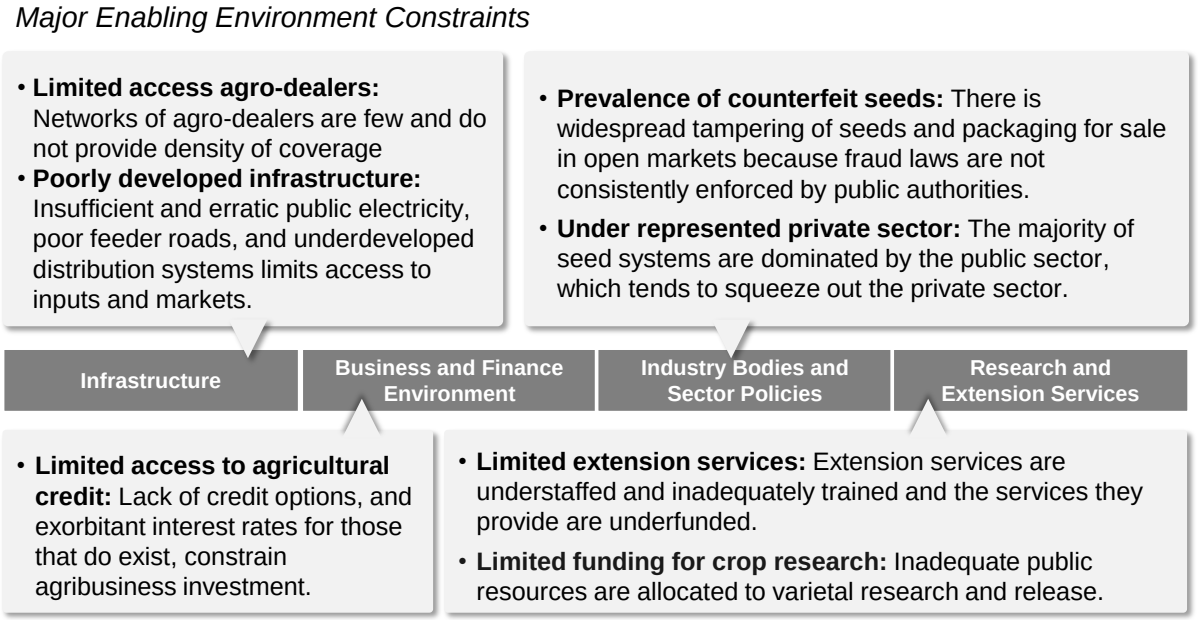
[1] Fertilizer use in Nigeria is estimated at only 13 Kg/Ha on average (WAAPP, 2014), compared to a global average of 100 Kg/Ha or an Asian average of 150 Kg/Ha. Statistics show that crop yields in Nigeria consistently rank poorly in a global context, ranking 79th for maize, 93rd for rice, 79th for soybean, and 31st for yam in 2014 (FAOSTAT).

Figure 12: **Major value chain constraints.**



Source: Field interviews (2016).

Figure 13: **Major enabling environment constraints[2].**



Source: Field interviews (2016), Innovating the Nigerian Agricultural Seeds Sector: A Proposed Plan for WAAPP Nigeria (2013).

[2] Interviews revealed that government payment to fund the NARIs' projects can be very slow. In some instances, breeders carry out varietal improvement research with personal resources.

Limited Access to Credit

Financial constraints affect both lenders and borrowers. Bank loans are usually available only for large, established agribusinesses, although recent initiatives from the Central Bank of Nigeria (CBN) and the FMARD have allowed some banks to increase their lending to smaller entities in the agricultural sector. According to the CBN, credit to the agricultural sector increased from 1.6% in 2009 to 3.7% in 2013.

Due to stringent lending requirements, most smallholder farmers in Nigeria cannot access loans from financial institutions to finance their farming activities and make capital improvements. These requirements often include collateral or forced savings systems which require smallholder farmers to meet a specific amount of individual savings in order to reduce the risk of defaulting on the loan. Instead, many have formed community-level credit unions in which members (typically similar in age, clan, gender, and interests) make fixed contributions at fixed intervals (weekly, semi-monthly or monthly). The total amount contributed by the entire group at this fixed period is then assigned to each of the members in rotation. In addition, farmers set aside money that is not distributed to any member in rotation but is instead loaned to members in emergencies or saved to achieve a communal goal. These credit unions vary in name and process by region; they are often called Ajo in the Southwest, Adashe in the North, and Esusu in the East.

Credit unions operate under an implicit understanding that members will adhere to group expectations and norms. In the best case scenario, collectives solve their own problems and enforce their own traditions. However, problems may arise in cases of death, default, or favoritism. Though some credit unions operate under written laws, most do not provide written guarantees.

Recently, Diamond Bank unveiled an electronic version of the traditional credit union savings system, called the Diamond eSUSU scheme. It is intended to improve savings habits by encouraging and helping participating groups to meet their targets in a timely and efficient manner.

However, many problems remain for lenders and borrowers. Key lender-related issues include:

- **Agriculture perceived as high risk:** Most commercial banks do not view agricultural lending as a profitable business because of the unpredictable impact of weather, pests, and disease on production levels. Unfortunately, there has been limited innovation in the adoption of agricultural insurance to give financial institutions the confidence required to lend to actors in the agricultural sector.
- **Dearth of knowledge of agricultural credit appraisal:** Credit officers at banks typically do not have experience or training in agricultural credit appraisal, monitoring, or administration because their focus has been on lending to other sectors.
- **Weak bank branch networks:** Very few commercial banks have rural branches, which severely limits their outreach. Furthermore, the geographically fragmented nature of smallholder farming adds to the complexity and cost of loan administration in those areas.
- **Insufficient funds:** Commercial banks and microfinance institutions (MFIs) in Nigeria are often insufficiently funded themselves, which limits their ability to meet the credit needs of smallholder farmers and other borrowers.

Smallholder farmer borrowers present certain unique challenges to the lending system, including:

- **Inadequate recordkeeping:** Most smallholders do not keep farm records that are detailed enough to allow loan officers to evaluate their creditworthiness. In addition, many smallholders lack the business know-how necessary to manage their farm finances that would provide additional confidence to the bankers that they are investment ready.
- **Lack of collateral:** Smallholder farmers often operate at a subsistence level and rarely save enough to meet the tangible security requirement for a bank loan. The communal land tenure system with shared land rights/ownership adversely affects the acceptability of land as legal collateral. In rural areas and villages, land values are low and might not offer easy foreclosure processes.
- **High cost of financing:** Financing options available to smallholder farmers are often cost-prohibitive, with high interest rates varying from 18% to 30% depending on the source of the loan.

To help resolve some of these problems, the CBN and FMARD have developed several programs that support smallholder farmers and agribusiness in Nigeria, including the Commercial Agricultural Credit Scheme (CACS), the Nigeria Incentive-based Risk Sharing Agricultural Lending (NIRSAL), the Micro, Small and Medium Enterprises (MSME) fund, and the Fund for Agricultural Finance in Nigeria (FAFIN), which are briefly highlighted below.

Commercial Agricultural Credit Scheme (CACS)

Established in 2009, CACS provides farmers with credit at a single-digit interest rate. It was developed by the CBN in collaboration with FMARD. Under the program, ₦200 billion (roughly $1.3 billion[3]) was earmarked for lending at 9% to agricultural entities involved in production, processing, storage, and inputs. Originally intended to end in 2015, the program was recently extended to September 2025. As of February 2014, the total amount disbursed to participating banks under CACS was ₦228.2 billion for 307 projects.

Nigeria Incentive-based Risk Sharing Agricultural Lending (NIRSAL)

Established in 2011 by the CBN, FMARD, and the Bankers Committee, NIRSAL aimed at encouraging growth of credit in the agricultural sector by fostering bank lending through increased incentives and technical assistance. One of the major deterrents to bank lending has been high perceived risk, and NIRSAL reduces this by guaranteeing up to 75% of agriculture bank loans. It pays about 50% of losses incurred to large farmers and roughly 75% of losses incurred for small and medium-scale farmers. The program addresses tomato, cassava, cotton, maize, soybean, and rice value chains in regions with the highest production, namely the North West, North Central, and South East. The CBN, in partnership with the Alliance for a Green Revolution in Africa (AGRA), has committed ₦75 billion (roughly $500 million) to support NIRSAL.

Micro, Small and Medium Enterprises (MSME) Development Fund

[3] Based on the October 2009 Naira to USD exchange rate of ~150. The Naira to USD exchange rate as of this report date is ~282.

The ₦220 billion MSME fund was launched in 2013 by the CBN to provide capital to entrepreneurs in various sectors. 10% of the fund is devoted to developmental objectives such as grants, capacity building, and administrative costs, with 90% reserved for commercial activities. This is managed by participating financial institutions including MFIs, finance companies, commercial banks, the Bank of Industry, and the Bank of Agriculture, at 2% on-lending to MSMEs at a maximum interest rate of 9% per annum. Specific to agriculture, the fund aims to address post-harvest losses among smallholder farmers, with 60% of the fund allocated specifically to women farmers and entrepreneurs. As of May 2014, the MSME fund had not yet been disbursed to farmers because the CBN had not yet established a mechanism for managing it. In addition, some SMEs have complained about stringent requirements for the fund, such as tangible collateral and registration under a cooperative society (FATE Foundation, 2015).

Fund for Agricultural Finance in Nigeria (FAFIN)

FAFIN is the only Nigerian private equity fund focused exclusively on agriculture. Its vision is to catalyze agriculture-led inclusive economic growth in Nigeria by increasing the amount of private capital available for agriculture. The fund has a preference for investment opportunities that enable import substitution, increase food security, or bridge gaps and fix inefficiencies along supply chains. Launched in January 2014 by three sponsors (the FMARD, the German government via KfW Development Bank, and the Nigeria Sovereign Investment Authority), its target fund size is $100 million and its first close was $33 million. FAFIN is managed by Sahel Capital.

FAFIN provides expansion capital to established SMEs with high growth potential, and is not focused on start-up companies or greenfield investments.[4] It will only consider early stage investments where the promoters and/or management team have demonstrated sector expertise by previously running companies within the same sector successfully. The minimum investment size for FAFIN is $500,000. A potential investor must be able to demonstrate the business case for this amount of funding. Some business-related eligibility criteria include a track record of strong performance, significant growth potential, a competent entrepreneur or management team, strong governance or ethical business practices, competitive advantage, and a well-developed exit strategy.

To date, FAFIN has completed investments in three companies in Nigeria namely L&Z Farms focused on dairy processing in Kano, Diamond Pearls focused on Oil Palm processing in Kwara, and Dayntee Farms focused on Poultry in Kwara.

NATIONAL AGRICULTURAL STRATEGY

Agricultural Transformation Agenda (ATA)

The ATA was launched in 2012 as a FMARD initiative to support the former presidential administration's broader Transformation Agenda. The goal of ATA is to build commodity value chains and the institutions required to unlock the country's huge agricultural potential, with a targeted outcome of adding 20 million MT of food to the domestic food supply by 2015, creating 3.4 million jobs, ensuring import substitution through accelerated production of local staples thus reducing dependence on food imports and turning Nigeria into a net food exporter. Crop value chains under the ATA include rice, cassava, sorghum, cocoa,

[4] A greenfield investment is a type of venture where finances are employed to create a new physical facility for a business in a location where no existing facilities are currently present.

cotton, oil palm, horticulture, maize, soybean, wheat, groundnut, ginger, cashew, rubber, and sugarcane (FMARD ATA Scorecard).

The Growth Enhancement Support (GES) program under the ATA is a key component of the FMARD's focus on increasing farmer adoption of inputs by improving delivery. The program provides a 50% subsidy of the cost of fertilizer and improved seed, with the FGN and state governments equally sharing the subsidy cost. Using an electronic wallet on a mobile phone, it was launched to provide targeted support for seed and fertilizer to five million farmers in the first year, and 20 million farmers within four years. In its first year, a database of 4.5 million farmers was developed and a loan facility of $200 million was secured from commercial banks, using government guarantees, to finance seed and fertilizer suppliers. Between 2012 and 2013, fertilizer companies sold a total of $100 million of product, while seed companies sold about $10 million worth of seeds to farmers. However, the impact of the GES is marred by its mixed results. Some stakeholders claim that fertilizer and seed distribution under the program was highly bureaucratic. In addition, many small scale seed companies sprang up to benefit from the government's seed intervention, but distributed low quality seeds to farmers due to their low seed production capacity and ineffective certification system. Furthermore, Nigeria's transition into a new administration in 2015 has stalled the continuity of the GES program. According to expert interviews, there will be an adjustment to the existing GES financing structure from 2016 in which state governments will no longer participate. Given the state governments' lack of funds for capital projects, farmers will contribute 75% of the cost of inputs while the remaining 25% will be supported by the FGN.

Agricultural Development Programs (ADP)

ADPs have evolved into agricultural extension agencies under state ministries of agriculture across the country. With the introduction of the Unified Agricultural Extension Services in 1989, the ADP strategy was changed from a crop-biased approach to include other sectors such as livestock, fisheries, forestry, and natural resource management. The National Agricultural Extension and Research Liaison Services (NAERLS) of Ahmadu Bello University, Zaria, is responsible for providing extension specialist support service to ADPs, while the Project Coordination Unit of FMARD is responsible for the coordination, monitoring, and evaluation of their extension delivery activities.

ADPs remain the main agencies responsible for public extension delivery at the grassroots level. However, ADP activities across the country are hampered by inadequate funding and low technical capabilities to carry out effective extension delivery. According to a recent survey, approximately 60% of ADP staff lack the necessary expertise to train farmers on good agricultural practices, while 75% do not have the equipment needed for field training due to lack of funding (Obiora, 2015). These problems have led local governments to become more involved in extension delivery. However, local governments are also plagued by the same issues regarding staff know-how and lack of funding.

Staple Crops Processing Zones (SCPZ)

Another FMARD endeavor is the Staple Crops Processing Zones (SCPZ), funded by the World Bank. The SCPZ focuses on attracting private sector agribusinesses to set up processing plants in zones of high food production to process commodities into food products. This is enabled by government-established fiscal, investment, and infrastructure policies for these zones, such as tax breaks on imported equipment. Although an SCPZ-related activity in Kogi state suffered a major setback in 2015 following the sudden exit of its

core investor, Cargill; a local private company, Union Dicon Salt Plc., recently replaced Cargill as the main investor in the zone focusing on cassava production and processing into starch and sweeteners. According to interviews, there are also ongoing discussions between the FMARD and the World Bank to distribute funds and launch operations across multiple zones.

1.3 DOMINANT SEED SYSTEMS IN NIGERIA

SEED SYSTEMS OVERVIEW

There are four identified seed systems in Nigeria, as shown in Figure 14. These include 1) farmer-saved, 2) public-private, but led by the NARIs with limited private seed company involvement in certified seed production, 3) public-led systems, and 4) private-led systems dominated mostly by local seed companies. The farmer-saved seed systems represent the majority of seed volume. The largest proportion of EGS volume is produced by the public and private systems, while farmer-saved seeds and farmer-to-farmer seed exchanges dominate the informal seed sector.

Figure 14*:* Dominant seed systems in Nigeria.

Seed Systems	Farmer-saved	Public – Private *Local Seed Businesses*	Public *Government-driven*	Private *Commercial Seed Companies*
Type of Crops	Local food crops	Food and cash crops	Major food and cash crops	High-value crops
Crops	• Maize (OPV) • Soybean • Rice • Cowpea • Sorghum • Groundnut • Millet • Yam • Cassava • Sweet potato	• Maize (OPV) • Soybean • Rice • Cowpea • Yam • Cassava	• Maize • Soybean • Rice • Yam • Cassava • Sorghum • Cocoa • Cotton • Oil palm • Wheat	• Maize (OPV and Hybrid) • Soybean • Rice • Cowpea • Wheat • Vegetables
Types of Varieties	Local (landraces) and Improved	Local and Improved	Improved	Improved and Hybrid
Quality Assurance System	Farmer-selected	Farmer-selected, certified	Certified	Certified
Seed Distribution	Farmer-saved, farmer-to-farmer seed exchanges, village market	Local sales and markets	ADPs, agro-dealers, NGOs	ADPs, agro-dealers, NGOs

Source: Field research team interviews (2016)[5].

While smallholder farmers in Nigeria are aware of improved varieties, the rate of adoption is low across most agro-ecological zones because most farmers recycle seeds to reduce their input costs. Adoption of improved varieties is higher for grain crops than for root and tuber crops, as root and tuber planting material is easily recyclable and there has been little demand for, or development of, improved root and tuber varieties. Among grain crops, improved varieties of maize (specifically hybrid maize) are adopted more than other grain

[5] The top three seeds produced by private seed companies in Nigeria include maize, soybean, and rice; only two registered seed companies produce seeds of wheat which is sold to Lake Chad Research Institute, Borno State for distribution to farmers.

cereals or legumes. This is because the maize value chain and seed system attracts more development initiatives from NGOs and donors than other grain value chains. While some farmers buy improved seeds, many acquire their improved seeds from donor- or NGO-funded input intervention programs.

1.4 KEY ACTORS IN THE SEED SYSTEM

PUBLIC SECTOR OVERVIEW

Federal Ministry of Agriculture and Rural Development (FMARD)

The mandate of FMARD is to be a significant net provider of food to Nigeria, through the promotion of agricultural development and management of national resources in a value-chain approach to achieve sustainable food security, enhance farm income, and reduce poverty. The ministry is primarily focused on developing strategic partnerships to stimulate investments in market-led agricultural transformation, focusing on value chains where Nigeria has a comparative advantage. In the last five years, the ATA has been the major vehicle of FMARD's agricultural development initiatives.

National Agricultural Seeds Council (NASC)

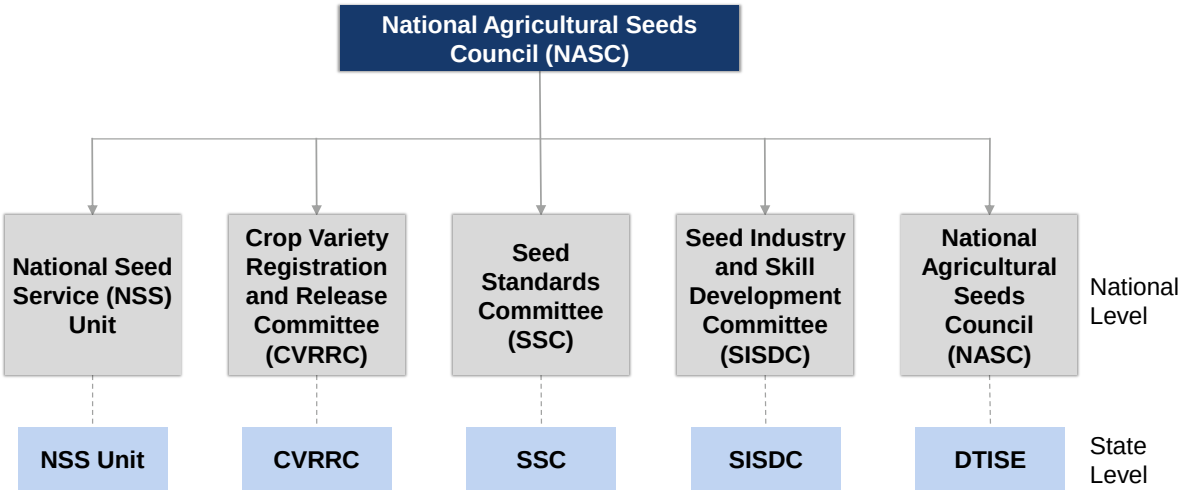
Under FMARD's authority, NASC is at the center of Nigeria's seed sector as the principal institution for the implementation of national seed policy. NASC's functions include regulating the volume of seed produced and supplied to the market to ensure competitiveness and controlling seed quality to protect farmers and the environment. Its vision is to build a market-driven seed industry to make the production and distribution of high-quality and improved planting materials available, accessible, and affordable to all farmers.

NASC was established in 2007 in line with the provisions of the National Agricultural Seeds Decree No. 72 of 1992. It evolved from the National Seed Service (NSS) established with technical assistance from FAO in 1975 under the Federal Ministry of Agriculture and Natural Resources. The World Bank assisted through the National Seed and Quarantine Project from 1991 to 1997.

Following the enactment of the Nigeria Seed Law, NASC was established to take over NSS functions and expand the scope of administration of the seed industry. In 2009, the governing board of NASC was inaugurated, and implementation of the seed policy began in 2010.

As contained in the Seed Act, five units, headed by directors, were established to work for NASC in developing the seed industry, including the NSS Unit, the Crop Variety Registration and Release Committee (CVRRC), the Seeds Standards Committee, the Seed Industry and Skill Development Committee, and the Department of Training, Information, and Seed Extension (Figure 15). At the state level, the State Seed Coordinating Committees perform all the functions of NASC's five supporting bodies. In most states, the committee is headed by the Commissioner of Agriculture, with an ADP manager serving as secretary.

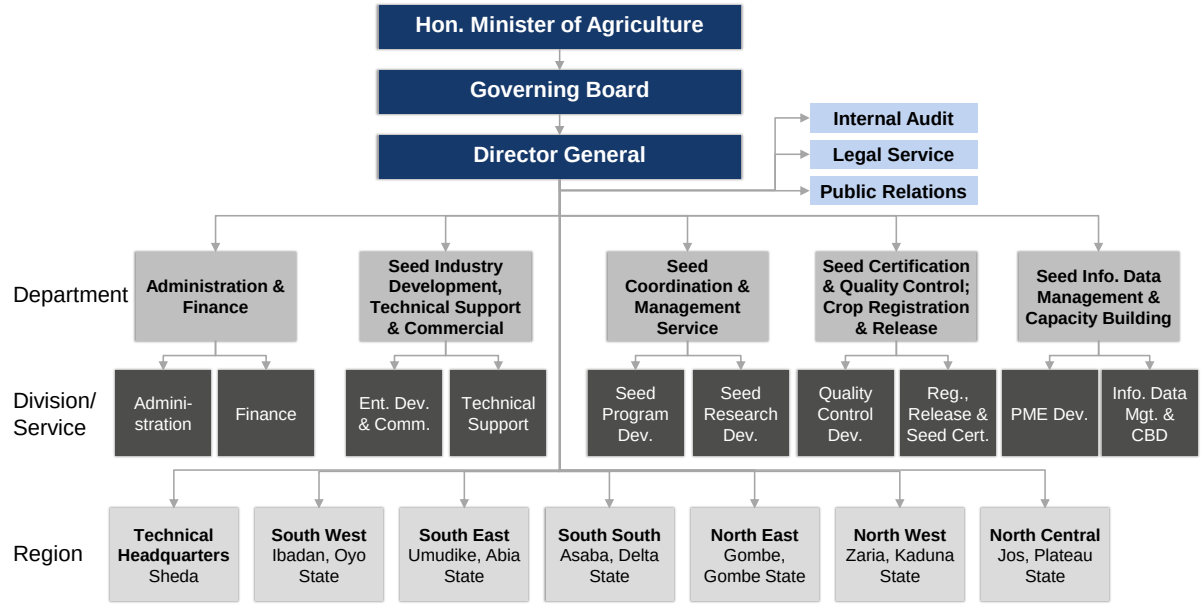
Figure 15: **Organizational structure for implementation of the National Agricultural Seed Policy.**



Source: Adapted from Baffour Badu-Apraku, Robert Agyeibi Asuboah, Bamidele Fakorede, and Baffour Asafo-Adjei (2014). Strategies for Sustainable Maize Seed Production in West and Central Africa. IITA, Nigeria. 140 pp.

NASC is headed by a governing board and a director general who coordinates all activities across various departments of the council. The operational structure of NASC is shown in Figure 16.

Figure 16**: Operational structure of NASC.**



Source: National Agricultural Seeds Council.

The states coordinated by each of NASC's regional offices are listed in Table 4 below.

Table 4: **Operational zones and secretariats of NASC.**

Zone (and Secretariat)	States Covered
Central (Ilorin)	FCT Abuja, Benue, Kwara, Kogi, Niger
Northwest (Zaria)	Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto
Northeast (Jos)	Adamawa, Bauchi, Borno, Plateau, Taraba, Yobe
Southwest (Ibadan)	Delta, Edo, Lagos, Ogun, Ondo, Ekiti, Oyo, Osun
Southeast (Umudike)	Abia, Anambra, Cross River, Akwa Ibom, Imo, Enugu, Ebonyi, Rivers, Bayelsa

Source: Baffour Badu-Apraku, Robert Agyeibi Asuboah, Bamidele Fakorede, and Baffour Asafo-Adjei (2014). Strategies for Sustainable Maize Seed Production in West and Central Africa. IITA, Nigeria. 140 pp.

National Seed Service (NSS) Unit

NSS unit keeps and maintains a register of individuals or organizations engaged in research and development that leads to the registration and release of improved crop varieties for commercial production and distribution. According to the Seed Decree, NSS is responsible for development, certification, and quality control of seeds, as well as seed technology development, technical support services, and seed industry development. Historically, NSS was involved in foundation seed production and distribution, and monitoring of certified seeds, which includes assisting the private sector in commercial seed production. However, given that the current National Seed Policy supports a private sector-led seed system, foundation and certified seed production is led by the private sector.

Crop Varieties Registration and Release Committee (CVRRC)

CVRRC is responsible for variety evaluation, release, and withdrawal. The committee is made up of key technical members of NASC, other relevant experts outside NASC, and researchers who may be relevant for specific crops or varieties. Prior to registration, a crop variety is generally required to undergo a minimum of two years of testing to determine its adaptability to a particular agro-ecological zone.

National Agricultural Research Institute (NARI)

The six NARIs in Nigeria are responsible for development and release of improved varieties. Each NARI focuses its breeding efforts on key crops grown in the agro-ecological zone in which it is located (Table 5). The NARIs are also responsible for production of breeder seed and are expected to meet the highest quality standards, including maintaining the genetic purity of varieties that have originated from their respective institutes. While not a core function, the NARIs also produce foundation seed, as private seed companies lack the technical know-how, facilities, and equipment to do so.

***Table 5*: National agricultural research institutes in Nigeria and their focus crops.**

INSTITUTE	LOCATION	MANDATE CROP
Institute for Agricultural Research (IAR)	Samaru, Zaria, Kaduna State	Maize, Cowpea, Sorghum, Cotton, Groundnut, Sunflower, Jatropha, Artemisia, Castor
National Cereals Research Institute (NCRI)	Badeggi, Niger State	Rice, Beniseed (Sesame), Castor Oil, Soybean, Sugarcane
Institute for Agricultural Research and Training (IAR&T)	Ibadan, Oyo State	Kenaf, Maize, Jute
National Institute for Horticultural Research and Training (NIHORT)	Ibadan, Oyo State	Fruits and Vegetables crops
Lake Chad Research Institute (LCRI)	Maiduguri, Borno State	Wheat, Barley, Millet
National Root Crops Research Institute (NRCRI)	Umudike, Abia State	Yam, Cassava, Sweet potato, Irish Potato, Ginger, Cocoyam

Source: Baffour Badu-Apraku, Robert Agyeibi Asuboah, Bamidele Fakorede, and Baffour Asafo-Adjei (2014). Strategies for Sustainable Maize Seed Production in West and Central Africa. IITA, Nigeria. 140 pp.

PROGRAMS AND NGOS

Consultative Group on International Agricultural Research (CGIAR)

CGIAR is a global research partnership for a food-secure future. Its work contributes to worldwide efforts to tackle poverty, hunger, major nutrition imbalances, and environmental degradation. Research is carried out by 15 CGAIR centers, in close collaboration with hundreds of partners, including national and regional research institutes, civil society organizations, academia, development organizations, and the private sector.

The following three CGIAR centers are very active in Nigeria, focusing on breeding for variety improvements and supporting the NARIs for the release of new and improved crop varieties:

- **International Institute of Tropical Agriculture (IITA)** supports the NARIs in breeding, testing, and release of improved varieties of cassava, cowpea, maize, yam, soybean, cocoa, coffee, banana, and plantain.
- **International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)** supports the NARIs focused on breeding and releasing improved varieties of sorghum, millet, pigeon pea, and groundnut. They are also actively engaged in Nigeria, partnering with NRCRI in Umudike on Irish potato and sweet potato.
- **The Africa Rice Center (AfricaRice)**, formerly known as the West Africa Rice Development Association (WARDA) is a Pan-African rice research organization committed to improving livelihoods in Africa through strong science and effective partnerships. AfricaRice's research activities in Nigeria led to the introduction of new rice varieties, including the New Rice for Africa "NERICAs" and the Federal Agriculture Research Oryza (FARO) varieties.

HarvestPlus: Agriculture for Nutrition and Health Program (A4NH)

HarvestPlus is working in 22 states in Nigeria to promote the availability, adoption, and consumption of bio fortified crops by supporting NRCRI in the breeding, testing, and release of Vitamin A-rich cassava developed through a partnership with IITA. HarvestPlus is also engaged in the research and release of bio fortified maize varieties that can provide up to 50% of daily Vitamin A needs. To date, two hybrid varieties of provitamin A (precursor of vitamin A) maize (Ife maizehyb-3 & Ife maizehyb-4) and two open pollinated varieties of provitamin A maize (Sammaz 38 & Sammaz 39) have been released. The project is being implemented across all states in Nigeria. HarvestPlus' main funders include the UK government, BMGF, USAID's Feed the Future initiative, and the European Commission.

West African Agricultural Productivity Program (WAAPP) Seed Distribution Initiative

WAAPP is a World Bank-funded program instituted in 2014 with a goal to increase agricultural productivity in Africa through scaling up of farmers' staple crop output. The strategy involves increasing the overall supply of seeds by making breeder and foundation seeds more readily available. WAAPP contracts mandated NARIs in Nigeria to produce breeder and foundation seed of rice, maize, and sorghum for sale to private seed companies with a 40% price support.

Improved seeds totaling more than 10.8 MT for rice, 3.6 MT for maize, and 1.05 MT for sorghum were distributed under the WAAPP initiative in 2014 (NASC, 2014).

Yam Improvement for Income and Food Security in West Africa (YIIFSWA)

The YIIFSWA project began in Nigeria in 2012 with BMGF funding. Its main objective is to increase yam productivity to improve livelihoods and food security of smallholder farmers in West Africa. Through partnerships with key stakeholders in the yam value chain, the project aims to benefit yam farmers and traders by transforming fragmented yam supply chains into more coherent value chains. The project has seven major objectives, including the development of technologies for high-ratio propagation of high-quality seed yams. The first phase of the YIIFSWA project ended August 2016.

Babban Gona "Great Farm"

Babban Gona is an agricultural franchise initiative developed by Doreo Partners, an impact investment firm in Nigeria that focuses on lifting rural farmers out of poverty. The program delivers cost-effective agricultural inputs and end-to-end services (such as training and financing) to smallholder farmers to enhance yields and labor productivity, while also linking farmers to profitable markets.

The Babban Gona franchise model provides four major services to help smallholder farmers be successful:

- Financial services: Raises cost-effective capital to finance members of the franchise farmer groups.
- Agricultural input services: Provides a timely and appropriate balance of inputs to farmer groups at highly competitive prices, as well as training to ensure inputs are used appropriately by farmers.
- Training and development: Provides the training required on how to use inputs, and best agronomic practices.
- Marketing services: Ensures members have an understanding of good warehousing practices and access to well-paying markets, which increases their profits.

Babban Gona, which began in 2012, is currently operating in Kaduna State, with plans to extend its activities to the south. Farmers who are members of the franchise have realized significantly improved yields. For example, one farmer attained yields of 4.6 MT/Ha in maize, about three times higher than the national average, and achieved an economic value (net of all loans) of more than $1,450 from 1.1 Ha, compared to $600 prior to joining the franchise. The Babban Gona initiative is funded by a number of organizations including AGRA, BMGF, Rockefeller Foundation, the U.K.'s Department for International Development (DFID), Skoll Foundation, and Nestle.

The Maximizing Agricultural Revenue and Key Enterprise in Targeted Sites (MARKETS II)

MARKETS II is USAID/Nigeria's flagship project under Feed the Future (FTF). It uses proven private sector demand-driven market interventions, focusing on constraints in the agricultural value chain to reduce poverty and enhance nutrition. Key objectives include increased income for smallholder farmers, ready markets, better inputs (improved seeds and optimal use of fertilizer), adequate credit, better water and pesticide management, appropriate technology, and extension services. Improved nutritional use of grown or purchased foods is also a major objective under the project. MARKETS II also targets agricultural value chain segments that are more favorable to the involvement of women and youth, such as service providers, processing, and micro-enterprises.

The project runs from 2012 to 2017, and implementation is now across all regions in Nigeria with emphasis on nutrition and rice, sorghum, soybean, maize, cassava, cocoa, and aquaculture value chains. To date, MARKETS II activities have received $17 million in private sector investment, and 131 public-private partnerships have been facilitated. In addition, 336,169 farmers have adopted new technologies and farm management practices.

PRIVATE SECTOR OVERVIEW

Private seed companies

Unlike many countries in West Africa, the role of the private sector has been vital to the transition and growth of Nigeria's seed industry, as the private sector has been active in production and marketing of improved certified seeds. According to NASC, there are 157 registered seed companies in Nigeria, with majority producing less than 1,000 MT of seeds annually. The majority of private seed companies in Nigeria are domestic. However, large foreign input companies focused on hybrid seed production have penetrated the commercial seed production and distribution market in recent years, including Syngenta and Monsanto.

***Table 6*: List of key private seed companies.**

Company	Country of Origin	Crop Seed Portfolio	Key Varieties
Premier Seeds	Kaduna, Nigeria	Maize (Hybrid and OPV), Rice, Soybean, Cowpea	• Maize Hybrids: Oba Super 1 & 2, Oba 98, New Kaduna • Rice: Upland - FARO 54 & FARO 55 • Soybean: TGX 1448-2E • Cowpea: IT-90K-277-2, IT-89KD-288, IT-93K-452-1
Maslaha Seeds	Zamfara, Nigeria	Maize (Hybrid and OPV), Cotton, Sorghum, Cowpea, Soybean	• Maize: DTMW maize, DTMY maize, QPM maize, Samaz-11, 15, 16, 17, 28, 32, SDM 1, 2, 3, 4, 5, 6, SUWAN-1-SR • Rice: FARO 44, 52, 61, SDR2 • Cowpea: IAR-48, IFE Brown • Soybean: ITZ452-1, KANANNADO, TGX 1448-2E • Sorghum: SAMSORG 17 & 47, SK5912 • Millet: SOSATC88, Super SOSAT
Nagari Seeds	Kaduna, Nigeria	Maize, Rice, Soybean, Sorghum	• Soybean: TGX 1448-2E, SamSoy
West African Cotton Company Limited	Katsina, Nigeria	Cotton, Rice, Maize, Sorghum	• Rice: Lowland FARO 44
Manoma Seeds	Katsina, Nigeria	Maize (Hybrid and OPV), Rice, Soybean	• Rice: Lowland FARO 44
Samlak Seeds	Ibadan, Nigeria	Maize (OPV), Rice, Soybean, Cowpea	• Maize: LNTP-Yellow, BR 9928 DMR, BR 9943 DMR, Suwan 1-SR, TZPBSR-Red • Rice: L 34, L 19, FARO 44 & 52 • Soybean: TGX 1448-2E • Cowpea: IFE Brown, IFE-BPC
Syngenta Nigeria	Switzerland	Maize (Hybrid), Rice, Potato, Sorghum	
Seedco	Zimbabwe	Maize (Hybrid)	• SC 510 (yellow hybrid) • SC 719, SC 645 (white hybrids)
DuPont Pioneer	United States	Maize (Hybrid)	• 30 F32 (white hybrid) • 30 Y87 (yellow hybrid)
Monsanto	United States	Maize (Hybrid)	• DK234(white hybrid) • DK920(yellow hybrid) • DK818(yellow hybrid)

Source: Field interviews (2016), National Agricultural Seeds Council (NASC), research team analysis (2016).

The majority of seeds produced by local seed companies in Nigeria are OPVs. However, many local seed companies in the north produce more hybrid seeds than OPV seeds, resulting in greater maize hybrid seed usage in the region (NASC annual report, 2014). This stems from the fact that available maize hybrid technology is better suited to agro-ecological conditions in the northern production belt. Farmers in the south continue to predominantly grow OPV maize. While IITA and NARIs have breeding activities in all agro-ecological regions in Nigeria, the north has received more attention due the north's higher maize production potential.

Seed companies face severe problems, including high production costs; competition from cheaper, uncertified seeds in the informal market; fake and illegal packaging of seeds using brand names of registered seed companies; and out growers who fail to meet their contractual agreements. Specific production problems with hybrid seeds include insufficient breeder and foundation seeds for commercial multiplication, stringent certification requirements, and a prolonged certification process.

Agro-dealers

Agro-dealers are an important link in the seed supply chain, as they provide smallholder farmers with access to inputs such as seeds, fertilizers, and plant protection products. Although the official number of registered agro-dealers in Nigeria is unavailable, most are concentrated in the north where production volumes are the highest. Agro-dealers are the most important distributors of OPV (mainly maize, rice, and soybean) and hybrid seeds produced by local private seed companies, typically buying products from seed companies at a 10% discount and selling them at the company price, earning a 10% profit margin.

NATIONAL SEED SYSTEM POLICY

A key component of the ATA is to promote efficiency and effectiveness of the production process along value chains, with quality assurance through regulatory mechanisms, monitoring, and supervision of agricultural materials, including seeds. The policy emphasizes withdrawal of government from direct production and distribution of agricultural inputs, such as seeds and fertilizers, and supports a private sector-led approach through the GES program described earlier in the report.

In order to make agriculture a sustainable business and address all regional seed regulations and global best practices, the existing seed policy was reviewed under the purview of FAO's Technical Cooperation Program's "Strengthening National Seed Systems in Nigeria." A major activity during this process was a review of the seed law. A two-stage methodology was adopted for development of the seed policy, including a review of the existing seed policy and consultative workshops with stakeholders in the seed value chain.

The national seed policy has six main objectives:

1. Support and fast-track varietal development, registration, and release of new crop varieties, as well as the rapid multiplication of released varieties.
2. Improve the quality of seeds sold to farmers in order to achieve higher yields and better income.
3. Re-orientate the operations of public sector agencies along commercial lines.
4. Encourage private sector participation in seed operations through appropriate policies and promotional activities/incentives.
5. Promote technology and policy best practices in the global seed industry.
6. Maintain genetic biodiversity of the crop ecologies.

In addition, under the ATA's GES, there are seed-specific interventions for selected crops, as shown in Table 7.

Table 7: **Seed-specific activities for government selected crops in ATA-GES.**

Prioritized Crops	Seed-specific Activities
Rice	• Raise grain quality standards by strengthening quality management across the commodity chain, focusing on mechanized post-harvest activities such as threshing, drying, milling, and elimination of mixing seeds. • Increase farmer accessibility to inputs such as seeds, fertilizers, and agrochemicals.
Cassava	• Focus breeding and selection on high starch-content cassava varieties. • Establish certified seed farms (1,000 Ha); RTEP & IITA produce improved, high-yielding, and disease-resistant planting material.
Sorghum	• Introduce and distribute improved varieties targeting 200,000 farmers. • Select community outgrowers to produce foundation seed. • Provide capacity building to support hybrid seed production.
Cocoa	• Provide improved planting materials to new and existing farmers. • Facilitate farmer access to selected hybrids as planting materials.
Cotton	• Promote pure cotton seed multiplication and distribute improved varieties of cotton seeds to farmers. • Deploy Bt cotton seed by research institutes in collaboration with National Biotech Dev. Agency.
Oil Palm	• Distribute sprouted nuts and improved tenera nuts and seedlings to farmers. • Collaborate with private seed companies to raise oil palm seedling nurseries.
Maize	• Ramp up production of breeder seed by research institutes, including IAR/ABU, IAR&T, and IITA. • Procure foundation seeds by seed companies through NASC. • Increase distribution of improved seed to farmers.
Soybean	• Increase soybean yields by focusing on increasing supply of improved seeds through creation of a functional seed value chain that produces breeder, foundation, and certified seed of improved varieties. • Increase distribution of improved soybean seeds to farmers.
Wheat	• Increase production of breeder and foundation seed of wheat and distribution of certified seed to farmers.
Groundnut	• Increase R&D for breeder and foundation seeds, as well as field trials. • Increase production of breeder, foundation, and certified seed.

Source: Agricultural Transformation Agenda Scorecard (2014).

CHAPTER 2: CURRENT SITUATION – PRIORITY CROPS FOR EGS STUDY

2.1 FRAMEWORK FOR SELECTING CROPS FOR STUDY

The selected crops for in-depth EGS system study in Nigeria were identified during a consultative process with seed industry stakeholders through roundtables in three regions, including the north, middle belt, and south agro-ecological zones. Discussions at the stakeholder roundtables were based on the crop prioritization framework developed to select crops for all EGS systems study countries. As shown in Table 8, a matrix of key indicators crossed with ratings and definitions was used as the basis for discussions. The framework was slightly modified based on feedback from stakeholders. Smallholder farmers are not included in key indicators because all food crops are considered important smallholder farmer crops in Nigeria, given that more than 80% of farmers are considered smallholder having less than 2 Ha.

***Table 8*: Crop selection framework.**

	RATINGS DEFINITIONS				
KEY INDICATORS	●	◔	◑	◔	○
DEMAND VS SUPPLY (FOOD SECURITY)	Greatest domestic utilization		Median domestic utilization		Lowest domestic utilization
NUTRITIONAL VALUE	Greatest protein, mineral, vitamin content		Adequate protein, mineral, vitamin content		Minimal protein, mineral, vitamin content
EMPLOYMENT GENERATION	Largest employment/income growth potential		Median employment/income growth potential		Lowest employment/income growth potential
IMPORT SUBSTITUTION	Largest import volume	2nd and 3rd largest import volume	4th and 5th largest import volume	6th and 7th largest import volume	8th, 9th, and 10th largest import volume
PRIVATE SECTOR ENGAGEMENT	Widespread activity in value chain		Adequate activity in value chain		Minimal activity in value chain
INDUSTRIAL APPLICATION	Large variety of processed products		Average variety of processed products		Small variety of processed products
GOVERNMENT STRATEGIC PRIORITY	Priority seed system and crop		Priority crop		No priority
FEMALE PARTICIPATION	Primarily female		Females and male		Primarily male

High ●◔◑◔○ Low

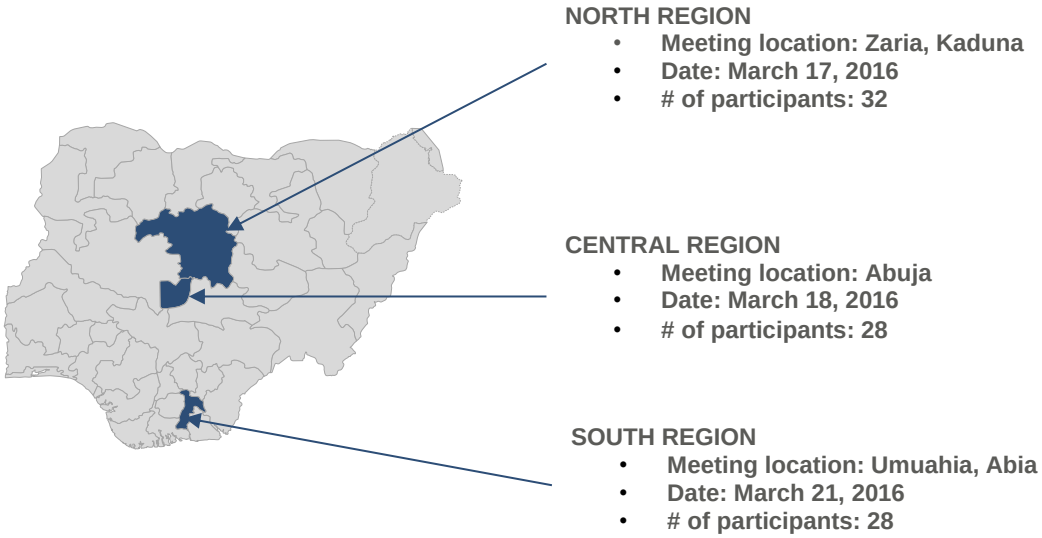
Source: Research team analysis (2016).

2.2 SELECTED CROPS

One of the major reasons for Nigeria's inclusion in the EGS studies is its high potential for agricultural production and processing. Each of the major agro-ecological zones is associated with specific crops and cropping systems. Given the diversity in agricultural production, the following three stakeholder roundtables were held to ensure wide

geographical coverage and adequate representation of stakeholders: a north region roundtable in Zaria (Kaduna State) on March 17, 2016; a central region roundtable in Abuja on March 18, 2016; and a south region roundtable in Umuahia (Abia State) on March 21, 2016 (Figure 17). There was a total of 88 participants in the three meetings (Annex D), drawn from the formal and informal seed sectors. The meeting agenda was the same at each of the meetings in order to ensure consistent results.

***Figure 17*: Stakeholder roundtable kick-off meetings.**



Source: Research team analysis (2016)**.**

Discussions at each of the stakeholder roundtables were based on the Crop Selection Framework developed to select crops for in-depth analysis in all EGS study countries. The framework consists of a matrix of ten key indicators such as area, production volume, production growth, private sector engagement, gender roles, and nutritional value, with up to five ratings definitions for each indicator. The ten shortlisted crops for consideration, based on area harvested and nutritional value, were: cassava, maize, sorghum, yam, cowpea, rice, groundnut, millet, sweet potato, and soybean. At each roundtable, participants added crops to this list that were of interest to the stakeholders in the region, as well as additional key indicators such as import competition, job creation, and economic development. Participants in each region were asked to come to a consensus on the priority crops for in-depth analysis by allowing each participant to nominate three crops, including reasons for improving those crops' EGS systems. Results were tabulated after this exercise, and the stakeholders' votes determined the top three crops.

Following this process, stakeholders at the north and middle belt region roundtables selected rice, maize, and soybean, while stakeholders at the south region roundtable selected rice, maize, and yam. This resulted in the selection of four key crops: rice, yam, maize, and soybean (as presented in Figure 18) for in-depth EGS analysis.

Rice: Annual rice demand in Nigeria is estimated at 5.4 million MT. However, only 3.8 million MT of milled rice is produced domestically, resulting in a significant supply gap that is met through imports (USAID MARKETS). In 2014, Nigeria was the world's second largest rice importer after China, importing 2.4 million MT of milled rice from various countries, including Thailand and India (USDA, 2014). To increase local production and processing, Nigeria's

rice sector would need to increase research, promote improved varieties and implement policies to encourage farmers to adopt improved high-yielding rice varieties.

Within the rice commodity chain, there is also a significant opportunity to improve smallholder farmers' income. Genetically impure seeds and seeds that are not true-to-type are a major problem, which makes it difficult for farmers to sell their crop to large processors who pay the highest prices. A more organized rice seed system that provides training on production and post-harvest best practices would promote planting of true-to-type seeds among farmers and enhance their access to more profitable markets.

Yam: Currently, the yam seed system is dominated by the informal sector, with 50-70% of smallholder farmers' production costs going toward the purchase of yam seed from rural markets. The commonly used old varieties or adopted landraces are subject to high disease pressure, which reduces yields. Furthermore, yam farmers save and replant about 30% of their harvest as seed, leading to genetic degradation and low yields over time. A structured yam seed system using relatively new rapid multiplication techniques to produce disease-free, clean seed yam would significantly increase yields and improve farmers' income.

Yam is traditionally propagated by tuber, with a low multiplication rate of less than 1:10, compared to 1:200 in many cereals. This is worsened by the long growth cycle of yam. The introduction and adoption of rapid multiplication technologies, such as aeroponics and autotrophic hydroponic systems, would increase the rate of propagation and accelerate the introduction of improved varieties.

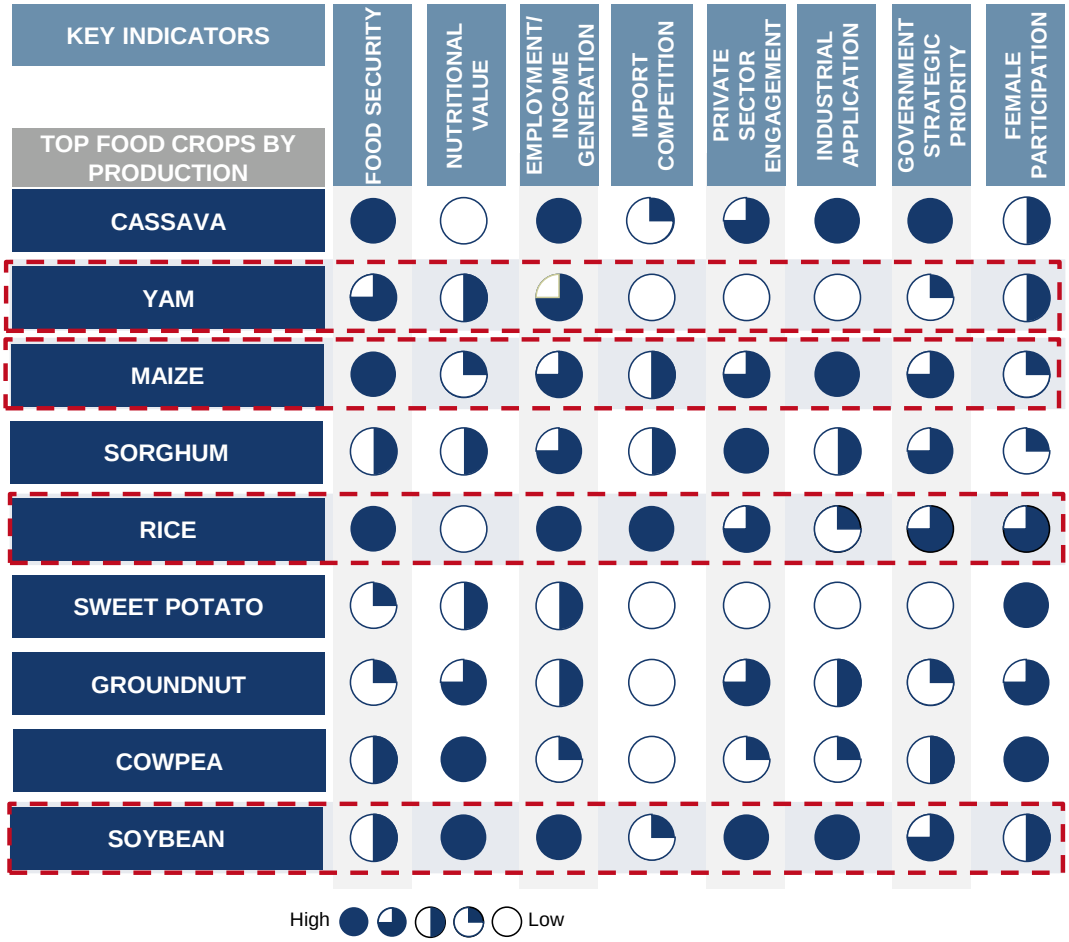
Maize: Increased production and farmer adoption of maize hybrid seeds is a priority for the FGN, as it will help ensure national food security. Due to a domestic supply gap, key producers of poultry and livestock feed, food processing companies, and breweries import large amounts of maize and maize products into Nigeria, mostly from North and South Americas, Asia, and neighboring African countries, particularly the Republic of Benin. A successful EGS system that guarantees adequate production and timely delivery of high-quality seeds, supported with the training of smallholder farmers, would increase domestic production and reduce imports.

Soybean: Given the importance of soybean as a key nutrition crop, there is a potential for increased demand for improved seeds by smallholder farmers. Malnourishment in Nigeria is among the worst 20 countries in the world. 10.2 million Nigerian children under the age of five are stunted, and about 11% of women are undernourished (DHS, 2013). The FGN and NGOs are working to boost awareness of high-energy foods and to increase household consumption of soybean. Improving awareness of the availability and affordability of processed soybean products to reduce malnutrition would generate more demand. A developed EGS system would play a key role in increasing domestic production through farmer education and the release of high-yielding varieties.

In addition, a rapidly growing animal feed sector in Nigeria has increased demand for soybean for industrial processing, which also necessitates the development and promotion of improved, more productive varieties. Currently, the most commonly grown variety is susceptible to rust disease, which reduces farmers' yield. However, other officially released varieties that are rust resistant are not adequately promoted to smallholder farmers through demonstration trials.

These four selected crops will be discussed in depth in subsequent chapters of this study.

Figure 18: **Priority crop selection results in Nigeria.**



Source: FAOSTAT (2014); Scholarly Journals of Agricultural Science (2013); Nigeria Agricultural Sector Risk Assessment, World Bank (2015).

CHAPTER 3: CURRENT SITUATION – EGS SYSTEMS

3.1 EARLY GENERATION SEED SYSTEMS

Nigeria has a three-tier system of seed production and multiplication: breeder seed, foundation seed, and commercial or certified seed under the seed certification scheme. While EGS systems and specific roles and responsibilities vary across the four selected crops for this study, some general themes resonate across crops. The NARIs are responsible for breeder seed production. Depending on the crop, private seed companies and seed production units of the NARIs also produce foundation seed. ADPs and private seed companies are the key actors involved in commercial seed production, but private companies willing to produce both foundation and certified seeds must do so under separate trade names. Historically, the NSS under NASC was responsible for foundation seed production, but under the current National Seed Policy, foundation and certified seed production is led by the private sector. NASC is now responsible for supervision, monitoring, coordination, assurance of quality, and certification, including licensing private seed companies to produce foundation and certified seeds.

3.2 RICE

SUPPLY

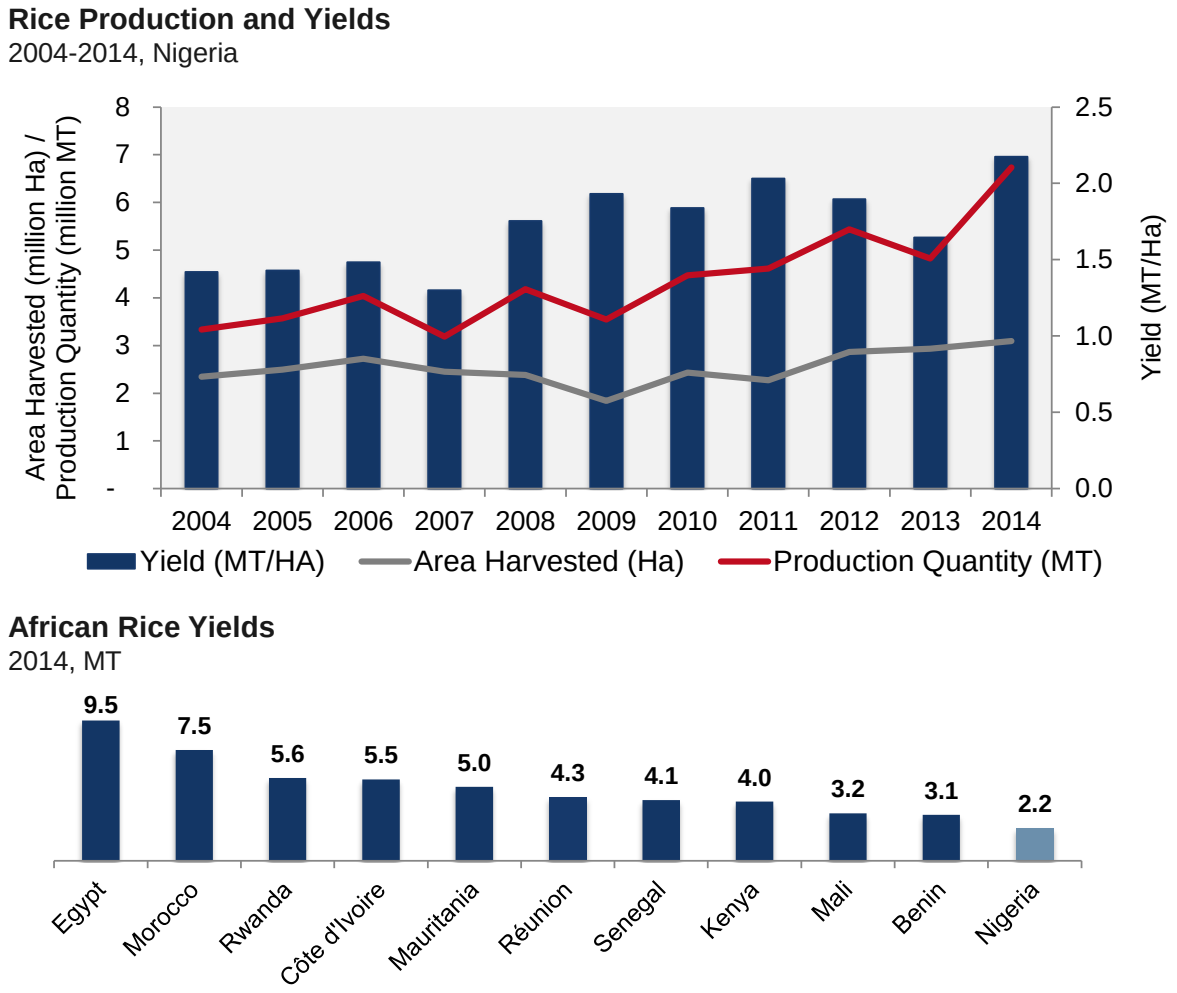
Rice represents the second largest grain crop in Nigeria after maize and is a key food crop across the country, constituting more than 20% of total food expenditure among urban and rural households. It is grown on approximately 3 million Ha, but experts estimate that this is less than 40% of the land suitable for its production in the country[6]. Nigeria is the leading producer of paddy rice in Africa, with 6.7 million MT in 2014 and an average paddy yield of 2.2 MT/Ha (FAOSTAT, 2015). Rice was a priority crop under the previous administration's ATA, and the increase in paddy production from 4.8 million MT in 2013 can be attributed to rice production intensification through dry season rice farming under the ATA.

Despite the ATA focus on the rice value chain, rice yields in Nigeria are well below other regional producers and among the lowest in Africa (Figure 19). Smallholder farmers, who dominate the production of paddy rice, generally neither utilize good agronomic practices nor improved inputs, accounting in large measure for low yields.

Rice can be grown year-round in Nigeria, with the use of irrigation in the dry season, an increasingly popular practice in the north. Paddy production occurs in three main systems: rainfed lowland (47% of national area and 53% of national production); rain fed upland (30% of national area and 17% of national production); and irrigated lowland (17% of national area and 27% of national production). The 6% balance in total national production is shared between mangrove swamps and flooded areas in the north and south, as shown in Table 9.

[6] A report on the status of National Rice Development Strategy implementation in Nigeria in 2013 showed that land suitable for rice production in Nigeria is 4.6 million Ha, and only 1.8 million Ha is cultivated.

***Figure 19*: Rice area, production, and yield.**



Source: FAOSTAT (Viewed in May 2016).

Rice production on rainfed lowland and irrigated lowland were the main priority of the Rice Transformation Agenda under the last administration. Fifteen states that produce mainly lowland rice are Kebbi, Sokoto, Kano, Niger, Kaduna, Taraba, Adamawa, Kwara, and Borno in the north and Ebonyi, Cross River, Bayelsa, Enugu, Ekiti, and Ogun in the south.

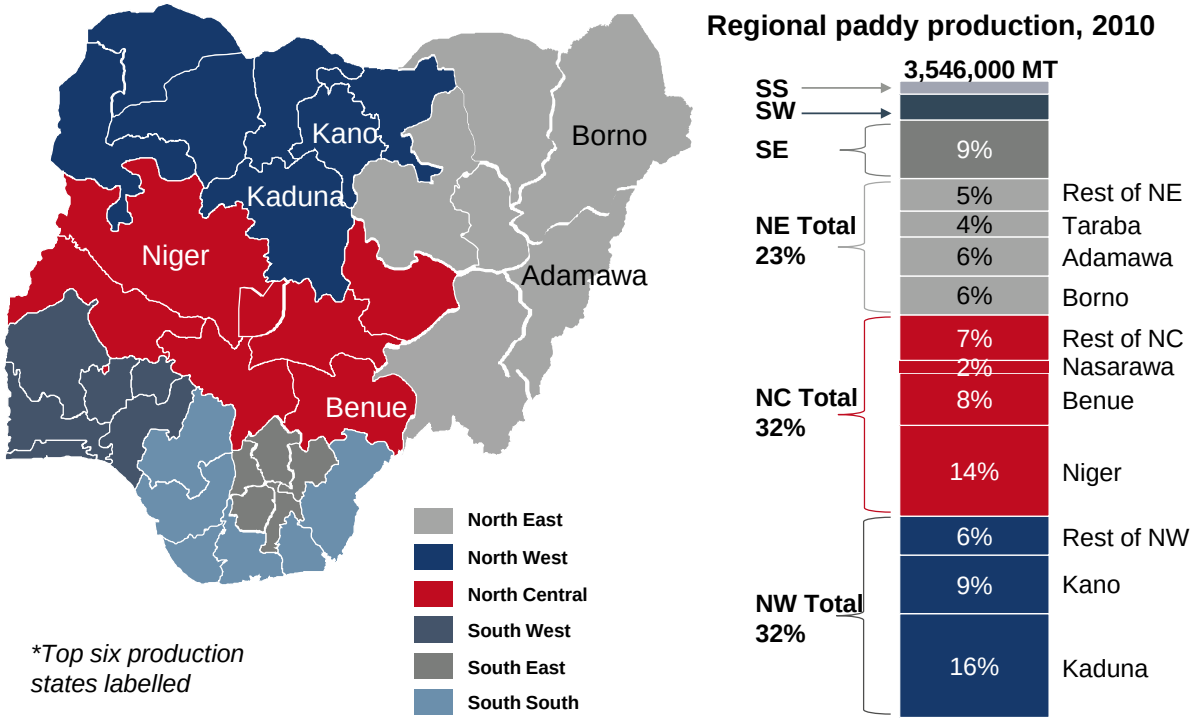
***Table 9*: Rice production systems.**

Production System	Major States Covered	Estimated Share Of Rice Area	Average Yield (Mt/Ha)	Share Of Rice Production
Rainfed Lowland	**North**: Adamawa and all major river valleys, e.g., shallow swamps of Niger and Kaduna basins **South**: Ondo, Ebonyi, Ekiti, Delta, Edo, Rivers, Bayelsa, Cross River, Akwa Ibom, and Lagos	52% (~854 Ha)	2.2	43%
Lowland Irrigation Schemes	**North**: Adamawa, Niger, Sokoto, Kebbi, Borno, Benue, Kogi, Adamawa, Kano, and Kwara **South**: Enugu, Ebonyi and Cross River, Lagos, Akwa Ibom, and Ogun	16% (~263 Ha)	3.7	29%
Rainfed Upland	**North**: Niger, Kwara, Kogi, Sokoto, Kebbi, Kaduna, FCT and Benue **South**: Ogun, Ondo, Abia, Imo, Osun, Ekiti, Oyo, Edo, and Delta	30% (~493 Ha)	1.9	28%
Mangrove Swamp	Ondo, Delta, Edo, Rivers, Bayelsa, Cross River, Akwa, Ibom, Lagos	1% (~16 Ha)	2.0	1%

Source: Chuma Ezedinma (2008), International Institute of Tropical Agriculture. Impact of Trade on Domestic Rice Production and the Challenge of Self-sufficiency in Nigeria.

Although rice is cultivated across all agro-ecological zones in Nigeria, production is concentrated in the north, particularly in west and central states such as Kaduna, Kebbi, Niger, and Jigawa. As shown in Figure 20, the north contributes approximately 90% of total rice paddy production.

***Figure 20*: Rice production by regions, 2010.**

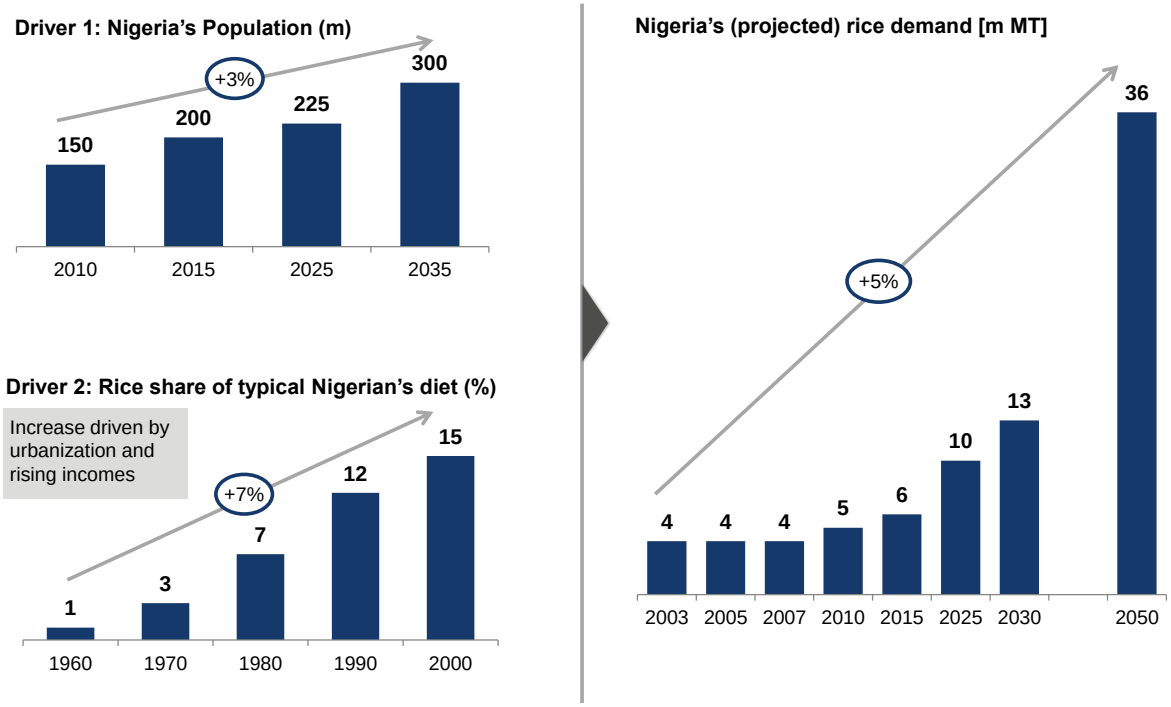


Source: Developing the Rice Industry in Africa – Nigeria Assessment. BMGF (2012).

DEMAND

Rice is an important food source for all households, regardless of lifestyle, and it is easier to prepare than staples such as yam, cassava, millet, and sorghum. In 2014, demand for milled rice in Nigeria was estimated at 5.4 million MT. However, only an estimated 3.8 million MT of milled rice was produced locally, leading to a demand-supply deficit of 1.6 million MT that was filled by imports. In 2014, Nigeria was the world's second-largest rice importer after China, importing an estimated 2.4 million MT of milled rice from countries including Thailand and India (USDA Economic Research Service, 2014). With population growth and changing consumer preferences and dietary patterns of the growing middle class, the FMARD estimates a six-fold increase in rice demand from 2015 to 2050 (Figure 21).

***Figure 21*: Projected rice demand in Nigeria.**



Source: Federal Ministry of Agriculture and Rural Development – ATA.

As shown in Figure 22, the majority of locally produced rice is sold to cottage millers and large-scale integrated millers. There are approximately 700 rice mills in Nigeria, which are mainly cottage millers. In 2014, there were 21 integrated rice mills in Nigeria, with a combined annual capacity of more than 1 million MT. However, they operate below capacity due to a shortage of rice resulting not only from poor yields but from competition with cottage millers who process most of the rice produced by smallholder farmers for rural and peri-urban markets. The integrated mills have relied on imported brown rice to make up for the shortfall in domestic rice. There are also a few large commercial processors that engage in processing local rice such as Ofada and import brown rice to meet specific demand characteristics for local dishes targeting urban consumers. While brown rice is considered more nutritious than Ofada, only a small urban segment consumes brown rice as Ofada is demanded by rural and urban markets.

An important component of the FGN's rice strategy has been an attempt to reduce Nigeria's dependency on rice imports by enacting policies that catalyze local investment and production. However, these policies have had mixed success. While the FGN has continued to alter policies in an attempt to better realize their rice strategy, frequent policy

changes have had the unintended consequence of increasing uncertainty, thereby discouraging private sector investment.

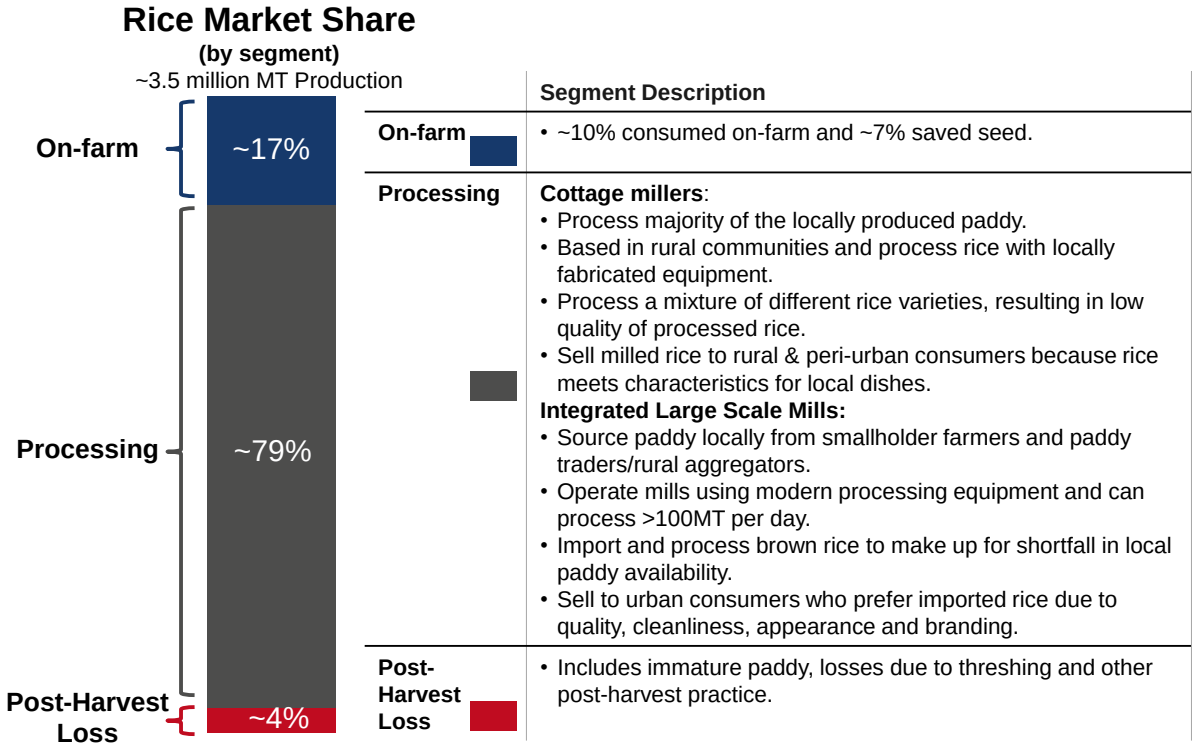
In 2013 the FGN placed a 110% import tariff on brown rice in the form of a 100% duty and 10% levy with the aim of discouraging imports and encouraging local production.[7] The unintended consequence, however was a significant increase of smuggled rice. In 2014, the FGN introduced a different approach that aimed to encourage the gradual growth of local production, while allowing some rice imports to meet domestic demand. The policy classifies rice importers into traders, who have no rice processing facilities and simply import rice to be resold in the country, and investors, who have processing facilities associated with or a part of rice farms. Under this policy, investors pay lower import tariffs than traders, with investors paying a 30% import tariff (10% duty and 20% levy) on imported rice, while traders pay a 70% tariff (10% duty and 60% levy).

Under this latest policy, the total amount of rice that can be imported into the country is limited to the FGN's estimated domestic supply gap each year. The current import quota is 1.3 million MT, with investors assigned 1 million MT of the quota and 300,000 MT is set aside for traders. Importers face penalties for exceeding these quotas.

Overall, the policy has had mixed success in encouraging local production. While the 2014 approach is more practical and gradual than the 2013 approach, factors such as granting duty waivers to rice processors, and the prohibitive costs of buying and processing local paddy have hindered the effectiveness of the policy. Retroactive penalties on exceeded importation quotas have also increased the costs for some importers. Additionally, there is often no alignment among the priorities of government ministries. While FMARD is interested in supporting an increase in local production, the Ministries of Finance and Trade and Investment are motivated to increase revenue by increasing duties on imports. This has led to smuggling of rice through the Republic of Benin due to the high cost of formal imports.

[7] Duties in Nigeria are normal fees charged to import any commodity. However, some specific commodities have an additional duty, called a levy, which is imposed by the Nigerian government to increase revenue and discourage importation of specific commodities.

***Figure 22*: Comparison of rice demand segments.**



Source: Developing the Rice Industry in Africa – Nigeria Assessment. BMGF (2012), Feasibility of the Establishment of Paddy Aggregation Centers in Nigeria. USAID Nigeria (2014).

IMPROVED VARIETIES OF RICE

There are more than 75 rice varieties in Nigeria (Table 10). NCRI has released 63 varieties that are nitrogen- and water- efficient, pest- and disease-tolerant, and adapted to all rice-producing regions in Nigeria. Five new varieties recently released are FARO 58, 59 (upland), FARO 60, 61 (lowland), and Ofada.

AfricaRice has released eight improved varieties, including FARO 55 (NERICA 1), FARO 56 (NERICA 2), FARO 46 (ITA 150) as upland varieties, and FARO 52 (WITA 4), FARO 57 (Tox 4004-43), FARO 51 (Cisadane), FARO 53 (ITA 321), and FARO 54 (WAB 189) as lowland varieties. In addition to the varieties released by NCRI and AfricaRice, AGRA, in partnership with the University of Port Harcourt in Rivers State released three lowland rice varieties in 2013, namely UPIA1, UPIA2, and UPIA3. These are long-grain, grade A, high-yielding, and resistant to abiotic stresses such as iron toxicity and drought.

Sixteen hybrid rice varieties developed by AfricaRice are undergoing evaluation trials in the north. Three hybrid varieties were selected for testing from a yield performance evaluation by Syngenta in collaboration with NCRI.

Under the Rice Transformation Agenda of the ATA, specific rice varieties were promoted for multiplication and distribution to farmers. These varieties were selected based on Nigerian consumers' preference for long grain rice. Lowland varieties, particularly FARO 44 (which is long grain and in high demand by processors), have the highest adoption rates among farmers.

Field interviews revealed that a majority of rice farmers grow long grain rice due to wide acceptance by consumers and therefore high demand from processors. As most of the long

grain varieties are suited to lowland conditions, and given the current trends in rice production and end market demand, the overall demand for lowland varieties will significantly increase in the medium to long term and likely lead to a decline in upland production over time.

Table 10: **Key rice varieties.**

Variety Name	Developing Institute	Characteristics	Yield Pot. (MT/Ha)	Agro-ecological Zones	Year of Release	Year of Reg.
FARO 1	NCRI, Ibadan	Medium grain	3.0-5.0	Southern, Northern Guinea Savanna	1954	1991
FARO 2	NCRI, Ibadan	Medium grain	3.0-4.5	Northern Guinea Savanna	1955	1991
FARO 3	NCRI, Ibadan	Medium grain	1.5-2.5	Forest Transition, Derived, Northern, Guinea Savanna	1958	1991
FARO 4	NCRI, Ibadan	Medium grain	2.0-4.0	Humid Forest	1959	1991
FARO 5	NCRI, Ibadan	Medium grain	2.0-4.5	Forest Transition, Derived, Northern, Guinea Savanna	1960	1991
FARO 6	NCRI, Ibadan	Medium grain	2.0-3.0	Humid Forest	1961	1991
FARO 7	NCRI, Ibadan	Medium grain	2.5-3.5	Humid Forest	1962	1991
FARO 8	NCRI, Ibadan	Long grain	3.5-4.5	Forest Transition, Derived Savanna	1963	1991
FARO 9	NCRI, Ibadan	Long grain	2.5-3.0	Forest Transition, Derived Savanna	1963	1991
FARO 50	IITA		High	Forest Transition, Derived Savanna	1990	1991
FARO 51	NCRI, IITA	Moderate African rice gall tolerance		Forest Transition, Derived Savanna	1998	1991
FARO 52	WARDA, IITA	Iron toxicity and drought tolerance	High	Forest Transition, Derived Savanna	2001	2001
FARO 53	NCRI Badeggi			Forest Transition, Derived Savanna	2003	2003
FARO 54	NCRI Badeggi	Early maturing, good weed competitiveness, drought tolerance	High	Northern, Southern Guinea Savanna, Sudan Savanna	2003	2003
FARO 55	NCRI, Badeggi	Early maturity, weed competitiveness, disease and lodging resistance, good cooking quality	High	Northern, Southern Guinea Savanna, Sudan Savanna	2003	2003
FARO 56	WARDA, NCRI Badeggi	Early maturity, drought tolerance, weed competitiveness, more grains/panicles	High		2005	2005
FARO 57	NCRI Badeggi	Medium maturity, long slender grains,, drought and iron toxicity tolerance, rice yellow mottle virus disease and blast resistance	High		2005	2005
FARO 58	Africa Rice, NCRI	Early maturation, high grain yield, good cooking quality, tolerance to lodging	5.0	Northern, Southern Guinea Savanna, Sudan Savanna	2011	2011
FARO 59	Africa Rice, NCRI	Early maturation, golden grain color, weed competitiveness, lodging tolerance	5.0	Northern, Southern Guinea Savanna, Sudan Savanna	2011	2011
FARO 60	Africa Rice, NCRI	High yielding, long and slender grains, iron toxicity tolerance	8.0	Forest Transition, Derived Savanna	2011	2011
FARO 61	Africa Rice, NCRI	Earliness, high yielding, anaerobic germination tolerance	7.0	Forest Transition, Derived Savanna	2011	2011
FARO 62	NCRI, Badeggi	High yielding, drought tolerance	4.0	Forest Transition, Derived Savanna	2011	2011
FUNAAB O R-1	FUNAAB (IFSERAR), NCRI Badeggi	Gold color grains with red strips, high swelling capacity, high ratooning ability	2.7	Forest Transition, Derived Savanna	2011	2011
FUNAAB O R-2	FUNAAB (IFSERAR), NCRI Badeggi	High nutrient, smooth long grains	2.5	Forest Transition, Derived Savanna	2011	2011
UPIA 1	Africa Rice, NCRI Badeggi	Early maturity, high yield, long slender grains, iron toxicity and African rice gall midge tolerance	6.6	Forest Transition, Derived Savanna	2013	2013
UPIA 2	Africa Rice, NCRI Badeggi	High yield, long slender grains, iron toxicity and African rice gall midge tolerance	8.0	Forest Transition, Derived Savanna	2013	2013
UPIA 3	Africa Rice, NCRI Badeggi	Early maturity, high yield, long slender grains, iron toxicity tolerance	7.0	Forest Transition, Derived Savanna	2013	2013

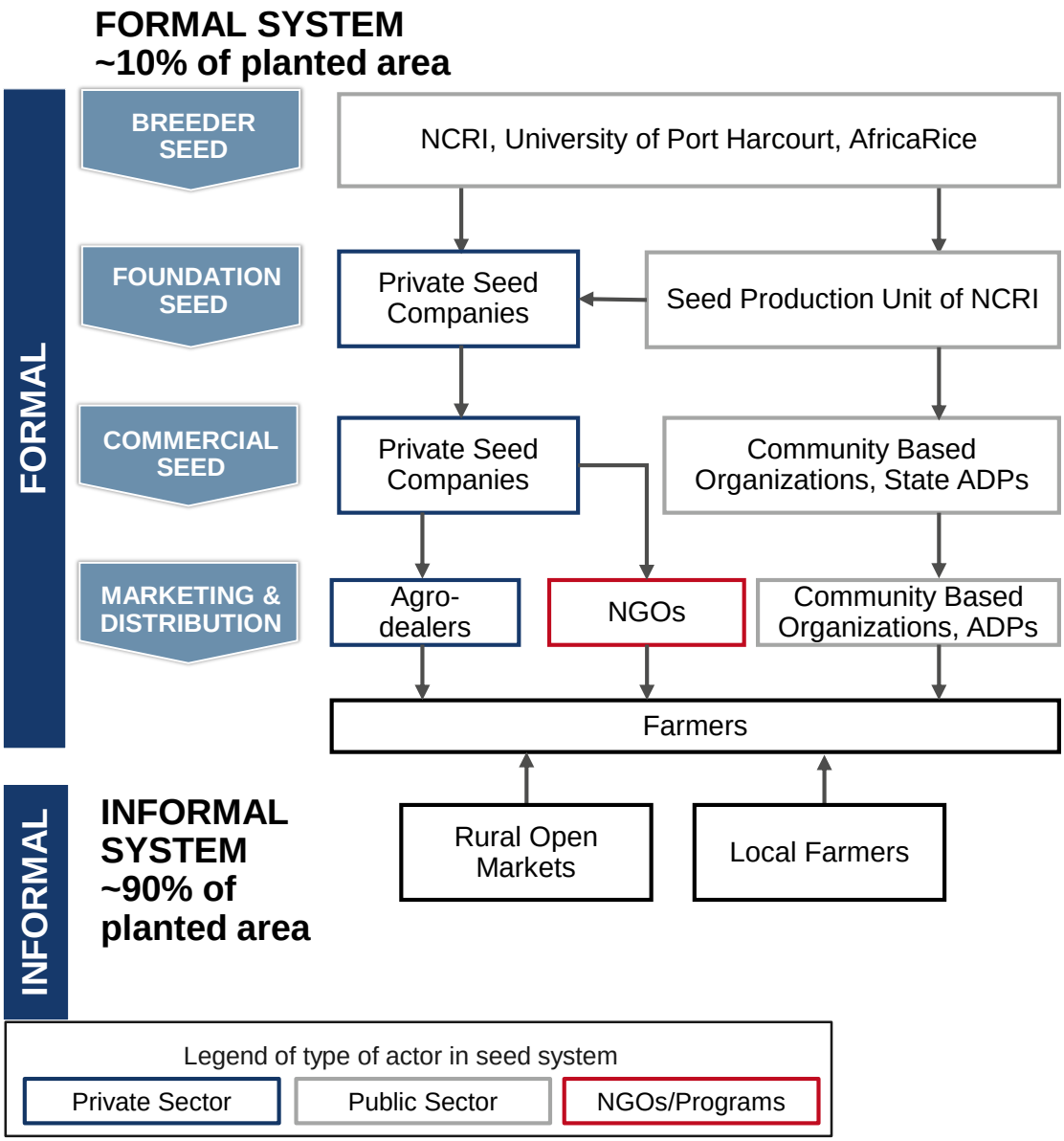
Source: NASC Regional Office, Zaria, Kaduna State, Nigeria.

STRUCTURE OF THE EGS VALUE CHAIN

Only ~10% of rice-planted area is supported by the formal seed system, while ~90% is planted with seeds sourced through informal means such as open markets, farmer-saved seed, and farmer exchanges, as shown in Figure 23. In the formal system, the public sector

is responsible for the production of breeder seeds while the private sector plays a key role in subsequent multiplication and distribution of seeds.

Figure 23: **Structure of rice seed systems.**



Source: Expert analysis (2016).

FORMAL SYSTEM

NCRI is responsible for genetic improvement, varietal maintenance, and breeder seed production of rice in Nigeria. With support from NASC and AfricaRice, NCRI has access to national, regional, and international gene banks for the development of new varieties. The National Crop Variety Registration and Release Committee under NASC is responsible for the evaluation, release, and withdrawal of varieties. AfricaRice works in partnership with NCRI, NASC, and FMARD's rice value chain team to produce breeder seeds of new varieties. A few universities that have breeding capabilities, such as the University of Port Harcourt, Rivers State, also partners with NCRI and AfricaRice to produce new rice varieties under donor-funded initiatives.

Production of foundation seed is decentralized, with NASC focused on supervision, certification, and licensing of private seed companies with adequate capacity to produce foundation seeds. Due to the low technical capacity of many private seed companies to produce foundation seeds, the bulk of rice foundation seed is currently produced by the seed production unit of NCRI, which is registered as a private seed enterprise. In 2014, the WAAPP seed intervention program contracted NCRI to produce breeder and foundation seeds of rice for distribution to seed companies at 40% price support.

The private sector dominates certified seed production. In 2014, 99 private seed companies and three community-based organizations (including ADPs) produced certified rice seed. The bulk of certified seed produced is marketed and distributed by agro-dealers, while ADPs and NGOs also distribute certified seeds under community seed intervention programs.

Organized rice farmer groups or cooperatives also buy certified seeds in bulk from seed companies and agro-dealers and share among individual farmers within the group. This increases smallholder farmers' access to certified seeds.

INFORMAL SYSTEM

The informal system plays a large and important role in seed distribution because the formal system cannot meet current EGS and certified seed demand. As with many other crops, the informal system is dominated by farmer-saved seed. However, farmers also obtain seeds from grain sellers in rural open markets and neighboring farmers when their saved seeds are not sufficient for planting.

In addition, farmers fall back on saved seeds and grains from local markets when donor-supported community-based intervention programs that distribute free seeds through ADPs are not available. This is particularly common in the north.

KEY EGS SYSTEM BOTTLENECKS AND CONSTRAINTS

Rice EGS supply bottlenecks stem from production and certification capacity problems throughout the system, as well as less significant problems with demand. These include:

Supply bottlenecks

- **Low technical capabilities and poor infrastructure of breeder seed and foundation producers:** Breeder seed producers often do not have the technical knowledge and/or facilities to produce sufficient quantities. Additionally, many private seed companies lack the technical know-how to produce good quality foundation seed due to limited training on best practices.
- **Absence of an adequate EGS demand forecasting system:** There is no formal centralized process in which demand for different varieties of commercial seed is captured, analyzed and disseminated about how much foundation and breeder seed needs to be produced on a given time horizon for each variety. Without a formal process for forecasting demand, EGS and commercial producers are unable to budget and plan seed production to supply the market, they cannot reduce production costs without achieving higher economies of scale.
- **Lack of credit and working capital for private foundation and certified seed producers:** Field interviews revealed a common theme: many private seed companies involved in foundation and certified seed production cannot obtain working capital for seed production operations and managing inventory. Many seed companies lack funds to buy back seed from out growers, forcing out growers to sell

seeds as paddy to processors. Also, commercial bank loans carry high interest rates, which discourages smaller private companies from entering the seed sector.

- **Inadequate storage and poor seed processing facilities:** Many private seed companies lack sufficient storage to maintain an inventory, which increases production risk. This problem is amplified by the lack of demand forecasting systems. Furthermore, seed companies do not have high-quality seed processing facilities and instead resort to manually processing seeds, which results in unclean seed.
- **Lack of capacity in the certification system:** NASC does not have enough field inspection officers, and without adequate oversight, some seed producers recycle certified seed and sell it to farmers informally without quality control, resulting in lower yields.
- **Inadequate commercial seed distribution networks:** Seed bags are often damaged in transport to agro-dealers, which contributes to germination problems. In addition, farmers in remote areas must travel great distances to reach agro-dealers, which further increases the risk of seed damage in transit.

Demand constraints

- **Unpredictable and often-changing government policies**: Erratic government policies in the rice sector have created market uncertainty and stifled private sector investment.
- **Limited awareness of the advantages of quality seed:** In certain states, such as Kebbi, many smallholder farmers do not buy quality seed from seed companies and instead recycle seeds or informally buy lower quality from out growers. This discourages private seed companies from investing in production, and as a consequence, seed companies often focus their efforts on selling seeds through donor-supported programs such as government interventions and ADPs.
- **Lack of demonstration trials:** While farmers are more aware of improved rice varieties than with other crops such as cassava and yam, there is significant opportunity to improve awareness and accelerate the adoption of new releases. Poor extension services in the public sector have adversely affected the dissemination of improved seeds and agricultural inputs. Additionally, seed companies lack the resources to finance and mount demonstration trials, extension services, and promotional activities. In the case of Syngenta's improved rice seed, many farmers were willing to buy the seeds after learning about their benefits over seeds from open markets.

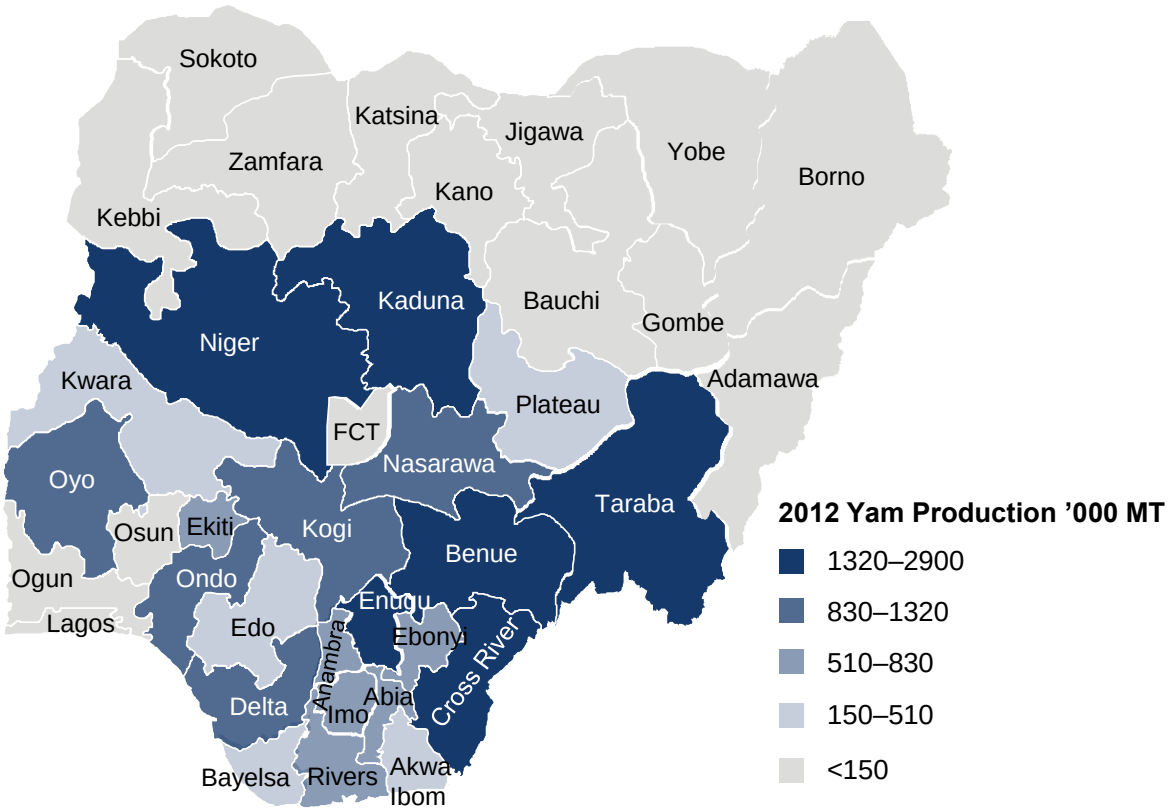
3.3 YAM

SUPPLY

Nigeria is the largest producer of yam in the world, producing 45 million MT in 2014 (FAO), approximately 66% of the world's total yam production. It is the largest contributor in West Africa's yam belt, a production area comprising Nigeria, Ghana, Côte d'Ivoire, Benin, Togo, Burkina Faso, and Mali that altogether accounts for 91% of the world's total yam production.

As shown in Figure 24, the largest producing states include Benue, Taraba, and Niger, while Nasarawa, Oyo, Kogi, Ondo, and Delta states also have high levels of production.

***Figure 24*: Yam producing regions and states in Nigeria, 2012.**

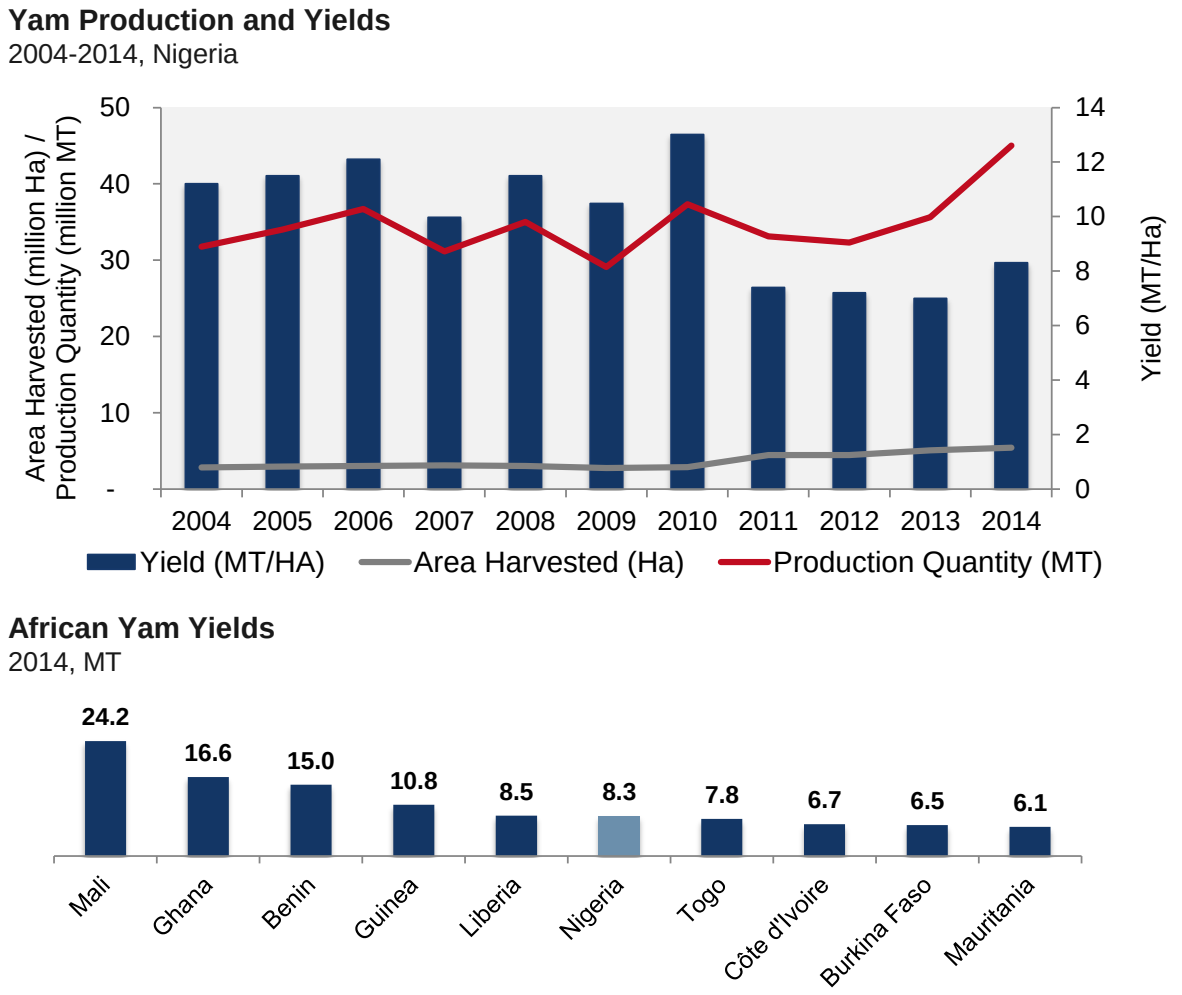


Source: National Bureau of Statistics Nigeria – Nigeria Socio-Economic Indicators, November (2012).

Due to its high market demand, yam-producing households in Nigeria rely on yam for their cash income. Field interviews revealed that most of the fresh yam produced in Nigeria is sold in traditional and open air markets and consumed domestically, with minimal exports.

Yam has received very low interest from the FGN, and it is not a priority crop for the ATA. In addition, private sector interest is low, and there has been limited donor support compared with other food staples such as cassava and cereals. While it isn't exactly clear why this is the case, the lack of industrial opportunities relative to cassava could be the main reason why the FGN has not focused more on yam to date. Furthermore, while yam is an important crop in Nigeria, it is not widely grown outside of Nigeria relative to cassava. This could explain why donors have focused more on cassava as it is a key crop in many countries around the world. Yields are very low relative to other countries (Figure 25), which is due to reliance on farmer-saved seeds highly infested with diseases caused by nematodes, yam mosaic virus, and fungi, as well as low use of fertilizer and crop protection products.

Figure 25: **Yam area, production, and yield.**



Source: FAOSTAT (viewed in May 2016).

DEMAND

Among the roots and tubers, yam is often viewed as superior for a range of cultural reasons. The New Yam Festival, which marks the commencement of the new yam season, is a glamorous traditional, social event in yam-producing areas, particularly among the Igbo people in the South East and certain parts of the South West. In addition, the Igbo people consider yam an essential object in rites of passage such as marriage and Thanksgiving, as well as an important ritual object for ceremonies (Nweke et al., 2013).

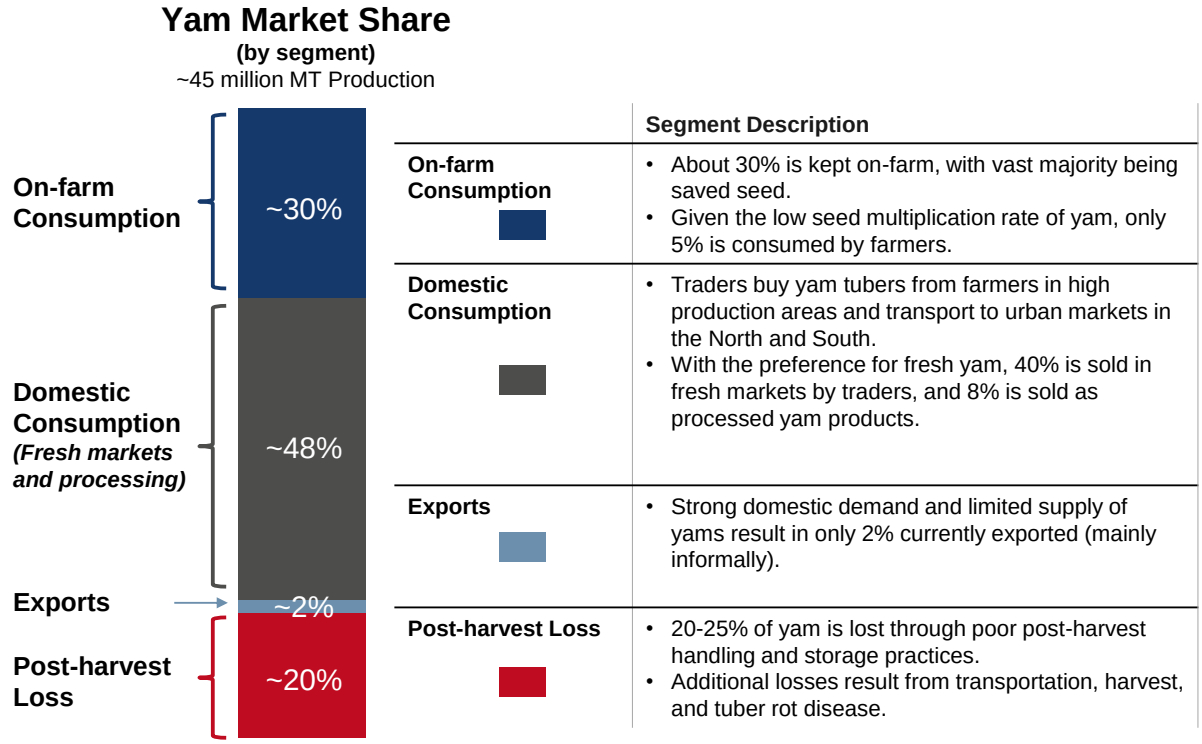
Most yam is sold in rural and urban markets for domestic consumption as fresh tubers or processed food forms. There are significant differences between formal and informal sector yam processing activities. Formal processing of yam in Nigeria entails the use of semi-automated machines such as grinders and flash dryers to produce yam flour, which is packaged and sold in supermarkets and open air markets. About 10 to 15 formal processors operate in Nigeria; however, apart from Ayoola Foods, none has a large-scale operation. They are concentrated in Lagos and mostly rely on traders or rural aggregators to source quantities of yam for processing, although a few have direct links with yam farmers. Major processed products include instant pounded yam flour (*poundo yam*) and yam flour, while a few companies also produce yam fries and yam chunks.

Informal processors manually process yam by cutting it into pieces and parboiling. These pieces are sun-dried into flakes and then further ground to be sold as yam flour in open air markets. There are numerous informal processors concentrated in the South West who process large quantities of yam flakes and yam flour during the dry season. Informal yam processors mostly use *"ikokoro yam,"* a yam type with small tubers or damaged ware yam tubers during harvest to avoid wastage.

The yam processing segment is currently underdeveloped, given the limited number of processed products available in Nigeria relative to cassava. However, there is an opportunity to increase yam processing potential by adapting new product innovations from developed countries (such as Japan) to the Nigerian traditional food system. This could greatly increase the demand for improved seed yam to produce suitable varieties for processors.

Currently, exports are estimated to represent approximately 2% of total yam production, although no official data exists. Substantial amounts of yam tubers are exported through informal channels. In the yam-producing areas of Oyo State in southwest Nigeria, truckloads of yam tubers are transported to neighboring countries such as the Republic of Benin and Togo. There is interest in more formal yam exports from the private sector and some state governments in yam growing areas such as Nasarawa State. According to informal reports, the diaspora has created a growing number of yam exports to Europe, the U.S., and neighboring countries. In 2011 the Nigerian Export Promotion Council established a yam conditioning and export center in Zaki Biam, Benue State, to regulate exports and issues certifications to interested exporting companies. Given that Nigeria is the largest global producer of yam, with current high levels of post-harvest losses along the value chain, there is a significant opportunity for Nigeria to become a leading yam exporter through strong policies at both state and federal levels of government that support yam exportation.

***Figure 26*: Comparison of yam demand segments.**



Source: Field interviews and analysis, FAOSTAT, 2009/2010 Nigeria National Household Survey.

IMPROVED VARIETIES OF YAM

A total of 19 improved varieties of yam have been released in Nigeria, all developed by NRCRI with support from IITA. However, adoption of these varieties by farmers is very low. Table 11 presents a list of commonly grown varieties of yam in Nigeria. Most of the commonly grown varieties were released between the early 2000s and 2010, aside from two new early-maturing varieties that are promoted through the formal system. While there is no available data on market shares of improved yam varieties, field interviews suggest adoption levels are very low due to the formal seed system serving only 2% of the total yam planted area.

***Table 11*: Key improved varieties of yam released in Nigeria.**

Variety Name	Developing Institute	Characteristics	Year of Release
TDR 89/02677	NRCRI, IITA	Stable yield, very good cooking and pounding qualities, cream tuber parenchyma, 25% tuber dry matter content	2001
TDR 89/02565	NRCRI, IITA	Stable yield, very good cooking and pounding qualities, cream non-oxidizing parenchyma, 35% tuber dry matter content	2001
TDR 89/02461	NRCRI, IITA	Stable yield, very good cooking and pounding qualities, cream tuber parenchyma, 26.7% tuber dry matter content	2001
TDR 89/02665	NRCRI, IITA	Stable yield, very good cooking and pounding qualities, cream non-oxidizing parenchyma, 35.3% tuber dry matter content	2003
TDR 89/01213	NRCRI, IITA	Stable yield, very good cooking and pounding qualities, white non-oxidizing parenchyma, 29.8% tuber dry matter content	2003
TDR 89/01438	NRCRI, IITA	Stable yield, very good cooking and pounding qualities, white non-oxidizing parenchyma, 29.3% tuber dry matter content	2003
TDR 95/01924	NRCRI, IITA	Stable yield, very good cooking and pounding qualities, white non-oxidizing parenchyma, 32.8% tuber dry matter content	2003
DRN 200/4/2	NRCRI	High yielding, pest and disease resistance, very good for fufu, frying and boiling	2008
TDa 98/01176	NRCRI	High yielding, pest and disease resistance, good for pounded yam, frying and boiling, suitable for both rainy and dry seasons	2008
TDa 98/01168	NRCRI	High yielding, pest and disease resistance, good for pounded yam, frying and boiling	2008
TDa 98/01166	NRCRI	High yielding, pest and disease resistance, good for pounded yam, frying and boiling, suitable for both rainy and dry seasons	2008
TDr 95/19158	NRCRI	High yielding, pest and disease resistance, very good for fufu, frying and boiling	2009
TDr 89/02602	NRCRI	High yielding, pest and disease resistance, very good for fufu, frying and boiling	2009
TDr 89/02660	NRCRI	High yielding, pest and disease resistance, very good for fufu, frying and boiling	2009
TDa 00/00194	NRCRI	High yielding, pest and disease resistance, very good for fufu, frying and boiling	2009
TDa 00/00104	NRCRI	High yielding, pest and disease resistance, very good for fufu, frying and boiling	2009
UMUDa-4	NRCRI	High yielding, good for amala, pounded yam, frying and boiling	2010
UMUDr-17	NRCRI	High yielding under dry season yam cropping system	2010
UMUDr-18	NRCRI	High yielding, pest and disease resistance, very good for fufu, frying and boiling	2010

Source: NRCRI Umudike, Abia State.

Predominantly, farmers plant landrace varieties that are heavily infested with diseases. Among the popular landraces are some premium varieties that are in high demand by consumers and processors because of their characteristics, such as tuber size, color, and taste. Some popular varieties include are listed below in Table 12.

Table 12: **Common local yam varieties in the informal system.**

	Variety Name		Harvest Timeline
South West	Amula	Ajebeluko	July through October (early maturing varieties) August through June (all other varieties)
	Agbaobe	Aganke	
	Omiefun	Aje lanwa	
	Lasinrin	Ada Onitsha	
	Efuru	Oju Iyawo	
	Lariboko	Okunmojo	
	Boki	Gbenra	
	Igangan	Gore	
	Gbongi	Saja	
	Sowofini	Ikokoro	
	Lofere		
South East	Abii	Ji Onitsha	August through September (early maturing varieties) February through March (all other varieties)
	Oku	Nwagba	
	Usekpe	Nwadaka	
	Obiaturugo	Okwocha	
	Nwapoko	Abana	
	Ji Mbana	Iyio	
North Central	Pampers	Pepa	December through January
	Ada Onitsha	Idiot/Lagos	
	Lagos/Ame/Idiot	Aloshi	
	Akwasi	Hembamkwase	
	Akulki	Ogoja	

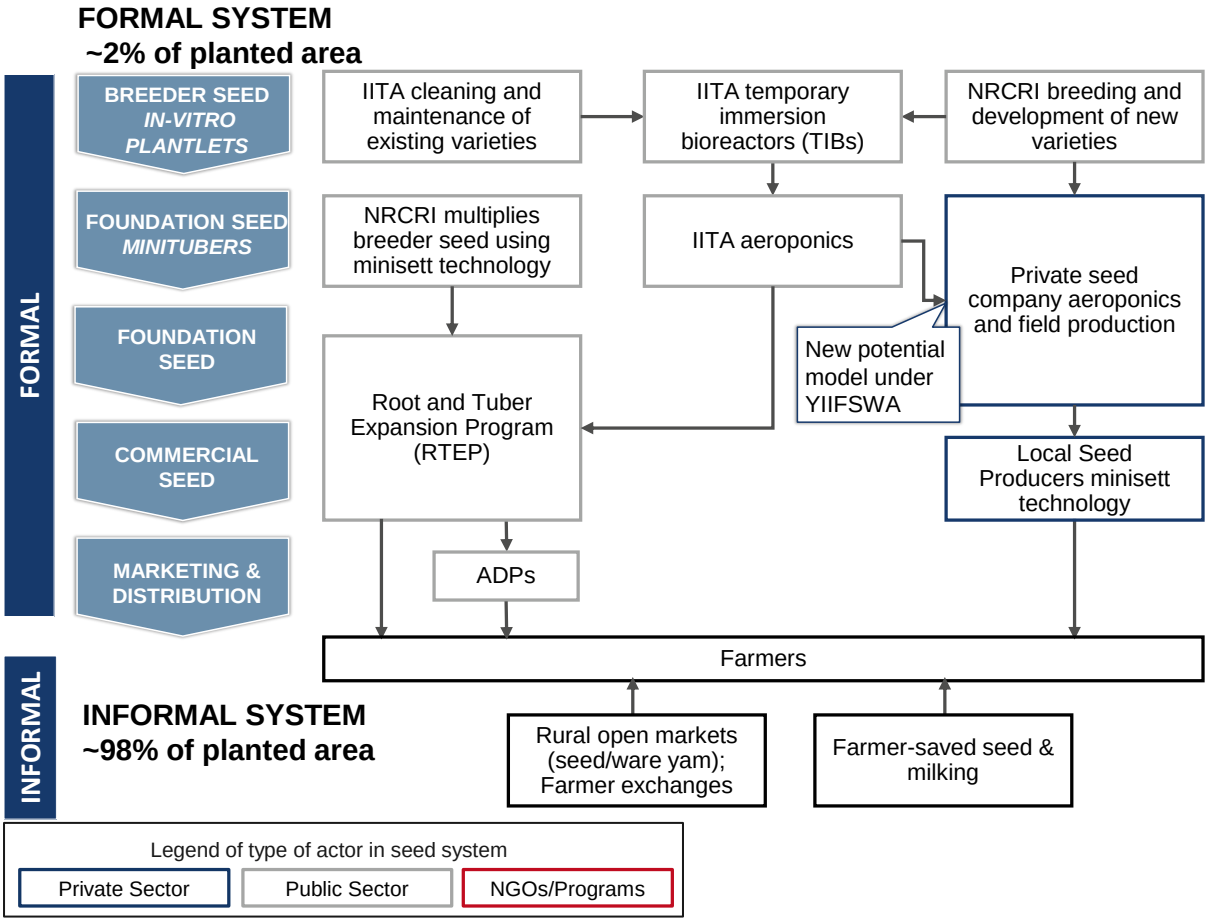
Source: Sahel Capital field research (2014).

A major issue that has stalled the development of a formal yam value chain and the demand for improved varieties, is the high level of fragmentation along the chain. This is caused by a lack of cooperation between actors, leading to significant knowledge gaps between the research community, farmers, and processors.

STRUCTURE OF THE EGS VALUE CHAIN

The yam EGS value chain is dominated by the informal seed system, which contributes ~98% of the total planted area, while only 2% is supported by the formal seed system as shown in Figure 27. The formal system is dominated by the public sector, with very little private sector participation. There are numerous EGS supply bottlenecks, as well as demand constraints in the yam seed system as further explained in this report.

***Figure 27*: Structure of yam seed systems.[8]**



Source: Expert analysis (2016).

FORMAL SYSTEM

The National Centre for Genetic Resources and Biotechnology is responsible for the registration of new varieties. To date, it has released and registered 19 improved varieties of yam, but none since 2010. NRCRI has the national mandate to produce yam breeder seed and maintain released varieties, with IITA supporting NRCRI to achieve this mandate.

Prior to the YIIFSWA project, the formal system was led by the public sector, with NRCRI producing breeder seed using the minisett technique, and subsequent multiplication and distribution to farmers handled by the Root and Tubers Expansion Program (RTEP) of the FMARD, supported by ADPs. In general, RTEP's multiplication and distribution of seed yam has been unsuccessful because of insufficient government funding, weak technical capabilities to execute demonstration trials, and anemic efforts to market and distribute the improved varieties.

The minisett technique involved cutting ware yam or "mother" seed tubers into small setts of 25-100g which possess a reasonable amount of peel (periderm) from which sprouting could

[8] In milking, tubers are harvested two-thirds into the growing season without destroying the root system, providing early ware yam for consumption. The parent plant regenerates new small tubers used as seed yam for the following season.

occur (Aighewi et al., 2014). This technique increased the seed multiplication ratio of yam from the traditional 1:5 to 1:30 (Orkwor et al., 2000).

However, this technique has little effect on improving the existing informal seed system because other problems persist, including a lack of credit, weak institutional capacity, and high levels of disease infestation. In the modified minisett technique (Ikeorgu et al., 2003), the use of 25-80g minisetts reduced the production cost of seed yam; however, the rate of adoption remained low (Oguntade et al., 2010).

In more recent years, the rooting of 20 cm-long 3-node vines has produced mini-tubers of 50-600g after eight months, giving a 1:22 propagation ratio (Agele et al., 2010). All of these field based propagation techniques are genotype dependent and therefore cannot guarantee cleaning of disease-infected seed yams.

However, a more optimized formal seed system is gradually evolving, thanks to positive strides made by the YIIFSWA project, especially with the use of novel technologies, as well as the subsequent multiplication and distribution of clean foundation and certified seed yam in large quantities. Novel technologies include aeroponics and temporary immersion bioreactors (TIBs). An aeroponics system is capable of producing clean disease-free vines and mini-tubers that can be used to produce high-quality seed yams. It has an enormous capacity to produce up to one million mini-tubers and clean vines a year. A one-node cutting from an aeroponics system produced an average seed yam of 250-300g. According to IITA, the extent of yield benefit of aeroponics over other sources of seed yam is currently being studied. TIBs is an in-vitro production technique that produces clean, disease-free yam vines that are fed into the aeroponics system or planted directly into the field for mini-tuber (or seed yam size tuber) production. Successful demonstration of the efficacy of these technologies to produce clean foundation and certified seed yam at high rates of multiplication and reduced cost could make seed yam production an attractive business to private seed companies.

Currently, a collaborative effort between NASC, NRCRI, and IITA is promoting two improved early-maturing yam varieties and supplies breeder seed to private seed companies to multiply into foundation seed, and subsequently, certified seed. The first set of certified seeds produced under this new arrangement was ready for sale in 2016 after a launch of the formal seed system by NASC. To date, four private seed companies have participated in multiplying yam foundation and certified seed. The aeroponics system has also been demonstrated to a total of ten private seed companies, in an effort to encourage their participation in commercial seed yam production. To date the ten private seed companies have expressed interest in testing the technology and potentially investing, but no firm commitments have been made.

In addition, YIIFSWA has developed the Yam Quality Management Protocol, a sub-standard for measuring quality across all classes of seeds including breeder, foundation, and certified seeds. The NASC has been trained on how to use standard protocols for the inspection of seed yam fields.

INFORMAL SYSTEM

The informal market plays an important role in yam, given the near absence of the formal system in the value chain. The most common practices in the informal system are milking and farmer-saved seed, both of which greatly limit yields due to high disease pressure on old stock. In milking, tubers are harvested two-thirds of the way into the growing season without

destroying the root system, providing early ware yam for consumption. The parent plant regenerates new small tubers used as seed yam for the following season. More commonly, farmers reserve up to 30% of their harvest for future planting, or they exchange with fellow farmers in order to refresh their seed yam stock or acquire a newly introduced variety from another region of the country (Balogun et al., 2014). Farmers will visit rural seed yam markets when they do not have sufficient seed yam from other informal sources of seed for planting.

KEY EGS SYSTEM BOTTLENECKS AND CONSTRAINTS

The current yam EGS system is essentially non-existent. The YIIFSWA project, which includes the testing and integration of new propagation technologies, quality management protocols, and the integration of a value chain approach presents a strong opportunity to establish a viable system to produce and deliver improved varieties, although these technologies and business models are in their early stages and will require close monitoring to demonstrate proof of concept. Currently, however, there are significant supply bottlenecks and demand constraints, as follows:

Supply bottlenecks

- **Absence of structure in the EGS system:** There is no clear division of responsibilities among stakeholders for producing foundation seed, i.e. RTEP, ADPs, and NARIs are all involved in foundation seed production.
- **Low multiplication rates and inadequate technical know-how for high throughput foundation seed yam production:** In the current system, the seed multiplication rate is very low, at <1:10 compared to 1:200 in some cereals. This problem is made worse by long growth cycles and long tuber dormancy, which is compounded by limited knowledge about, and low expertise in, the use of yam multiplication technologies such as biotech tissue culture, bioreactors, and aeroponics.
- **Lack of private sector interest in yam EGS production:** High production costs for seed yam, specifically at the foundation seed production level has discouraged private seed companies to venture into production. Under the YIIFSWA project seed companies that have participated in the successful demonstration of aeroponics technology at IITA have expressed interest in potentially adopting the promising technology. While the technology appears to lower production cost, a comprehensive analysis of the profitability of the technology in commercial situations outside of IITA's controlled R&D environment is necessary to convince private seed companies to invest.
- **Ineffective public production and distribution system of commercial yam seed:** The distribution of improved seeds of yam has been poorly carried out by the public entities charged with this responsibility, e.g., RTEP and ADPs, which have limited capacity to produce, market, and distribute sufficient quantities of seed at the right time at an affordable price. This is caused by insufficient government funding and overly complex management structures within the public system.

Demand constraints

- **Poor quality production of EGS producers lowers yield potential of improved varieties:** Apart from IITA, NRCRI lacks the laboratory facilities, capacity, and expertise to produce and multiply disease-free seed yam.

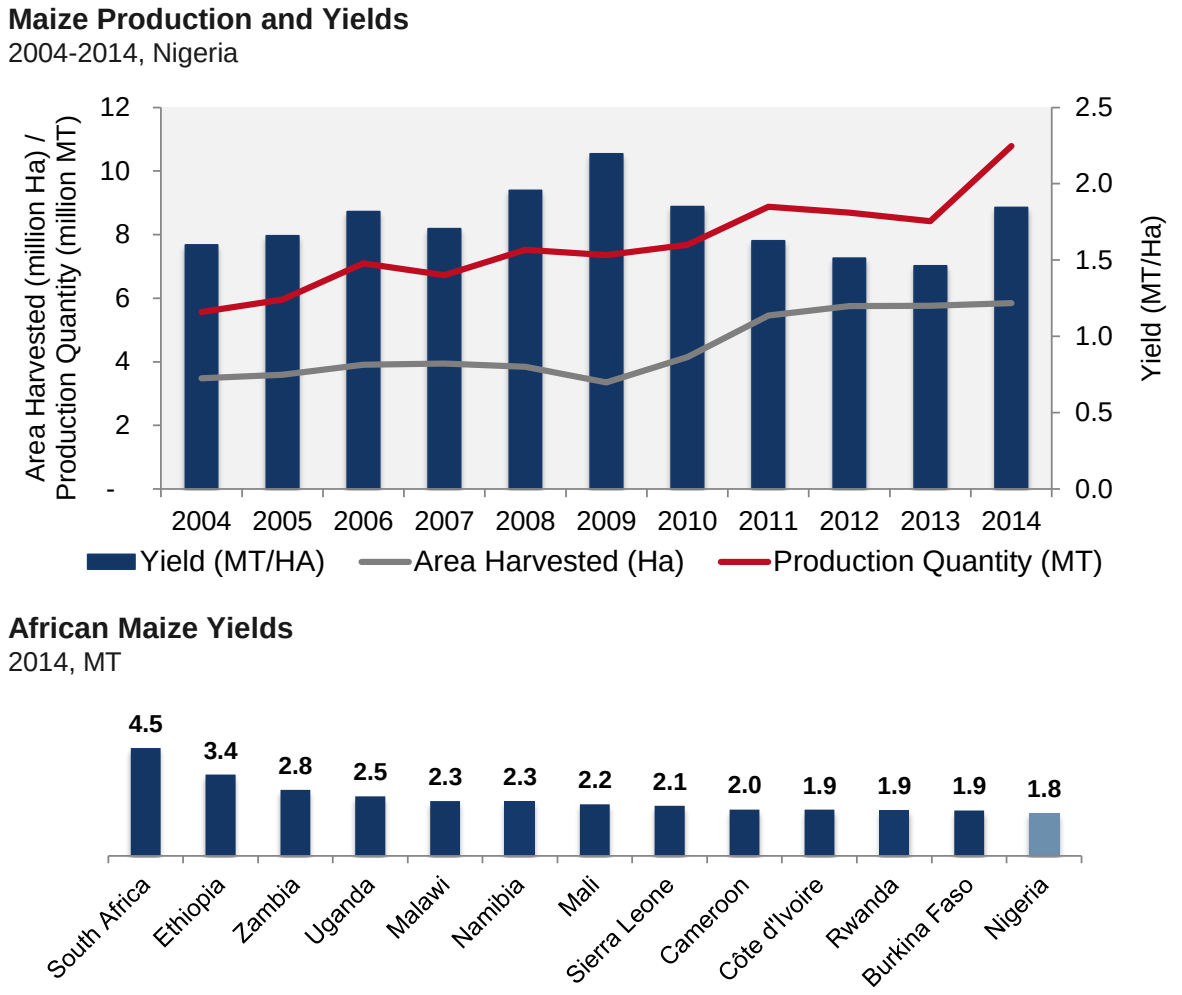
- **Low private sector interest in value chain development**: Unlike cereals, private seed companies producing certified seeds are reluctant to produce planting materials for roots and tubers (particularly seed yam) due to low multiplication rates (of existing technologies), limited industrial application, and limited product innovations that would spur farmers' demand for improved varieties of yam.
- **Low demand for improved varieties**: Although 19 new varieties have been released by NRCRI/IITA, few have been adopted by farmers because there have not been sufficient on-farm demonstration trials to prove the benefits of improved seeds. Farmers are also unaware that the practice of seed recycling leads to declining yields and thus do not see a need for the use of improved seeds.
- **Slow pace of varietal improvement:** The failure of the FMARD to select yam as a key crop in the ATA has led to limited funding for breeding activities to increase the rate of genetic gain. The lack of release of improved varieties since 2010 is an evidence of low interest from the government.

3.4 MAIZE

SUPPLY

Nigeria is the 12th-largest maize producer in the world and is second only to South Africa in Sub-Saharan Africa, with an estimated 10.7 million MT produced in 2014 (FAOSTAT, 2014). Maize is a very important staple food in Nigeria. However, yield gains are limited by slow adoption of newer maize OPV varieties and hybrids, as well as the limited availability of, and knowledge about, the corollary inputs (Figure 28). Nigeria is endowed with high-potential production areas that also have low population density, making them suitable for expanding maize production. In key maize-growing regions, it is often mono-cropped. Less than 10% of maize is irrigated, which limits its potential in the northern edges of the Sudan and Sahel regions.

Figure 28: **Maize area, production, and yield.**



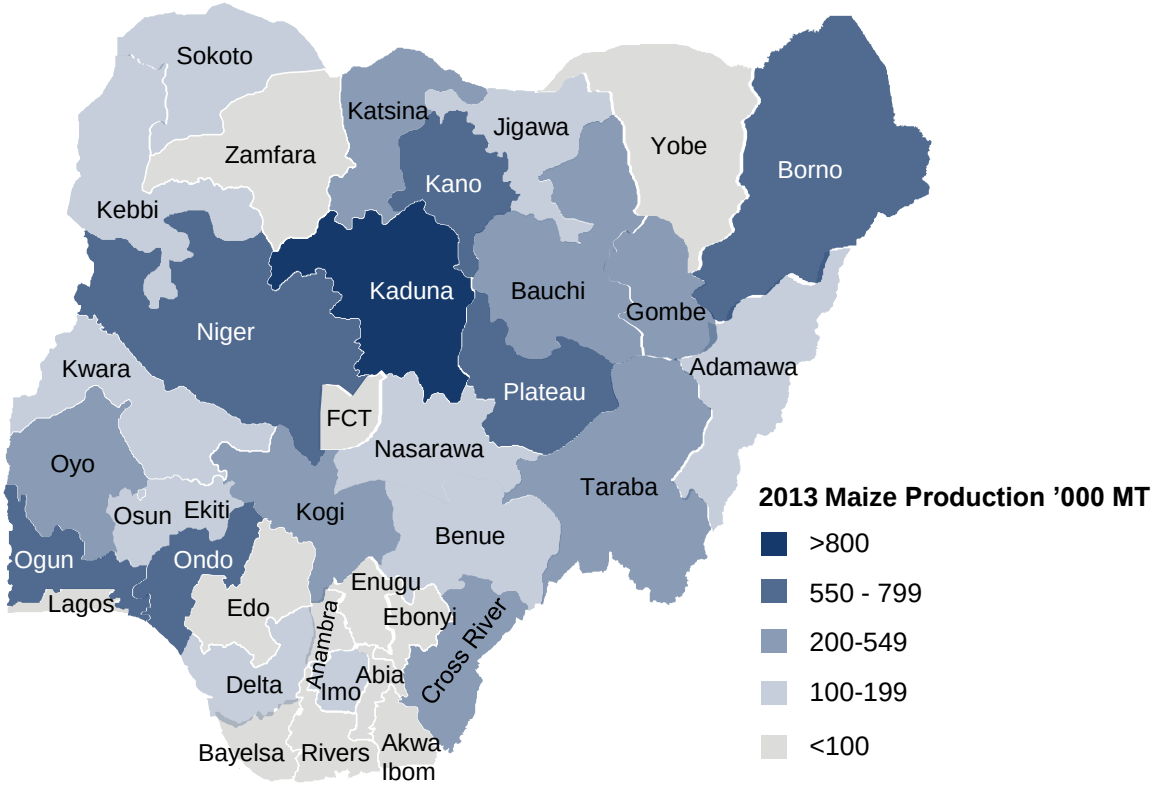
Source: Nigeria Country Stat (viewed in February 2016), FAOSTAT (viewed in February 2016).

Maize is widely grown across all 36 states and the Federal Capital Territory, as illustrated in Figure 29. States with the highest maize area are Niger, Kaduna, Ogun, Kogi, Taraba, Katsina, Oyo, Plateau, Ondo, and Kano, accounting for nearly 57% of the total maize planted area (DTMA, 2014). A similar list of states (Kaduna, Niger, Plateau, Borno, Kano, Ondo, Ogun, Taraba, Kogi, and Bauchi) account for close to 60% of maize production.

Nigeria's average yield of 1.8 MT/Ha lag behind other African countries such as South Africa, Ethiopia, Uganda, Mali, and Rwanda (FAOSTAT, 2013). Key factors limiting maize yield are Striga and aflatoxins. Striga is a genus of parasitic plants in the *orobanchaceae* family that occurs naturally in parts of Africa, Asia, and Australia. The parasite competes with the host for resources, altering plant architecture (which potentially leads to lower yield) and reducing the photosynthetic rate and water-use efficiency of the host (Cechin and Press, 1994; Van Ast et al., 2000; Watling and Press, 2001). Striga depresses maize grain productivity by 20–100%, often leaving farmers with little or no food grain at harvest.

Contamination of maize by aflatoxins renders it unsafe for human consumption, which is a major concern to both the FGN and the international community. Contaminated maize constitutes a major economic loss in food production.

***Figure 29*: Maize producing states in Nigeria, 2013.**



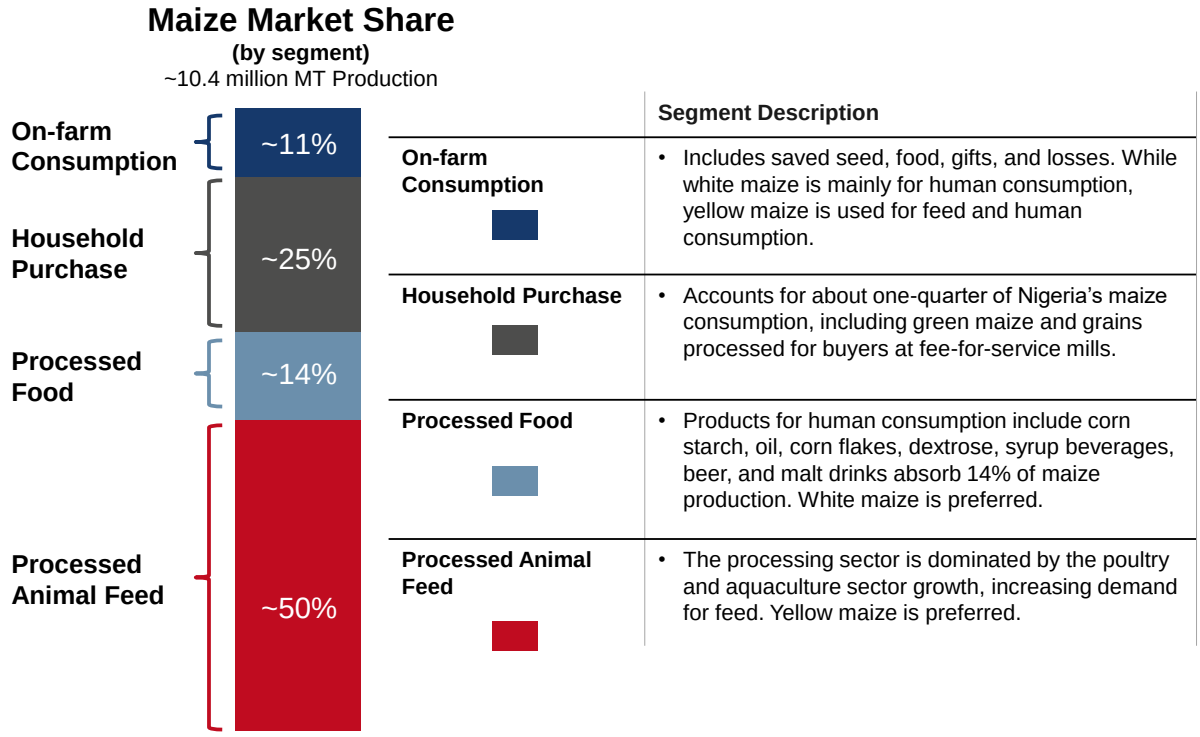
Source: Agricultural Performance Survey of 2013 Wet Season in Nigeria, NAERLS.

DEMAND

Trade data shows that Nigeria was a net importer of maize in 2013, with 300 MT of imports to meet current domestic demand (FAOSTAT). Approximately 11% (an estimated 1 million MT) of annual maize produce is used as food, saved seed, gifts, or post-harvest loss. Being a primary food staple, maize is consumed across the country and among households of varying wealth. It is widely used in the preparation of traditional foods. Main local dishes include pap, tuwo, gwate, and donkunu, with the cereal cooked, roasted, fried, ground, pounded, or crushed (Abdulrahaman et al., 2006). The rest is sold commercially into both the food and animal sector processing sectors.

According to IITA estimates, maize demand will increase 3.2% per year over the next five years due to overall population growth and increasing urbanization. Maize has become indispensable for food security and is also in demand as an industrial crop. Brewery demand for maize grits is growing in tandem with the consumption of beer, but domestic production cannot fully meet this need due to competitive demand from other maize processing sectors. Breweries instead turn to maize alternatives such as barley and sorghum. Utilizing corn as feed is also increasing with the steady recent growth in the poultry and aquaculture sectors. The poultry sector claimed as much as 98% of the total feed produced in Nigeria between 2005 and 2010 (USDA, 2005-2010).

***Figure 30*: Comparison of maize demand segments.**



Source: Nigeria maize value chain analysis, Context Network (2014).

The proximity of Lagos State to Benin and Kano State to the Republic of Niger makes them among the prominent market centers for informal trade. According to a FAO report, maize prices in Jibia, Illela, and Mai Adua markets (in Northern Nigeria, at the border with Niger), along with prices in Malanville (in Benin, at the border with Niger) have a strong influence on maize prices in the three countries (FAO, 2008).

IMPROVED VARIETIES

Numerous improved varieties of maize have been developed and released in Nigeria that contain desirable characteristics, such as striga tolerance, low soil nitrogen, and water-use efficiency. Since 2014, 22 varieties of maize have been released, of which 20 were hybrids. However, there have been only three hybrids released during this period that are well adapted to the Humid Rain Forest agro-ecological zone in the south. The majority of the hybrids are adapted to the Savannah agro-ecological zones. Although most of the newly released hybrids and OPVs have better performance than local varieties (i.e., higher yields and resistance to striga and drought), adoption is very low because of limited farmer awareness due to poor agriculture education efforts. Sammaz 15, an OPV released in 2008 continues to be one of the most popular varieties for farmers. According to field interviews, farmers prefer Sammaz 15 because it is the highest yielding of the available OPVs and requires less investment in collateral inputs compared to hybrids. While hybrids are generally seen as providing a higher return on investment than OPVs despite the higher costs, there have been very few on farm demonstrations of the financial returns of hybrids.

Despite these issues, hybrid adoption continues to trend upward due to increased efforts in research and growing involvement by private seed companies. This trend is projected to steadily, gradually replace OPV seed. However, in order to accelerate hybrid maize

adoption, there is a need to reduce the cost of certified hybrid maize seed and promote awareness among farmers through multiple demonstration trials.

Table 13: **Recent maize varieties released.**

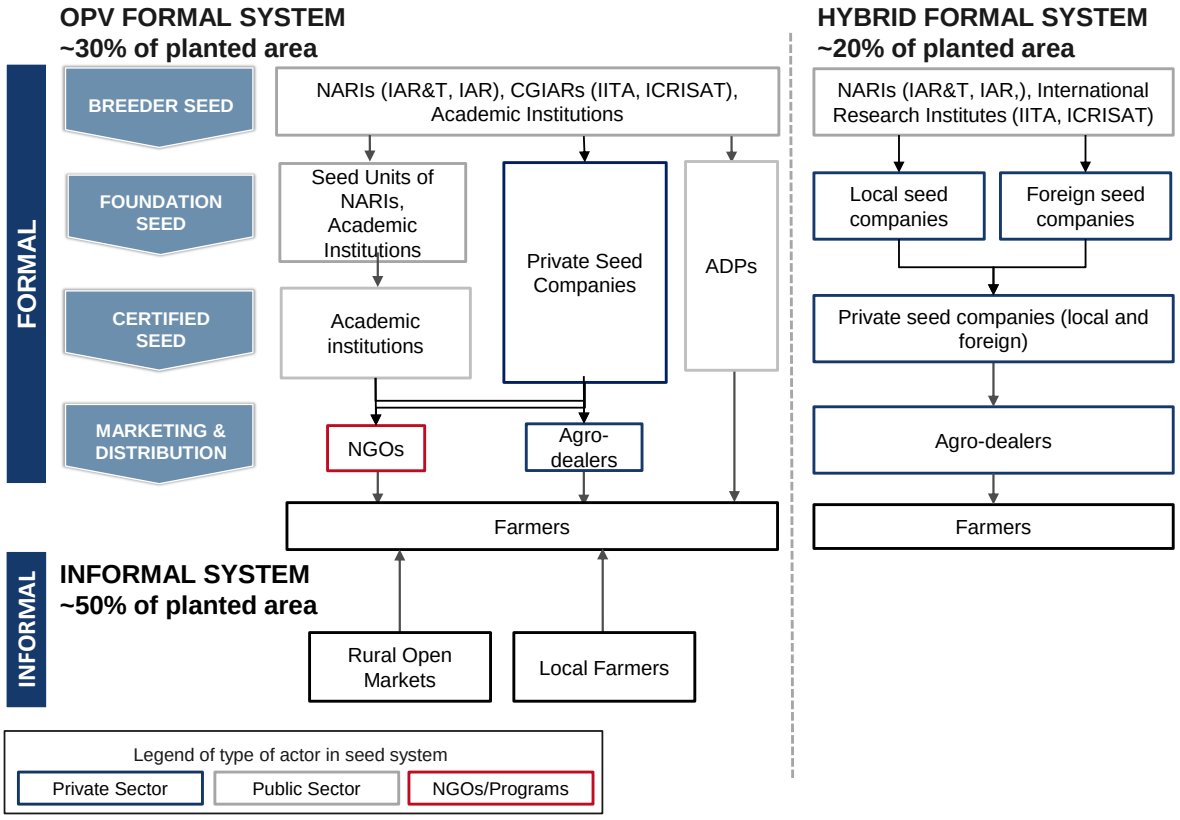
Variety Name	Type	Developer	Characteristics	Pot. Yield (MT/Ha)	Agro-ecological Zones	Year of release	Year of reg.
SC719	Hybrid	Seed Co, IAR, IAR&T, IITA	Large grain	12	Southern and Northern Guinea Savanna	2014	2014
30Y87	Hybrid	Pioneer	Excellent staygreen characteristics, uniform ear placement, good standability	12	Forest, Forest transition, Southern and Northern Guinea Savanna	2014	2014
30F32	Hybrid	Pioneer	Resistant to root and stalk lodging	9	Southern and Northern Guinea Savanna	2014	2014
P48W01	Hybrid	IITA	Resistant to Striga	5	Southern and Northern Guinea Savanna	2014	2014
P48W03	Hybrid	IITA	Prolific, combines host plant resistance to striga	4.5	Northern Guinea Savanna and Sudan Savanna	2014	2014
SAMMAZ-41	Hybrid	IITA	Early maturing, highly stable and low soil nitrogen tolerant	7.8	Northern Guinea and Sudan Savanna	2014	2014
SAMMAZ-42	Hybrid	IITA	Early maturing, low soil nitrogen tolerant	7.8	Northern Guinea and Sudan Savanna	2014	2014
SAMMAZ-43	Hybrid	IITA	Intermediate levels of provitamin A content (8.4ug/g)	9.9	Northern and Southern Guinea Savanna	2015	2015
SAMMAZ-44	Hybrid	IITA	Intermediate levels of provitamin A content (8.8ug/g)	9.7	Northern and Southern Guinea Savanna	2015	2015
SAMMAZ-45	OPV	IITA	Resistant to aflatoxin	6.2	Northern and Southern Guinea Savanna	2015	2015
Ife Hybrid 08	Hybrid	IAR&T		8.6	Forest and Derived Savanna	2015	2015
Ife Maize Hybrid 09	Hybrid	IAR&T	Prolific maize cobs	12.9	Forest and Derived Savanna	2015	2015
SC651	Hybrid	IITA	Tolerant to drought and Striga hermonthica, good husk cover	9.7	Guinea Savanna	2015	2015
DK234	Hybrid	Monsanto	Tolerant to striga hermonthica	13.2	Southern and Northern Guinea Savanna	2016	2016
DK777	Hybrid	Monsanto	Tolerant to striga hermonthica	10.9	Forest, Southern and Northern Guinea Savanna	2016	2016
DK818	Hybrid	Monsanto	Stable, tolerance to striga hermonthica	10	Southern and Northern Guinea Savanna	2016	2016
DK920	Hybrid	Monsanto	Prolific, tolerance to Striga hermonthica	10.7	Southern and Northern Guinea Savanna	2016	2016
Oba Super 11	Hybrid	IITA, Premier Seed	Striga and drought tolerance	9.6	Southern and Northern Guinea Savanna	2016	2016
Oba Super 13	Hybrid	IITA, Premier Seed	Striga and drought tolerance	9.7	Southern and Northern Guinea Savanna	2016	2016
SAMMAZ 46	Hybrid	IITA, IAR	Tolerance to drought, Striga hermonthica, low soil nitrogen	9.6	Northern Guinea and Sudan Savanna	2016	2016
SAMMAZ 47	Hybrid	IITA, IAR	Tolerance to drought, Striga hermonthica and low soil nitrogen	10.3	Northern Guinea and Sudan Savanna	2016	2016
SAMMAZ 48	OPV	IITA, IAR	Stable,tolerance to drought and Striga hermonthica.	7.8	Northern Guinea and Sudan Savanna	2016	2016

Source: Varieties Released Catalogue, National Center for Genetic Resources and Biotechnology (NACGRAB), Nigeria.

STRUCTURE OF THE EGS VALUE CHAIN

About 50% of maize planted area is supported by the formal seed system, while the remaining 50% is planted with seed sourced by farmers through informal means, as shown in Figure 31. Hybrid seeds, which are planted on more than one-half of the area served by the formal system, are a key factor in the growth of the formal system. Historically, the public sector has dominated the formal system; however, there is growing private sector participation, e.g. seed companies and agro-dealers.

Figure 31: **Structure of maize seed systems.**



Source: Expert analysis (2016).

FORMAL SYSTEM

NASC plays a supervisory role in the quality assurance and production of breeder, foundation, and certified seeds. Production of breeder and foundation seeds is mostly done through the appointed NARIs, which include IAR&T, NCRI, and IAR. The breeder seeds are given to seed units of the institutes, seed companies, and ADPs for multiplication to foundation seed as NARIs are mandated to distribute breeder seed free of charge. Through inspections, NASC monitors the production of breeder and foundation seed at various institutions to ensure that seeds are true to type.

Increasingly, commercial seed companies employ out growers to produce certified seed because they do not have the land to do so themselves. Premier Seeds, Maina Seed, Techni Seed, and Green Spore Seed are among the out growers producing, marketing, and selling seed. Through the efforts of seed companies and their out growers, there has been a gradual increase in awareness among farmers about the benefits of using new seeds every season.

In 2014, a total of 15 maize varieties were imported for research and development purposes by Syngenta (12 varieties) and Terreatiga (3 varieties) (NASC, 2014). These varieties are being tested for adaptability, and if approved for commercial multiplication, will greatly increase the availability of maize EGS within the next five years.

Agro-dealers, ADPs, and NGOs dominate the marketing and distribution of maize certified seed in the formal sector, with agro-dealers dominating.

INFORMAL SYSTEM

Because the formal system cannot provide enough quality maize seed to meet demand, the informal market plays a large and important role. As with many other crops, much of the demand for seed need is met by farmers saving their own seed. However, due to the high prevalence of disease, farmers cannot re-use their own seed indefinitely and must either refresh it through the formal or, more often, the informal system.

Informal sources of maize seed include neighboring farmers, local food markets, and seed traders where large quantities of grain are sold as seed. A significant number of farmers obtain their seeds from agro-dealers and seed companies at initial planting and then use saved grains from harvest for planting the next season. This practice is repeated for several years.

KEY EGS SYSTEM BOTTLENECKS AND CONSTRAINTS

Current EGS demand is estimated to be well above that of supply, due to supply bottlenecks that are further explained below. There are also critical demand constraints that if addressed could further increase demand for EGS.

Supply bottlenecks

- **Inadequate supply of breeder seed:** The NARIs have the national mandate to provide small volumes of breeder seed free of charge to seed companies for multiplication to foundation seed, which strains the already severely underfunded NARI budgets. Additionally, the volumes are grossly inadequate, considering the demand for improved seeds and the number of out growers involved in seed production.
- **Absence of an adequate EGS demand forecasting system:** There is no formal centralized process in which demand for different varieties of commercial seed is captured, analyzed and used to guide how much foundation and breeder seed needs to be produced on a set time horizon for each variety. Without a formal process for forecasting demand, EGS and commercial producers are unable to budget and plan seed production to supply the market. Accordingly, they cannot reach economies of scale and, thereby, lower production costs.
- **Breach of agreement between parties in the production cycle:** Maize out growers complain that seed companies do not comply with agreed terms, which often come in the form of oral agreements. In these agreements, seed companies provide farmers the necessary inputs to grow hybrid maize, with the commitment that farmers will pay the costs back in the sale of hybrid maize to the seed companies. Seed companies justify these breaches in cases where farmers don't meet the volumes and acceptable quality levels that were agreed upon. The lack of written contracts

and enforcement of the terms by both parties impedes the production of maize foundation and certified seeds, reducing supply.

- **Lack of capacity in the certification system:** As with other crops in this study, NASC lacks adequate numbers of qualified personnel and the basic equipment, e.g. vehicles, to effectively monitor and inspect EGS production. This slows and limits the extent of the certification process and reduces the quantity of quality maize seeds produced.
- **Lack of incentives for breeders:** Poorly defined IP law does not adequately underpin licensing agreements, and current royalty sharing does not provide incentives for the NARIs to be more active in breeders' seed production.

Demand constraints

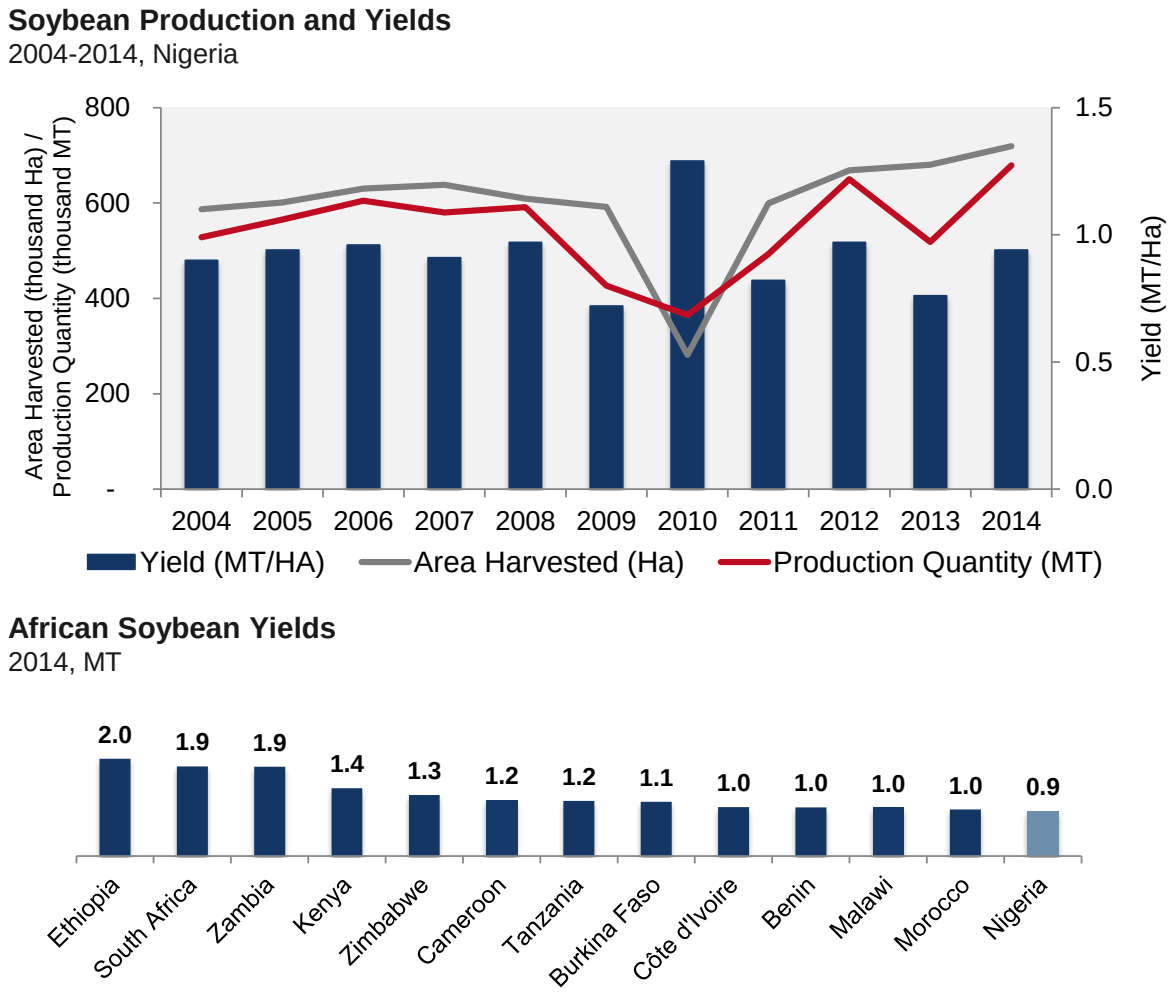
- **High cost of hybrid seed, and the lack of yield benefits from hybrids in low-input conditions:** Hybrid maize costs about $1.26 per Kg compared to OPV which is sold at ~$1 per Kg. In addition, current hybrids require high levels of non-seed inputs, such as fertilizer, to achieve yield benefits as compared to OPVs, which makes hybrids less appealing to many farmers who can't afford the collateral, high-quality, non-seed inputs. While there have been several drought tolerant maize varieties released in Nigeria which require less intensive input use, adoption is quite low.
- **Smallholder farmers lack access to credit:** Hybrid seed is much more expensive than non-hybrid seed, and many smallholder farmers lack access to production credit that would enable them to purchase seed and related inputs. The Babban Gona model (see pp. 62 below) has demonstrated that farmers will buy unsubsidized seed if they have access to demonstration trials, inputs, training, and credit.
- **Presence of counterfeit seeds results in farmers being skeptical about improved seeds:** The GES program was a major driver for improved seed use among smallholder farmers. However, due to limited supply of EGS, many seed companies fraudulently packaged grains and sold them as seeds to farmers, which had low germination rates, high incidence of diseases, and poor yields.
- **Poor agro-ecological adaptation of hybrids in the south:** Most of the available maize hybrids are suited for Savannah agro-ecological zones. Since 2014, only three hybrids suitable for the Humid Rain Forest agro-ecology have been released in Nigeria, and the rate of adoption of these hybrids among smallholder farmers is currently low due to inadequate farmer education and/or on-farm demonstration trials.

3.5 SOYBEAN

SUPPLY

Nigeria is the second-largest soybean producer in Sub-Saharan Africa, with a production of 679,000 MT in 2014 (FAOSTAT, 2016). Soybean is the tenth-largest crop area in Nigeria and has a ten-year compound annual growth rate of 2.1% in terms of harvested area. Perhaps due to the emergence of maize as the dominant national cereal, production improvement in soybean has stalled, resulting in stagnating yields over the last ten years, despite government interest in the crop.

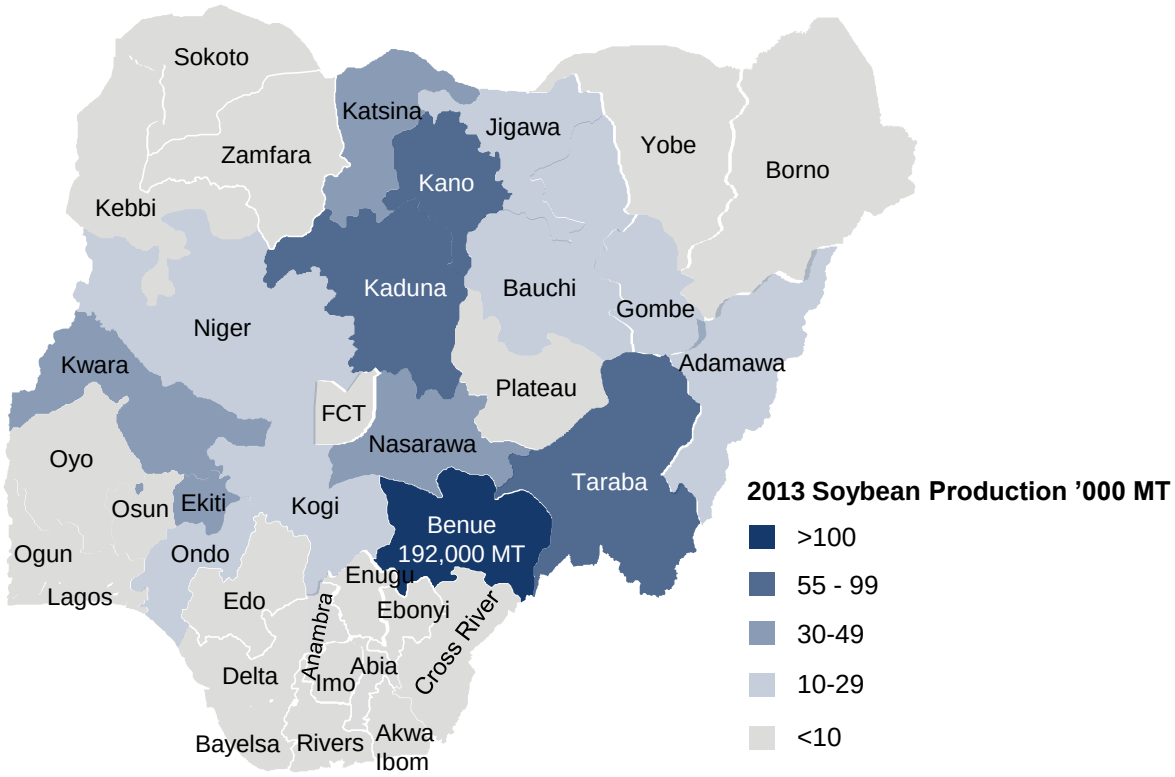
***Figure 32*: Soybean production, area and yields.**



Source: FAOSTAT (Viewed 2016).

Soybean is mainly produced in the northern parts of Nigeria, with the North Central and North West zones accounting for ~97% of production (Figure 33). The major producing states are Benue, Kaduna, Taraba, and Nassarawa (NAERLS, 2013). The total estimated soybean planted area in 2014 was 719,300 Ha, reflecting an increase of 5.7% from 2013 (FAOSTAT, 2014). It is relatively common for farmers in the Guinea Savannah to intercrop soybean and maize because soybean has a nitrogen fixation characteristic which helps increase yield for maize. Soybean is an important cash crop to farmers and a good raw material for oil and cake extraction, as well as livestock and poultry feed.

Figure 33: **Soybean producing states in Nigeria, 2013.**



Source: Agricultural performance survey of wet season in Nigeria, NAERLS, 2013.

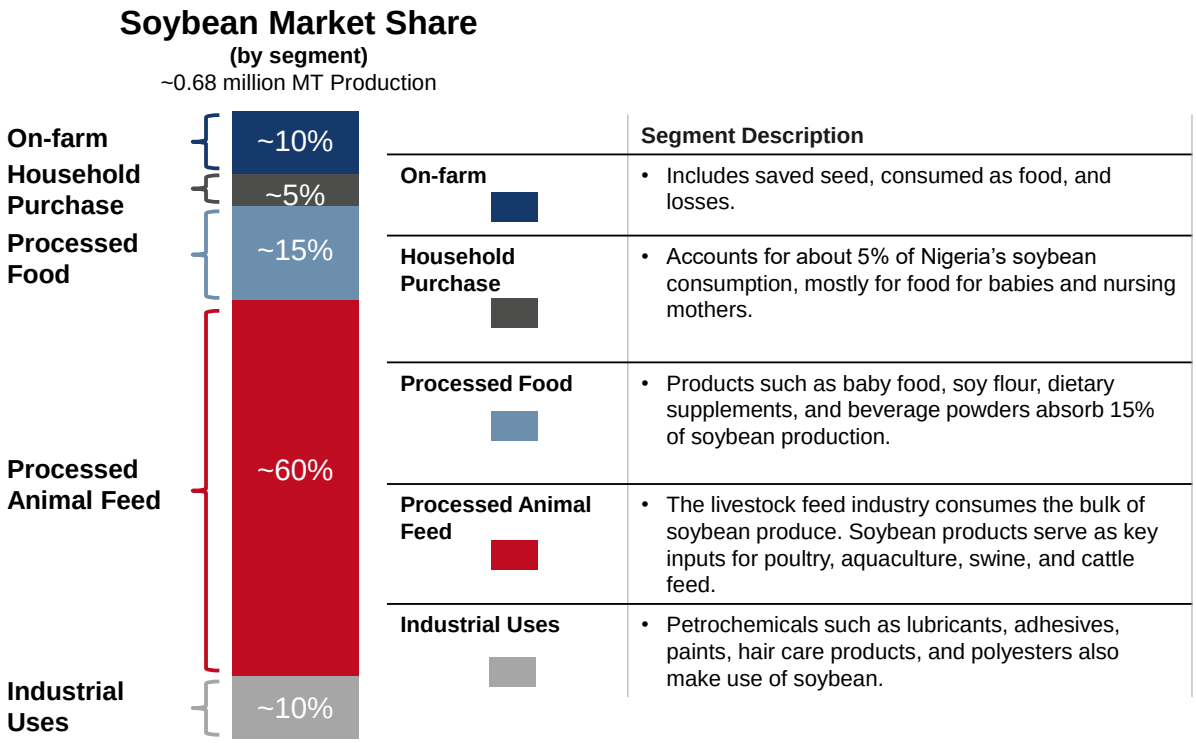
Soybean yields are low in Nigeria compared to other African countries. One factor contributing to low yields is poor agricultural practices. Farmers are not knowledgeable about the best agricultural practices and proper use of agrochemicals for improved yields. In addition, poor access to quality inputs such as fertilizer and certified seeds, as well as lack of mechanized agricultural systems, translates into low yields. Inefficient storage practices play a role too, leading to inconsistent supply levels, price volatility, and early harvesting to take advantage of high prices.

During the last ten years, private sector demand for soybean has increased as a result of new processing facilities built in both northern and southern areas. Currently, the processing capacity of soybean in Nigeria exceeds the production and supply of local soybean.

DEMAND

Demand for soy-based products in Nigeria is substantial, especially among commercial consumers in the food, paint, pharmaceutical, and confectionery industries. More than 70% of soy is processed for industrial use (Figure 34). These industries utilize soybean in various forms, such as bean, meal, cake, and oil.

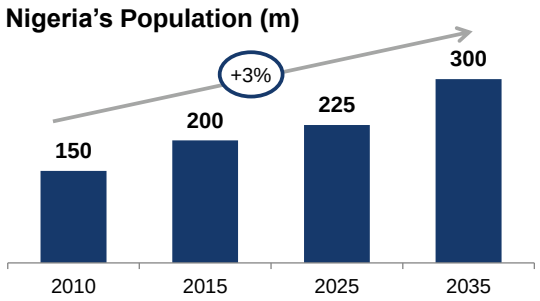
Figure 34: **Soybean demand segments in Nigeria.**



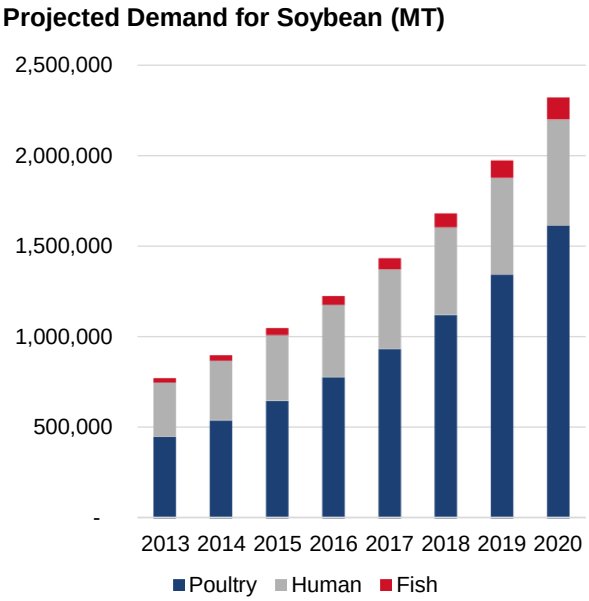
Source: Soybean Value Chain in Nigeria, Isaac Boateng (2012).

Local production of soybean has been increasing but continues to fall short of demand because of low yields and poor agronomic and postharvest practices (Boateng, 2012). Currently, imports of soybean and its derived products from neighboring countries as well as the U.S. and Argentina contribute less than 6% to the total supply. However, soybean demand is projected to increase to 2.3 million MT by 2020, because of a steady increase in poultry sector consumption (Figure 35). Although there are anecdotal reports of informal cross border soybean exports to other countries, there is no formal, organized trade, nor are there any publicly available records.

Figure 35: **Projected soybean demand in Nigeria.**



The growth in the poultry and vegetable oil industries, coupled with the growth in aquaculture and fish feed are projected to increase domestic demand to 2.3 million MT by 2020.



Source: Sahel Capital Analysis, 2014*;* Federal Ministry of Agriculture and Rural Development – ATA.

IMPROVED VARIETIES

Between 1983 and 2014, 22 improved soybean varieties were released in Nigeria. However, only seven varieties—TGX 1835-10E, TGX 1904-6F, TGX 1987-10F, TGX 1987-62F, TGX 1951-3F, NCRISOY 1 (TGX 1988-5F), and NCRISOY 2 (TGX 1989-19F) —have been released since 2008. These newer varieties have low shattering qualities and are resistant to rust disease, a significant issue that accounts for ~40% of soybean loss in Nigeria. Despite these benefits, farmers' adoption of the new soybean varieties has lagged due to an insufficient number and coverage of demonstration field trials. Instead, older, less productive varieties continue to be popular among smallholder farmers, such as TGX-1448-2E, a variety released in 1992.

Table 14: **Key soybean varieties.**

Variety Name	Developing Institute	Characteristics	Yield Pot. (MT/Ha)	Agro-ecological Zones	Year of Rel.	Year of Reg.
TGX-1448-2E	IITA, NCRI	Shattering and frog eye leaf resistant			1992	1996
TGx 1835-10E	IITA, NCRI	Early maturing, high promiscuous nodulation, highly resistant to rust, cercospora leaf spot and bacterial pustule	1.5-2.0		2008	2008
TGx 1904-6F	IITA, NCRI	Medium maturing, high promiscuous nodulation, high % nitrogen derived from atmosphere, high fodder yield and resistant to lodging, cercospora leaf spot and bacterial pustule	1.5-2.0	Forest Transition/Derived Savanna and Northern Guinea Savanna	2008	2008
TGx 1987-10F	IITA, NCRI	Early maturing, high promiscuous, highly resistant to rust, cercospora leaf spot and bacterial pustule	1.5-2.0	Forest Transition/Derived Savanna and Northern Guinea Savanna	2010	2010
TGx 1987-62F	IITA, NCRI	Early maturing, high promiscuous nodulation, highly resistant to rust, cercospora leaf spot and bacterial pustule	2.1	Forest Transition/Derived Savanna and Northern Guinea Savanna	2010	2010
TGx 1951-3F	IITA, NCRI	Low shattering, tolerant to rust, cercospora leaf spot and bacterial pustule and poor soils	2.5	Guinea and Sudan Savanna	2014	2014
NCRISOY 1	IITA, NCRI	Extral early maturing, promiscuous nodulation, resistant to rust, cercospora leaf spot and bacteria pustule.	2.5	Guinea and Sudan Savanna	2014	2014
NCRISOY 2	IITA, NCRI	High yield, promiscuous nodulation, resistant to rust, cercospora leaf spot	3.0	Guinea and Sudan Savanna	2014	2014

Source: Variety Release Catalogue, National Center for Genetic Resources and Biotechnology (NACGRAB), Nigeria.

STRUCTURE OF THE EGS VALUE CHAIN

The soybean formal seed sector represents an estimated 20% of national planted area, with the informal seed sector playing a larger role through farmer-saved seed or seed obtained from neighboring farmers (Figure 36). Both the public (i.e., the NARIs, universities) and private (i.e., seed companies) sectors are involved in the formal system. Current EGS demand is estimated to be well above supply, due to several supply capacity bottlenecks that will be further explained in the following section.

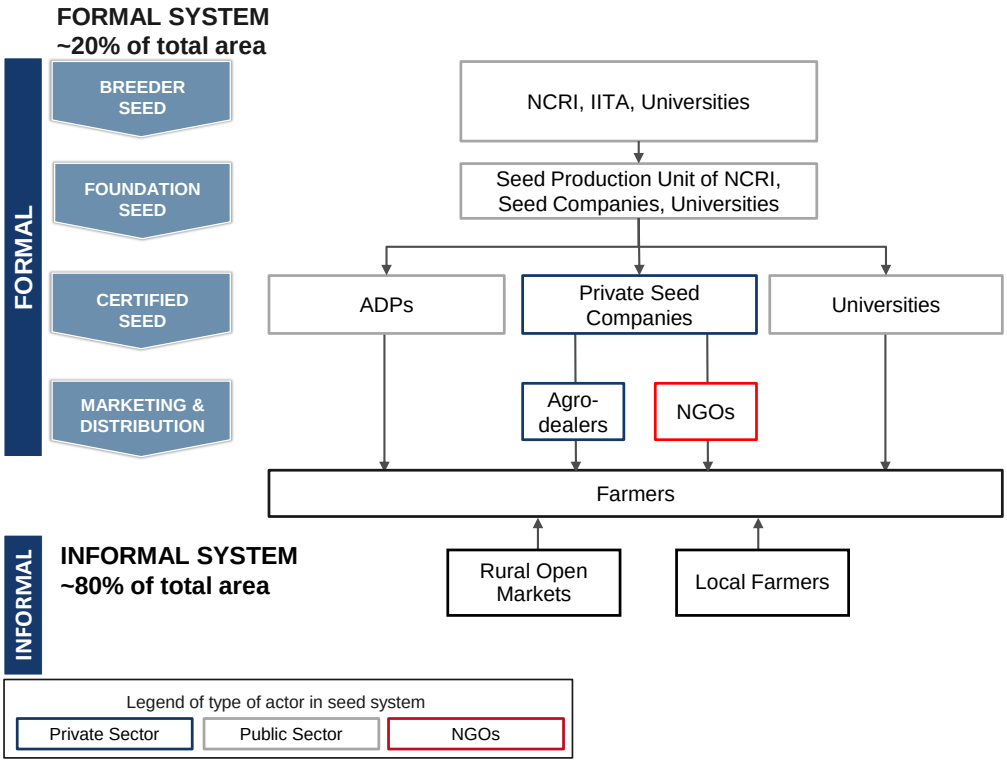
FORMAL SYSTEM

NCRI is responsible for genetic improvement, varietal maintenance, and breeder seed production of soybean in Nigeria. With support from NASC and IITA, NCRI has access to national, regional, and international gene banks for the development of new varieties. The National Crop Variety Registration and Release Committee under NASC is responsible for the evaluation, release, and withdrawal of varieties.

NASC is responsible for the supervision, certification, and licensing of private seed companies that produce foundation seeds. Due to the low technical capacity of many private seed companies, the bulk of soybean foundation seed is currently produced by the seed production unit of NCRI, with additional production coming from IITA.

The private sector dominates certified seed production. In 2014, 16 private seed companies produced 1,234 MT of certified seeds on 1,015 Ha, representing 95% of total certified seed production. The bulk of certified seeds produced is marketed and distributed by agro-dealers and the producing seed companies, while ADPs and NGOs also distribute certified seeds under community seed intervention programs.

***Figure 36*: Structure of soybean seed systems.**



Source: Expert analysis (2016).

INFORMAL SYSTEM

The informal market plays a large and important role in soybean, representing about 80% of planted area, i.e. including farmer-saved seed, trading seed with neighbors, local food markets, and seed traders.

Some farmers obtain seeds from agro-dealers and seed companies for initial planting and then save a portion of their harvested grain to plant in the next season. Farmers will repeat this practice for several years to minimize purchasing new seed and thus reduce their operating costs. However, this practice increases the incidence of disease over time as well as declining yields. Farmers cannot re-use their own seed indefinitely and must eventually replenish through the aforementioned means.

KEY EGS SYSTEM BOTTLENECKS AND CONSTRAINTS

There are several soybean EGS supply bottlenecks and demand constraints explained below.

Supply bottlenecks

- **Lack of funding for breeder seed production:** Due to inadequate funds for public breeding institutes, breeders cannot produce enough EGS to meet the demands of seed multiplication companies.
- **Limited private sector capabilities to produce foundation seed:** Although a few large-scale seed companies such as Premier Seeds, Maslaha, and Nagari Seeds produce soybean foundation seed, most private seed companies lack the technical know-how to produce foundation seed.

- **Lack of capacity in the certification system:** NASC does not have enough qualified personnel to effectively carry out certification in EGS and certified seed production systems. Field interviews in Kano State revealed that only two NASC officials are assigned to four seed companies.

Demand constraints

- **Farmers' lack of awareness of the benefits of improved varieties:** Some farmers, particularly in northern states, do not see the same need to plant improved soybean varieties as they do with maize. Farmers continue to grow varieties, such as TGX-1448-2E, that have high susceptibility to rust, despite the release of improved, rust-resistant varieties, because the extension system is not reaching enough farmers.
- **Presence of counterfeit seed:** A number of community-based seed sellers fraudulently package grains in the brand name of established seed companies. These counterfeit products reduce confidence in the EGS system, as farmers who believe they have previously bought "certified seed" but obtained dismal yields are reluctant to purchase it again.

3.6 RECENT DEVELOPMENTS

West Africa Agricultural Productivity Program (WAAPP)

WAAPP is a World Bank-funded program instituted in 2014 that aims to increase the overall supply of EGS by making breeder and foundation seeds more readily available. WAAPP contracts mandated NARIs in Nigeria to produce breeder and foundation seed of rice, maize, and sorghum for sale to private seed companies with a 40% price support.

WAAPP-Nigeria selected eight crops, including maize, rice, sorghum, cassava, wheat, cocoa, cotton, and yam. To date, the program has partnered with mandate NARIs to produce and distribute breeder and foundation seeds of three crops: rice, maize, and sorghum.

WAAPP-Nigeria has established partnerships with some NARIs to develop a platform for producing seeds of specific crops and varieties. It has also extended this partnership to private seed companies for seed multiplication. Since 2012, WAAPP has supported four NARIs including IAR, IAR&T, NCRI, and NRCRI to produce breeder and foundation seeds. About 22 MT of maize breeder seed, 84 MT of maize foundation seed, 34 MT of sorghum breeder seed, 16 MT of sorghum foundation seed, 17 MT of rice breeder seed, and 113.75 MT of rice foundation seed have been produced. WAAPP-Nigeria also partnered with private seed companies to produce 436 MT of certified rice seed, 432.5 MT of certified maize seed, and 135 MT of certified sorghum seed. In addition, 12,400 bundles of cassava and some quantities of seed yam were also produced (WAAPP Nigeria, 2016).

West African Seed Program (WASP)

Funded by USAID, WASP started in 2012 and runs through 2017, with 17 countries participating in the program. It was initiated in Nigeria through USAID's regional partner, the West and Central African Council for Agricultural Research and Development. WASP aims to increase the production of quality-improved certified seeds in West Africa's seed supply from 12% to 25% by 2017 by facilitating strong links between public and private sector stakeholders. It also focuses on increasing the coordinating capacity of regional seed networks, including national seed associations.

WASP program components include:

- The creation of a regional-level alliance of seed sector actors to interact and exchange best approaches to strengthen the seed sector;
- The establishment and support of networks of plant breeders, quality controllers, certification personnel, and West African members of the African Seed Trade Association;
- The effective implementation of a regional seed policy to create a harmonized environment to facilitate seed trade among ECOWAS member states;
- The production of sufficient quantities of quality-improved seeds to meet breeders' demand to expand certified seed production;
- The development of a strong West African private sector to ensure the supply of certified seeds of standard quality;
- The capacity building of the National Seed Trade Association, so it can play its role as a seed industry leader.

AGRA's Program for Africa's Seed Systems (AGRA-PASS) – Initiatives in the Nigerian Private Seed Industry

In 2008 AGRA-PASS began providing support to help Nigerian seed companies become more responsive to smallholder demand by introducing better hybrids, investing in the production of quality seeds, and packaging in small packs that are delivered to smallholder farmers by village shops or agro-dealers.

To date, the following seed companies have received grants and technical support in Nigeria: Manoma Seeds (Funtua, Katsina State); Jirkur Farmer Association (Biu, Borno State); Share Foundation (Isheyin, Oyo State); Seed Project (Kano, Kano State); Da All Green Seeds (Kaduna, Kaduna State); Maslaha Seeds (Gusau, Zamfara State); Value Seeds (Kano, Kano State); and Maina Seeds (Kano, Kano State). Grants are typically a one-time investment, although AGRA has recently made exceptional second grants to Maslaha Seeds and IITA in order to increase foundation seed production.

Other seed companies including Premier Seeds (Zaria, Kaduna State); Techni Seeds (Kano State); Savannah Seeds (Jos, Plateau State); and Notore Seeds (Lagos State) have benefited from AGRA's technical and business development services facilities, in the following ways:

- **Grant funds**: The grant is a two-year fund designed to help startups increase seed production capacity, increase farmer awareness, and establish mechanisms for seed dissemination through a network of agro-dealers.
- **Loan (and equity) facility**: Fast-growing companies are linked to the West African Agricultural Investment Fund, an AGRA facility managed by Injaro, a private investment firm. This credit facility complements the GES scheme developed by the FGN.
- **Linkage with breeders**: Since seed companies in Nigeria do not have research capability, AGRA encourages them to partner with public breeding institutions such as IAR (Zaria), IAR&T (Ibadan), and IITA (Ibadan) to obtain new and higher yielding hybrids for their activities. Some of the breeders were supported by AGRA to develop more adapted germplasm by taking farmers' preferences into consideration and to speed up their release.

- **Classroom training**: AGRA introduced the Seed Enterprise Management Institute, which is housed at the University of Nairobi, Kenya, and all Nigerian seed companies were sponsored to participate in the institute's annual series of short courses covering seed production, i.e. processing, business management, marketing, and quality assurance.
- **Business development services**: AGRA assembled a team of experienced seed experts to visit farms, warehouses, staff, and out growers in Jos, Kaduna, Zaria, Kano, Funtua, and Gusau. They provided on-farm support to seed companies in areas including seed production and processing, business management and marketing, and financial management.
- **Practical support**, such as manuals on production research and plots at the sites of two private seed companies (Manoma Seeds and Maslaha Seeds), and an equipment catalog including the identification of adapted seed processing equipment that suits the requirements and conditions of companies in Sub-Saharan Africa. At least six sets of equipment were acquired by Nigerian seed companies and are operational without any major breakdown.
- **Embedded technical assistance**: AGRA-PASS acknowledged the need for day-to-day assistance for some companies to improve seed production. Seed specialists were attached to startup seed companies such as Seed Project, Maina Seeds, Value Seeds, and Techi Seeds for two seasons to enable them to evaluate hybrids, increase parental seeds, and start hybrid seed production.
- **Learning trips**: Nigerian seed companies were part of groups led by AGRA to look at alternatives in the seed systems of Malawi and India, as well as in a foundation seed learning trip at the University of Illinois-Champaign in the U.S.
- **Improved access to foundation seeds**: The issues of accessing quality foundation seeds of public varieties was approached by AGRA in two ways. First, FMARD was made aware of the poor quality of foundation seed produced under the monopoly of NASC, which has since been dismantled. Second, AGRA is funding IITA and a private seed company (Maslaha Seeds) to implement foundation seed projects whereby each institution will supply adequate quantities of the seed and provide training and coaching to new seed companies (AGRA-PASS Team).

Anchor Borrowers Program

The Anchor Borrowers Program was conceived by the CBN to achieve a strong and viable agricultural base with integrated value chains, enhanced productivity, and reduced importation of food and agricultural raw materials.

Launched in late 2015, the program aims at creating linkages between smallholder farmers and large scale processors of agricultural produce to increase agricultural output and significantly improve capacity utilization of integrated mills. Value chains include rice and wheat in 14 states (Kebbi, Sokoto, Niger, Kaduna, Katsina, Jigawa, Kano, Zamfara, Adamawa, Plateau, Lagos, Ogun, Cross River, and Ebonyi). Stakeholders include financiers and insurance agencies (CBN, NIRSAL, Nigerian Agricultural Insurance Corporation, and commercial banks), state governments and ADPs, anchor processors, and farmer cooperatives and out growers.

The CBN is providing low-interest (9%) loans from the MSME Development Fund. These loans are administered through commercial banks who work with farmers through registered

cooperatives. NIRSAL is collaborating with ADPs to develop farmer cooperatives and provide technical assistance to farmers.

Currently, the program is being piloted in Kebbi State and is expected to empower at least 100,000 rice farmers; increase the processing capacity of Labana Rice Mills, a processor in the state; and increase the adoption and use of new, improved lowland rice varieties among farmers. The program is also expected to increase the total value of agricultural lending from 3.72% in 2014 to ~7% of total bank lending, and will be extended to more crop value chains including oil palm, cotton, and wheat in the next five years (Central Bank of Nigeria Website).

3.7 PROMISING MODELS

Babban Gona "Great Farm"

Babban Gona is a private, for profit agricultural franchise that provides smallholder farmers access to high-quality training, financial services, agricultural inputs, and marketing services to help them increase their yields and incomes. Developed by Doreo Partners, a Nigerian based impact investment firm, Babban Gona has received funding from donors including the BMGF, the Rockefeller Foundation, and DIFD. Doreo Partners and its non-profit arm Doreo Institute, provide investment options in the form of micro-investments for individual investors and larger scale opportunities for institutional investors. In targeted regions of the north, Babban Gona has successfully demonstrated the benefits of using new seeds of improved varieties every planting season to smallholder farmers growing maize. The program has also proven that farmers will buy unsubsidized inputs if they know they will have guaranteed access to markets for their produce.

Using an innovative model, Babban Gona provides members of its franchised farmer groups with the following four-fold services designed to increase farmer's yields and profits, as well as their access to markets:

- **Financial services**: Using an innovative approach to mitigate risks to members of the farmer groups, Babban Gona raises capital to finance members of its franchise.
- **Agricultural input services**: Babban Gona provides agricultural inputs to help farmers achieve optimal productivity and product quality, while minimizing negative environmental impacts. According to field interviews, each farmer in the group deposits ~$45 per Ha to qualify for improved seeds and fertilizers. A minimum of 20 Kg improved maize seed and 7 bags of fertilizer (5 bags of urea and 2 bags of diammonium phosphate – DAP) is provided to each farmer.
- **Training and development**: Training on good agricultural practices helps to ensure that farmers will adhere to production standards to achieve optimal yields.
- **Marketing services**: These services include access to good warehouses and profitable markets. Immediately after harvest, Babban Gona buys produce from farmers at 75% the estimated off-season (peak of the growing season during the rains) price. During off-season, Babban Gona sells the produce to premium buyers and pays the balance to farmers.

At the beginning of the production season, Babban Gona sets a minimum yield threshold of 2 MT for all farmers. After harvest, 2 MT is deducted from each farmer's yield and the current market price is determined. Babban Gona deducts the farmer's initial payment and pays the balance to the farmer. In addition, when the 2 MT is sold to large-scale processors at premium prices during the off season, the farmer receives additional payment beyond the

initial market price. 90% of the increase in profit is paid to farmers, while 10% goes to Babban Gona[9].

Youths make up approximately 50% of membership. In its first two years (2012-2014), about 12,600 smallholder farmers participated in Babban Gona, which continues to attract new members. Members report a 34% increase in income from the sale of maize, with yields averaging 6.9 MT/Ha compared to the national average of 1.4 MT/Ha. A member farmer in Kaduna State, North Central region, said he now understands the benefits of planting new maize seeds every planting season, but he still recycles soybean seed. This suggests that similar initiatives across multiple value chains could change farmers' perceptions (Babban Gona website).

Syngenta Seed Program

Syngenta's program, which was executed between 2014 and 2015, also proved that with adequate demonstration trials and acquiring an understanding of benefits, farmers will buy unsubsidized improved seeds. The program focused on production and marketing of certified seed of improved lowland FARO 44 and FARO 52 long grain rice in Benue, Taraba, and Nasarawa States.

Syngenta procured foundation seeds of improved FARO 44 and FARO 52 rice from NCRI and multiplied using out growers to produce certified seeds. Through partnerships with state ADPs, the company selected lead farmers across the focus states for product demonstration. 10 Kg of Syngenta certified seed and other inputs, such as fertilizer and crop protection chemicals, were given to farmers to establish one-eighth of a hectare, while the farmer's variety was also planted for comparison. Farmers were trained on good agricultural practices to achieve optimal yields.

Results from demonstration trials revealed that an average yield of 10 MT of FARO 44 and FARO 52 rice was achieved with Syngenta's seed, while farmers' seed produced only 2 MT. This result convinced farmers to purchase Syngenta's seed (which cost N350 per Kg compared to N55 per Kg conventional seed from the open market). The program reached more than 30,000 farmers (Field interviews, 2016).

[9] Field interviews revealed that 10% of increase in profit belongs to the franchise.

CHAPTER 4: ECONOMIC ANALYSIS

4.1 POTENTIAL EGS DEMAND

INTRODUCTION

A major step in identifying the optimal market archetype for a given crop is to determine the amount of EGS required for it. In order to guide the identification of these market archetypes, the team developed an EGS demand model for the four crops included in this study.

Given that official EGS supply and demand figures were difficult to obtain, the team conducted a series of interviews with key stakeholders to obtain information on current usage of EGS and identify demand constraints. Because much of the data obtained in interviews was informal (i.e., the reported usage and determinants of usage were based on the interviewee's experience and view of the system rather than formal records), the team attempted to triangulate data through interviews with several individuals about a given crop and in several links of the value chain.

The information and data obtained during field interviews was used to formulate assumptions that informed models about the potential demand for EGS. To account for the lack of precision and accuracy in the data underlying the assumptions, the team modelled cases and sensitivities to estimate not only the magnitude of potential demand but the impact of the key variables within the model on demand. The three cases developed include:

- **Current EGS supply:** Current level of supply in the market.
- **Potential EGS demand - base case:** All EGS-specific recommendations are implemented, with other market impediments assumed to remain in place.
- **Potential EGS demand - best case:** All EGS-specific recommendations are implemented, with other value chain and policy constraints addressed (e.g., non-EGS policy changes, agricultural education, agronomic best practices, etc.).

The potential EGS demand cases are based on a five- to seven-year timeline for implementation of recommendations. These models are not seed production plans or detailed bottom-up evaluations of demand but rather, a high-level analysis to illustrate optimal market archetypes.

RICE

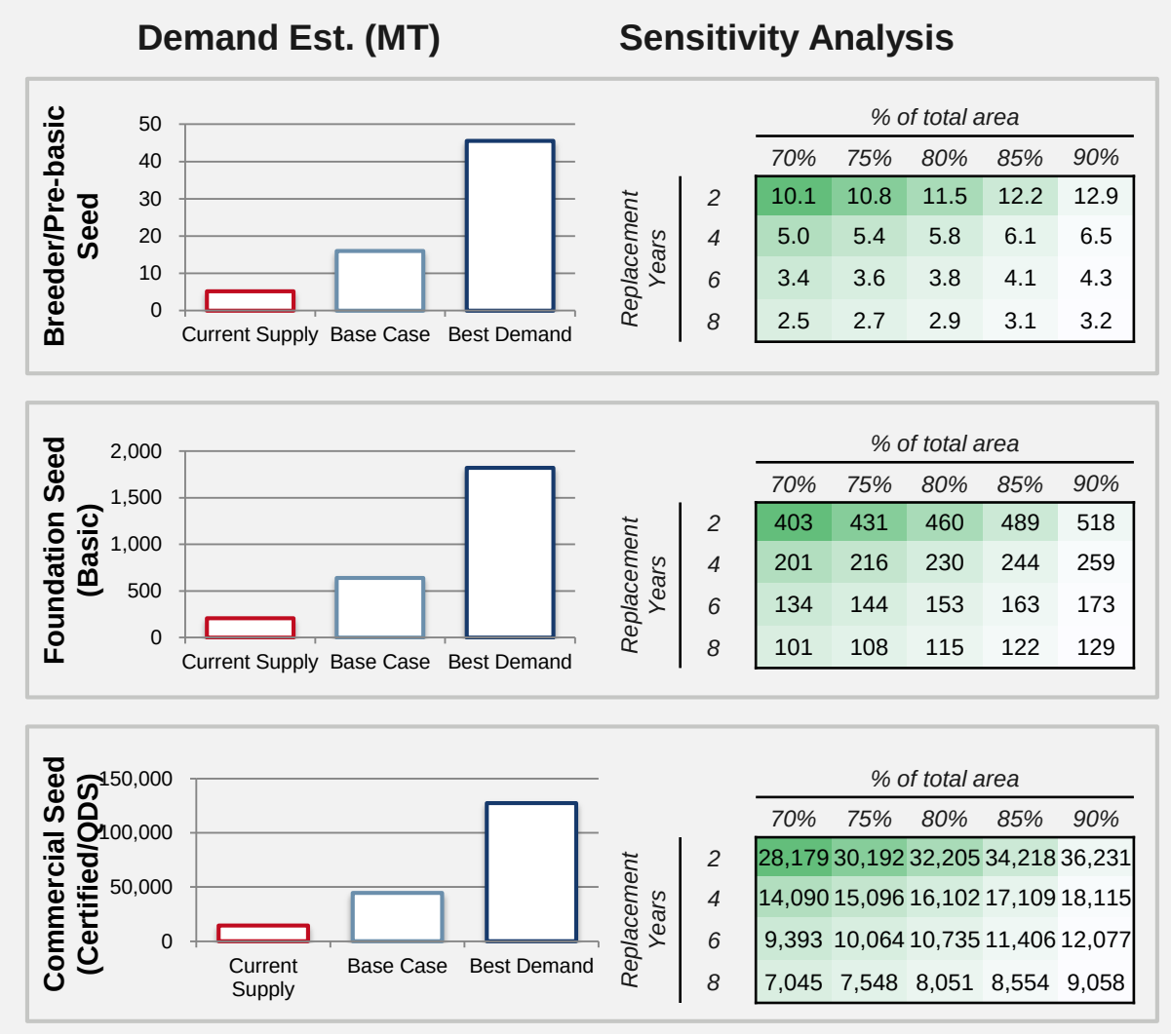
Lowland rice varieties are planted on approximately 72% of the total rice planted area in Nigeria. This is due to high demand from processors for high-quality long grain rice, as well as the government's focus on agricultural transformation programs for lowland rice varieties. Given that officials have limited data on supply and demand of EGS, model assumptions are based on figures from NAERLS, NASC, and interviews with other stakeholders including private seed companies.

Estimates for replacement rates and non-adopter rates vary widely and the assumptions used to build the base case and best potential demand estimates were conservative (Figure 37). Therefore, the current breeder seed supply of lowland rice is estimated at 2.16 MT, which would imply a foundation seed supply of 86.26 MT and certified seed supply of 6,038 MT. These amounts could supply about 55% of farmers, assuming they purchase seed from

the formal system every eight years. In addition, the model assumed that with increasing support and demand for lowland rice in Nigeria, the estimated percentage of upland rice acreage would decline over time, as indicated in the base case and best case for upland rice.

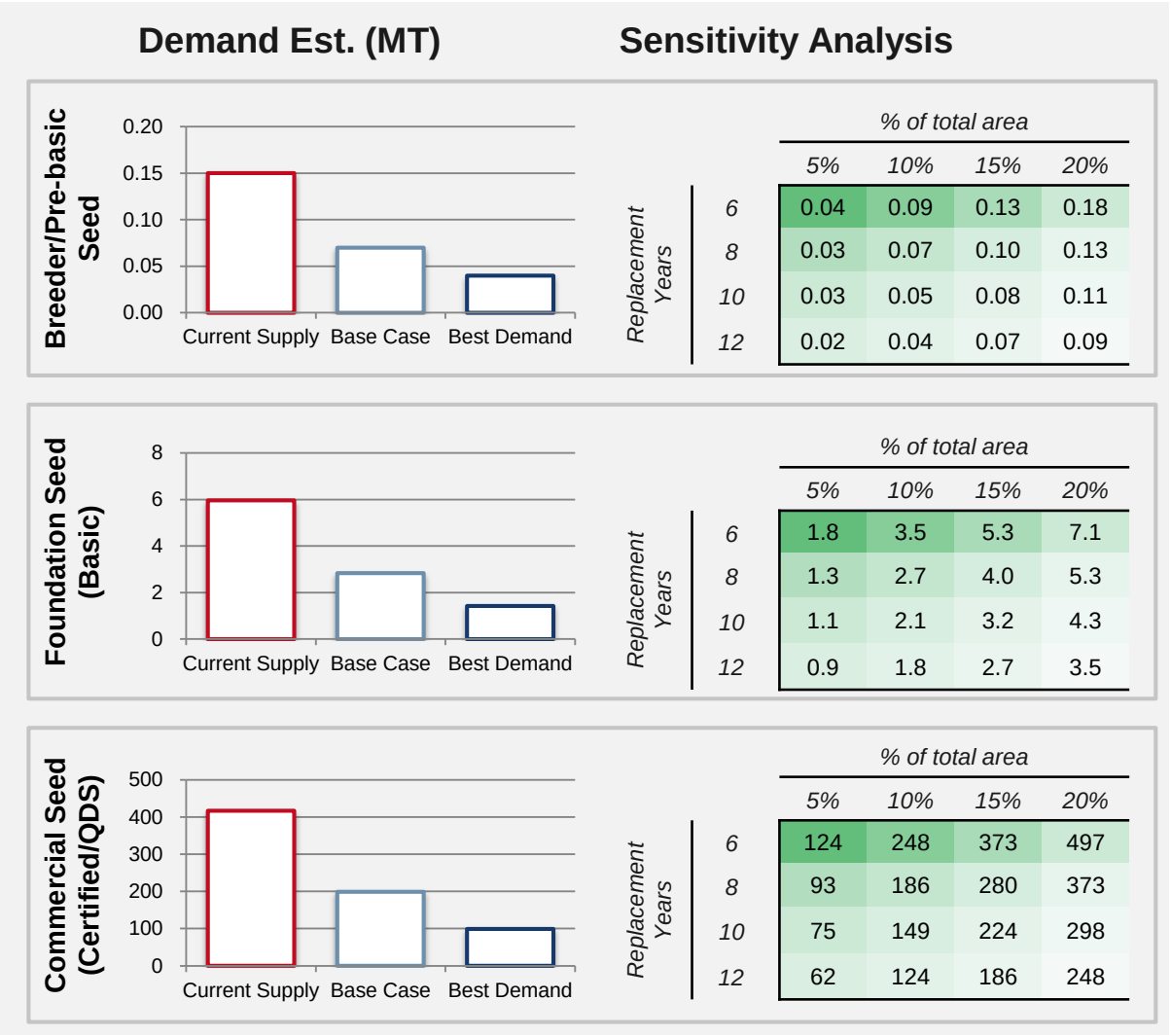
As mentioned earlier, farmers tend to obtain their seeds from the informal system or through government-sponsored seed intervention programs for certified seed. With FGN's keen interest in increasing rice supply to reduce import competition, it will be important to create an enabling environment for integrated processors to operate at full capacity. Increased farmer education by processors, seed companies, and NASC through demonstration trials will increase awareness and result in a reduction in lowland rice seed replacement rates by half in the base case and a quarter in the best case. In addition, there will be significant improvements in adoption rates in the next five years, which will require three times the current EGS supply in the base case and roughly ten times the current supply in the best case.

Figure 37: **Lowland rice – potential EGS demand.**



Source: Field research team interviews (2016).

Figure 38: **Upland rice – potential EGS demand.**



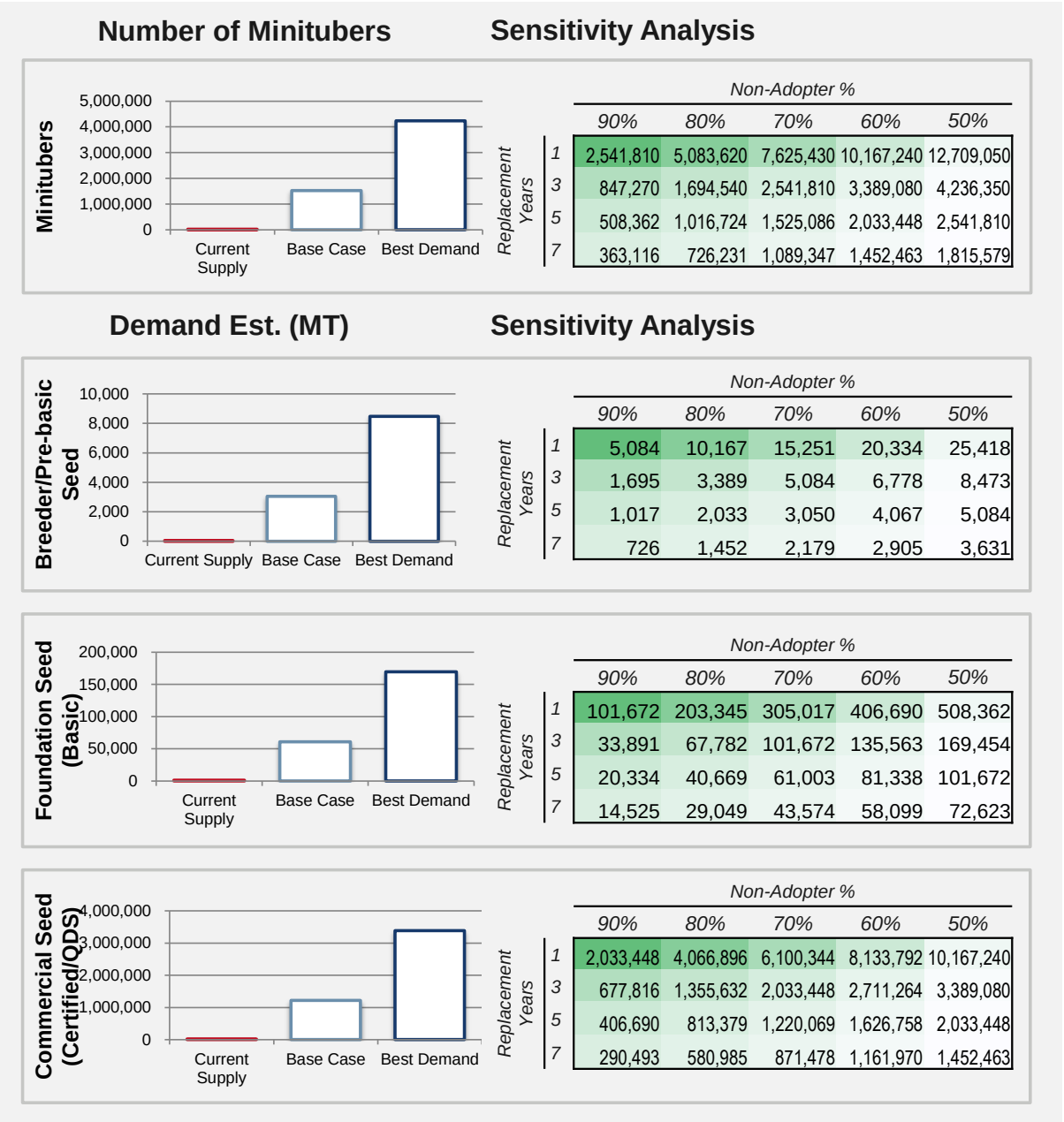
Source: Field research team interviews (2016).

YAM

The formal seed system for yam in Nigeria is currently transitioning between older seed production techniques and emerging seed production technologies. Traditional techniques produce seed yam using 25-100g yam minisett to increase seed multiplication rates, while the emerging seed yam production technology utilizes TIBs and aeroponics to significantly increase the multiplication rate and produce clean, disease-free seed yam from *in vitro* plantlets.

Scaling up yam EGS to reach a significant number of farmers through the traditional techniques is unlikely to be a sustainable approach due to high costs. The emerging multiplication model pioneered in the YIIFSWA project provides the most compelling opportunity for scaling up yam EGS. To date, the technologies associated with the YIIFSWA model are yielding promising results, but due to the early stages of testing, robust data sets on multiplication rates are not available. Aside from IITA and NRCRI, which are mainly focused on research, only Biocrops Biotechnology Limited currently has a bioreactor laboratory and aeroponics capabilities for commercial seed production in Nigeria. Based on interviews with stakeholders involved in the YIIFSWA project, potential demand was modelled and is displayed below in Figure 39.

Figure 39: **Yam – potential EGS demand**

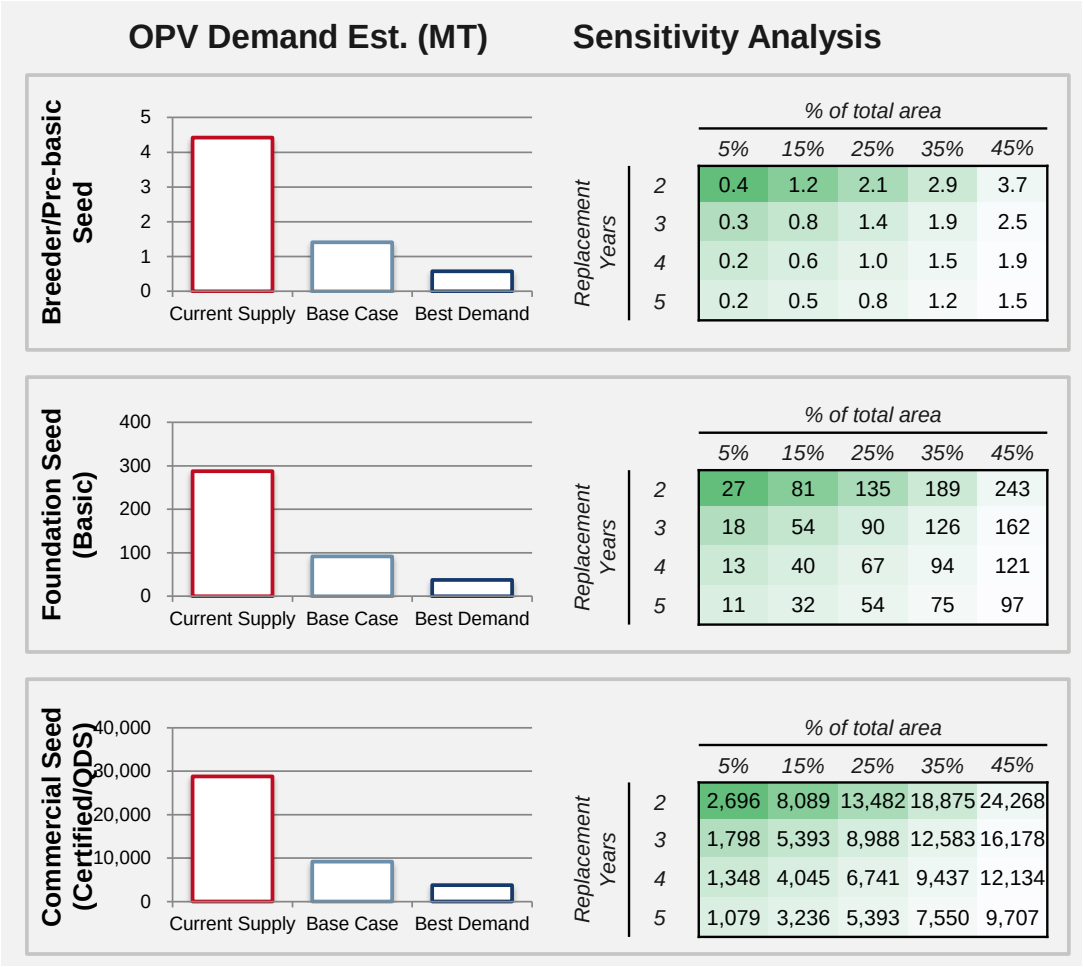


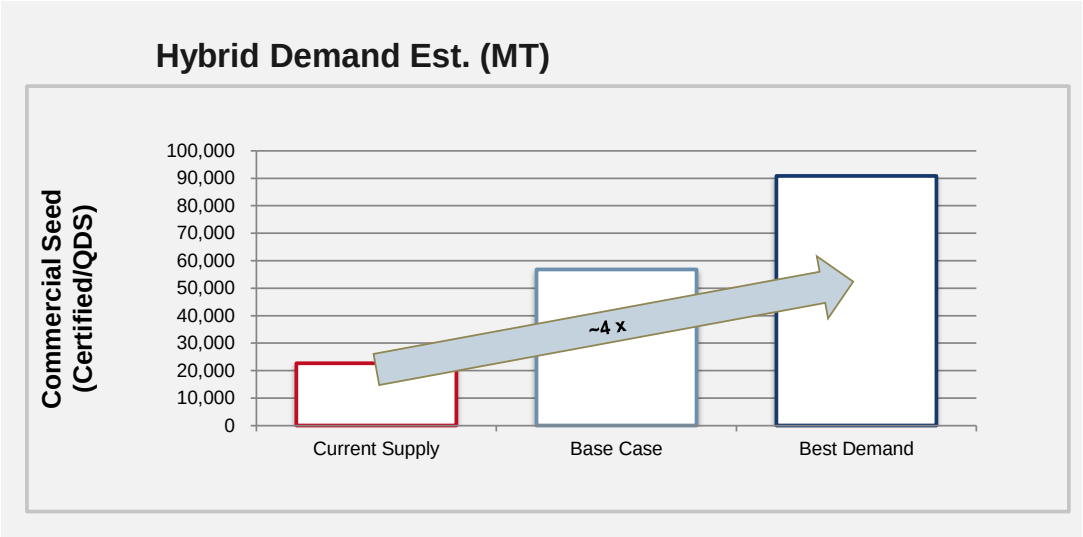
Source: Field research team interviews (2016).

MAIZE

There are two key sub-segments of maize in this study, OPV and hybrid. OPV will likely decrease from its estimated 80% of current supply because of the projected increase in the production of hybrids and the growing awareness among farmers about hybrids, the introduction of locally produced hybrid varieties adapted to forest ecologies, and the expansion of the hybrid seed market by foreign seed companies. These factors are expected to cause a gradual decline in demand for OPV EGS, eventually reaching approximately 20% of total area planted (Figure 40). Conversely, hybrid maize seed demand is estimated to increase to 80% of total area planted in the best case. As more OPV maize farmers shift to hybrid production in the next five to seven years, current non-adopters of improved seeds may first adopt improved OPV maize seeds and the percentage of non-adopters will reduce by more than half the current rate.

Figure 40: **OPV and hybrid maize – potential EGS demand.**





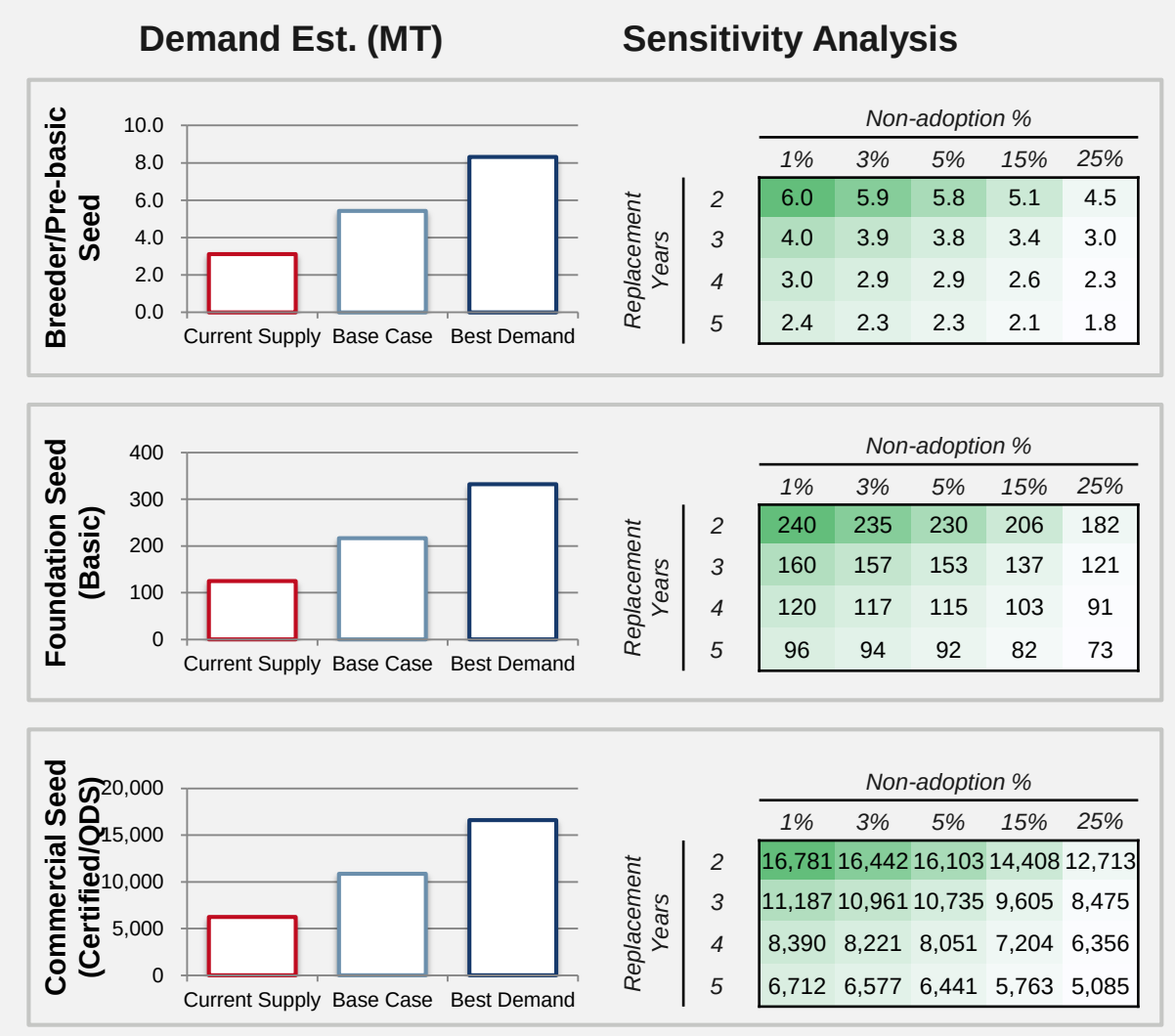
Source: Field research team interviews (2016).

SOYBEAN

Although adoption rates of improved soybean varieties are high in Nigeria, at approximately 92% according to figures from NASC, there is low demand for newly released varieties because farmers have not been made aware of these varieties' benefits through demonstration trials or other agricultural education efforts. Many farmers still grow TGX

1448-2E, an improved but rust-susceptible variety, rather than newer rust-resistant varieties. In spite of the varied seed replacement rates, estimated EGS demand is expected to nearly double in the base case and almost triple in the best case (Figure 41). This scenario is plausible if the agricultural community is better educated about improved soybean varieties through on-farm demonstrations and field days to promote adoption, as well as private sector-led awareness education on the nutritional importance of soybean.

Figure 41: **Soybean – potential for EGS demand.**



Source: Field research team interviews (2016).

4.2 PRODUCTION COST OF EGS

INTRODUCTION

The cost of EGS production has a major impact on the optimal archetype for each crop, on the ability to take EGS to scale, and on the sustainability of the system. Understanding the cost is critical to developing a realistic and achievable plan for increasing the supply of EGS.

For this study, cost models were built using very limited data from official sources and obtaining best estimates of production costs through interviews with NARIs and private seed companies. Accordingly, the study team primarily focused on the variable costs of production. This analysis is not a full costing of production costs, as factors such as start-up costs, infrastructure, depreciation of fixed assets, the cost of unapproved varieties, testing, and other early-stage investments were not included.

The tables below provide a directional view of production cost levels for each crop. It is important to note that breeder seed is not a profit center, and the actual cost of producing breeder seed is trivial compared to the cost of the R&D activities that led to the variety being produced. If there is an interest in making the research and variety development programs whose end product is breeder seed financially self-sustainable, that would be a distinctly different question and should be addressed separately.

Currently in Nigeria, the NARIs that are responsible for breeder seed production are funded by the government through general agriculture funding to FMARD. In many instances, the NARIs are also engaged in producing foundation seeds because seed companies do not have the technical capacities to do so. In these instances, the institutes must register as private seed enterprises in order to collect the profits to fund foundation seed production activities.

RICE

As a government priority crop that receives a lot of interest from private sector and donor organizations alike, rice boasts EGS production costs that are the lowest among all crops analyzed in this study (Table 15). This is the consequence of a high level of technical support and funding for research, as well as government and private sector focus in developing the rice sector.

Table 15: **Rice – EGS cost of production.**

	Breeder Seed	Assumptions	Foundation Seed	Assumptions	Certified Seed	Assumptions
Demand MT	2.16		86.26		6,038	
Variable Cost $ per Ha	$2,900		$2,723		$711	*Highest cost allocated to harvesting at $126*
Fixed Cost $ per Ha	$1,110	*Breeder salaries $303*	$832	*Breeder salaries $303*	$328	*No lab equipment cost allocation*
Total Costs	$4,009		$3,556		$1,039	
Margin	$401	*10% base assumption*	$356	*10% base assumption*	$104	*10% base assumption*
Costs + Margin $ per Ha	$4,410		$3,911		$1,143	
Costs + Margin $ per Kg	$2.21	*2,000 Kg/Ha yield*	$1.12	*3,500 Kg/Ha yield*	$0.29	*4,000 Kg/Ha yield*

Source: Field research team interviews (2016).

YAM

EGS production costs for yam are the highest of all crops in this study, mainly because of the low multiplication rate of seed yam. As data for costs of the rapid multiplication technologies utilized in the YIIFSWA project are not yet available, costs were calculated based on the current multiplication process being used. It will be critical to monitor the progress of the YIIFSWA production costs over time to compared with current production costs and, thereby, gauge the profitability potential. The comparison will (or will not) attract broader private sector interest.

Table 16: **Yam – EGS cost of production.**

	Breeder Seed	Assumptions	Foundation Seed	Assumptions	Certified Seed	Assumptions
Demand MT	537		5,368		53,683	
Variable Cost $ per Ha	$2,934	*Driven by cost of procuring seed yam at ~52%*	$4,109	*Driven by cost of procuring seed yam at ~49%*	$3,572	
Fixed Cost $ per Ha	$16,611	*Breeder salaries at >40%*	$10,594	*Mainly driven by breeder salaries*	$2,405	
Total Costs	$19,545		$14,702		$5,977	
Margin	$1,954	*10% base assumption*	$1,470	*10% base assumption*	$598	*10% base assumption*
Costs + Margin $ per Ha	$21,499		$16,173		$6,575	
Costs + Margin $ per Kg	$1.34	*16,000 Kg/Ha yield*	$1.01	*16,000 Kg/Ha yield*	$0.41	*16,000 Kg/Ha yield*

Source: Field research team interviews (2016).

OPV MAIZE

Other than rice, OPV EGS production costs are lower than other crops in this study because the cost of labor is lower than other crops. Compared to hybrid maize EGS production, OPV requires less frequent field monitoring. Given that hybrid maize will gradually replace OPV, resources used for producing OPV seed could be reallocated by NARIs and seed companies to hybrids.

Table 17: **OPV maize – EGS cost of production.**

	Breeder Seed	Assumptions	Foundation Seed	Assumptions	Certified Seed	Assumptions
Demand MT	4.42		287.62		28,762	
Variable Cost $ per Ha	$1,601		$754		$704	*Drop from foundation seed stage is attributed to lower labour cost*
Fixed Cost $ per Ha	$5,749	*Breeder Salaries is ~70%*	$813	*Breeder salaries is >90%*	$67	*No breeder salaries and equipment cost allocation*
Total Costs	$7,351		$1,568		$772	
Margin	$735	*10% base assumption*	$157	*10% base assumption*	$77	*10% base assumption*
Costs + Margin $ per Ha	$8,086		$1,724		$849	
Costs + Margin $ per Kg	$6.22	*1,300 Kg/Ha yield*	$0.86	*2,000 Kg/Ha yield*	$0.21	*4,000 Kg/Ha yield*

Source: Field research team interviews (2016).

HYBRID MAIZE

Production costs of hybrid maize EGS are higher than OPV costs, because of the higher cost of labor, as well as the frequency of testing, field visits, and plot observation. However, higher yields, as compared to OPV, make up for high costs of production, particularly at the foundation seed stage. It is critical that fixed and variable costs are reduced to improve the profitability of hybrid maize.

Table 18: **Hybrid maize – EGS cost of production.**

	Breeder Seed	Assumptions	Foundation Seed	Assumptions	Certified Seed	Assumptions
Demand MT	2.56		227.06		22,706.48	
Variable Cost $ per Ha	$4,763	*Labour cost is ~27%*	$1,268		$1,138	*Drop from foundation seed stage is attributed to lower labour cost*
Fixed Cost $ per Ha	$5,749	*Breeder Salaries is ~70%*	$870	*Breeder salaries is ~87%*	$429	*No equipment cost allocation*
Total Costs	$10,512		$2,138		$1,566	
Margin	$1,051	*10% base assumption*	$214	*10% base assumption*	$157	*10% base assumption*
Costs + Margin $ per Ha	$11,564		$2,352		$1,723	
Costs + Margin $ per Kg	$7.71	*1,500 Kg/Ha yield*	$0.78	*3,000 Kg/Ha yield*	$0.25	*7,000 Kg/Ha yield*

Source: Field research team interviews (2016).

SOYBEAN

Soybean EGS production costs are slightly higher than those of rice and OPV maize because of high labor costs and more intensive in-field management. However, the EGS production cost per Kg improves at each stage in the production process, resulting from higher yields.

Table 19: **Soybean – EGS cost of production.**

	Breeder Seed	Assumptions	Foundation Seed	Assumptions	Certified Seed	Assumptions
Demand MT	3.12		124.75		6,238	
Variable Cost $ per Ha	$2,636	*Labour cost is ~48%*	$2,714		$771	
Fixed Cost $ per Ha	$5,164	*Breeder salaries is ~73%*	$1,021	*Driven by breeder salaries at >90%*	$1,084	*Proceeds of outgrowers is >80%*
Total Costs	$7,801		$3,735		$1,856	
Margin	$780	*10% base assumption*	$373	*10% base assumption*	$186	*10% base assumption*
Costs + Margin $ per Ha	$8,581		$4,108		$2,041	
Costs + Margin $ per Kg	$4.29	*2000 Kg/Ha yield*	$1.64	*2,500 Kg/Ha yield*	$0.68	*3,000 Kg/Ha yield*

Source: Field research team interviews (2016).

4.3 EGS MATCHED WITH REVENUE/COST

The key takeaway from matching revenues with costs of the selected crops in this study is that rice, maize, and soybean are more commercially attractive crops than yam (Table 20). However, yam may be profitable with the introduction of technologies with high-multiplication ratio that will lower costs, as well as the introduction of favorable export policies that will create demand for quality yam varieties in the processing sector.

While it is expected that breeder seed in all crops is unprofitable, rice and soybean appear to be profitable at the breeder seed stage because the NARIs engaged in producing those seeds have introduced a commercial element into its production and distribution by selling to foundation seed producers.

Hybrid maize profitability is currently low across all levels. This is because hybrid maize EGS production cost is high, and current seed prices do not fully offset those high production costs. However, given that the current OPV maize market will be gradually replaced with hybrids, seed producers should be able to increase seed prices if they can adequately demonstrate the benefits of hybrid seed to farmers.

In general, profitability levels are very low across all assessed crops, and this is probably because seed prices are not aligned with the value of improved varieties. Tables 21, 22, 23, and 24 provide summaries of the four crops in terms of the marginal economic value of improved varieties compared to the demand of improved varieties, which helps to determine their optimal market archetype classification in the next chapter.

Table 20: **EGS matched with revenue/cost.**

BREEDER SEED							
Crop	Price / Kg	Cost + Margin / Kg	Seed Rate (Kg/Ha)	Demand (MT)	Total Revenue (Ha)	Total Cost (Ha)	Contribution (Ha)
Rice	$5.04	$2.21	50	5.2	$252	$110	$142
Soybean	$5.04	$4.29	50	3.1	$252	$215	$38
OPV Maize	$1.51	$6.22	20	4.4	$30	$124	($94)
Yam Existing	$1.26	$1.34	1,600	813.4	$2,017	$2,150	($133)
Yam Emerging	$1.13	$1.26	4,000	508.4	$4,539	$5,052	($513)
Hybrid Maize	$2.52	$11.56	20	1.0	$50	$231	($181)
FOUNDATION SEED							
Crop	Price / Kg	Cost + Margin / Kg	Seed Rate (Kg/Ha)	Demand (MT)	Total Revenue (Ha)	Total Cost (Ha)	Contribution (Ha)
Rice	$1.21	$1.12	50	207.0	$61	$56	$5
Soybean	$1.26	$1.64	50	124.8	$63	$82	($19)
OPV Maize	$1.17	$0.86	20	287.6	$23	$17	$6
Yam Existing	$0.95	$1.01	1,600	8,133.8	$1,513	$1,617	($104)
Yam Emerging	$0.85	$0.79	4,000	10,167.2	$3,404	$3,167	$237
Hybrid Maize	$1.26	$0.78	20	151.38	$25	$16	$10
CERTIFIED SEED							
Crop	Price / Kg	Cost + Margin / Kg	Seed Rate (Kg/Ha)	Demand (MT)	Total Revenue (Ha)	Total Cost (Ha)	Contribution (Ha)
Rice	$1.26	$0.29	50	14,492.2	$63	$14	$49
Soybean	$1.26	$0.68	50	6,237.7	$63	$34	$29
OPV Maize	$1.01	$0.21	20	28,761.5	$20	$4	$16
Yam Existing	$0.25	$0.41	1,600	81,337.9	$400	$657	($257)
Yam Emerging	$0.23	$0.11	4,000	203,344.8	$900	$454	$446
Hybrid Maize	$1.26	$0.25	20	22,706.48	$25	$5	$20

Source: Field research team interviews (2016)

Table 21: **Summary of rice assessment.**

Rice	Assess-ment	Comments
MARGINAL ECONOMIC VALUE OF IMPROVED VARIETIES		
Differential performance of improved varieties	**High**	Improved varieties have been widely adopted by farmers which has propelled the release of new, preferred long grain varieties in recent years.
Frequency of seed replacement	**Low**	Replacement rate is still very low, which impacts yields, but farmers unaware due to lack of agriculture education generally and demonstration trials in particular.
Differentiating characteristics	**Med./High**	The growth of integrated rice processing mills has increased the demand for lowland varieties.
Fragility of seed	**Low**	Hard seed coat of paddy enables and encourages long storage.
Cost of quality seed production	**Low/Med.**	Low fixed and variable costs reduce overall production costs of quality seed.
Overall Value of Improved Varieties	**Med./High**	**Marginal economic value of improved varieties is medium to high as the cost of production is low and pricing opportunity is relatively high.**
MARKET DEMAND FOR QUALITY SEED OF IMPROVED VARIETIES		
Total demand for seed	**High**	Real seed demand is generally high, but demonstration of importance of replacing seed could further increase growth.
Requirement for quality assurance	**Med.**	Quality assurance important but not as critical compared to hybrids.
Farmer demand for specific varieties	**High**	Despite the availability of several improved varieties, the majority of growers prefer long grain, lowland FARO 44, FARO 52 and FARO 57.
Market demand for specific varieties	**High**	There is a clear preference for long grain parboiled rice, and a limited market for local rice. However, the growing number and dispersion of processing plants will foster the demand for lowland rice.
Overall Demand for Quality Seed	**High**	**Current high demand can further grow with increasing local processing.**

Source: Research team analysis (2016).

Table 22: **Summary of yam assessment.**

Yam	Assess-ment	Comments
MARGINAL ECONOMIC VALUE OF IMPROVED VARIETIES		
Differential performance of improved varieties	**Low**	While improved varieties have recently been released, adoption is very low as farmers are skeptical that new varieties are better than landraces.
Frequency of seed replacement	**Low**	High disease pressure and low yields motivates farmers to buy seeds from the informal market due to unavailability of a functioning formal system.
Differentiating characteristics	**High**	Consumer markets and processors have distinct varietal preferences. Quality seeds of preferred varieties are sold at a premium price.
Fragility of seed	**Med.**	Most durable in storage among roots & tubers (can store for up to 6 months under shed), but less durable when compared with grains.
Cost of quality seed production	**Med./High**	Low multiplication rates and high seed rate translates into high labor cost in traditional system; high multiplication technologies are costly.
Overall Value of Improved Varieties	**Low/Med.**	**Marginal value of improved varieties is limited by the high cost of seed production and transportation, and the lack of technology adoption to lower costs.**
MARKET DEMAND FOR QUALITY SEED OF IMPROVED VARIETIES		
Total demand for seed	**Low**	Despite the largest area in the world, real demand for quality seed of improved varieties is currently very low as farmers mostly recycle their seed.
Requirement for quality assurance	**High**	Quality assurance important to ensure seed is pure and disease free.
Farmer demand for specific varieties	**Low**	While farmers have high preference for specific varieties such as Abuja, Ada Onitsha, Amula, Pepa in the informal system, the effective demand for released varieties is very low.
Market demand for specific varieties	**Low**	Traders and processors are not aware of the presence of improved varieties as landraces are dominating the market.
Overall Demand for Quality Seed	**Low**	**Demand can increase with the development of a formal system that combines the production of clean improved seed through the use of high multiplication technologies with intensified on-farm demonstration of the benefits of improved varieties versus landraces**

Source: Research team analysis (2016).

Table 23: **Summary of hybrid maize assessment.**

Hybrid Maize	Assess-ment	Comments
MARGINAL ECONOMIC VALUE OF IMPROVED VARIETIES		
Differential performance of improved varieties	**High**	*Hybrid yield performance significantly better than OPVs especially in the North where they are mostly grown.*
Frequency of seed replacement	**High**	Hybrid seeds are purchased every year due to high rates of yield degeneration compared to OPVs.
Differentiating characteristics	**High**	Hybrids produce higher yields and commands high sales prices compared to OPVs.
Fragility of seed	**N/A**	Hybrid seeds must be purchase every season due to rapid yield degeneration.
Cost of quality seed production	**High**	Requires intensive management and a high level of expertise to ensure quality.
Overall Value of Improved Varieties	**High**	**Although marginal economic value is high, there is a need to reduce cost and capture more value through price premiums to processors demanding higher quality production.**
MARKET DEMAND FOR QUALITY SEED OF IMPROVED VARIETIES		
Total demand for seed	**Low/Med.**	Hybrid maize is predominantly grown in the North; however, only ~20% of farmers are currently growing hybrids due to high cost of inputs to optimize production.
Requirement for quality assurance	**High**	High certification standards required to ensure high seed purity and quality.
Farmer demand for specific varieties	**High**	Variety selection is driven by need for adaptation to different agro-ecologies.
Market demand for specific varieties	**Low**	End users and processors demand for either yellow or white maize depending on end use purpose, but cannot distinguish between hybrids and OPVs.
Overall Demand for Quality Seed	**Med.**	**Demand for hybrids is currently hampered by low adaptation to forest ecologies, high cost of hybrid seed versus OPVs, and high input requirement to unlock yield potential.**

Source: Research team analysis (2016).

Table 24: **Summary of soybean assessment.**

Soybean	Assess-ment	Comments
MARGINAL ECONOMIC VALUE OF IMPROVED VARIETIES		
Differential performance of improved varieties	**Low/Med.**	Several improved varieties that are rust resistant have been released, but farmer interviews revealed the adoption of these varieties is low because farmers are unaware of them and their benefits.
Frequency of seed replacement	**Low**	Farmers plant saved seed for about five years to reduce production costs.
Differentiating characteristics	**Low**	Although differentiating characteristics such as color and oil to kernel ratio exist, these characteristics do not currently command higher prices if quality levels are achieved.
Fragility of seed	**Low**	Seed is only produced for a period of one year or growing season, so seed fragility is not a problem.
Cost of quality seed production	**High**	High production costs due to high fixed and variable costs.
Overall Value of Improved Varieties	**Low/Med.**	**Marginal economic value of improved varieties low to medium due to high production costs and differential characteristics do not command a premium price.**
MARKET DEMAND FOR QUALITY SEED OF IMPROVED VARIETIES		
Total demand for seed	**High**	Real seed demand is generally high, but widespread demonstration of yield benefits would spur demand.
Requirement for quality assurance	**Low/Med.**	Quality assurance is important but it is not as critical as with hybrids.
Farmer demand for specific varieties	**Low**	Although many varieties have been released, farmers have limited choices because only TGX 1448-2E is readily available.
Market demand for specific varieties	**Med./High**	TGX 1448-2E is highly preferred due to its high oil content.
Overall Demand for Quality Seed	**Med.**	**Although demand is relatively high, more improved varieties, particularly rust resistant types, must be promoted to farmers through agricultural information campaigns and demonstrations trials.**

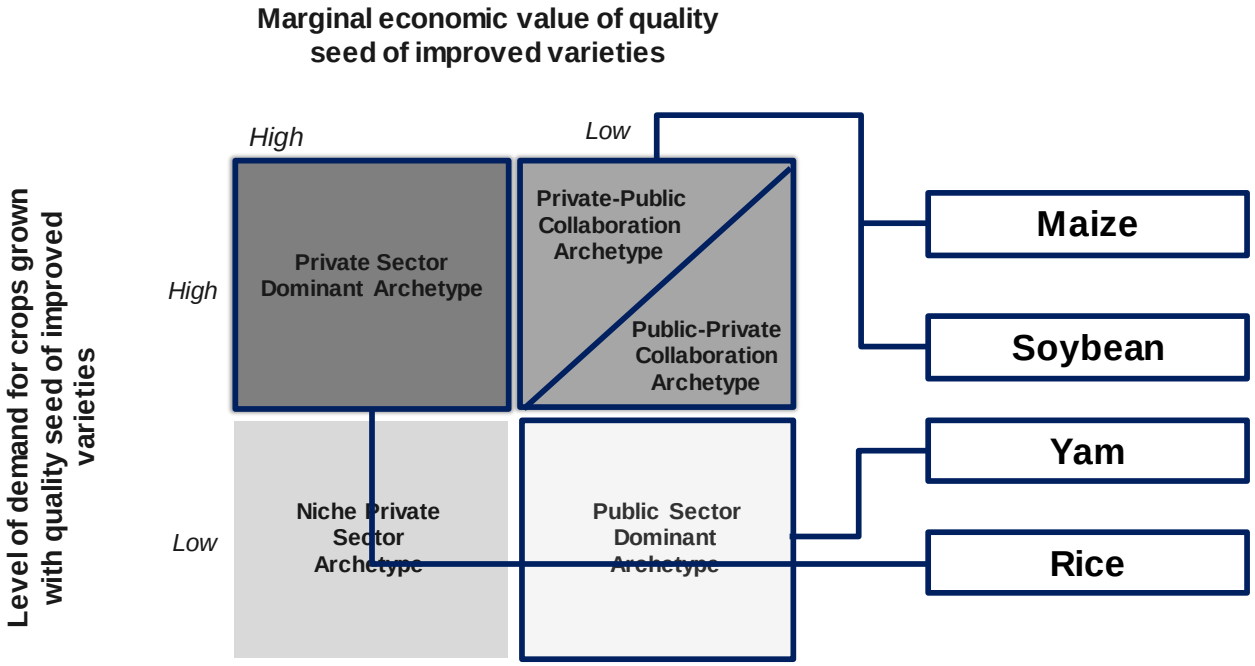
Source: Research team analysis (2016).

CHAPTER 5: EGS OPERATIONAL STRATEGIES

5.1 OPTIMAL MARKET ARCHETYPE

Rice, yam, hybrid maize, and soybean have been classified in specific market archetypes based upon the respective marginal economic value of quality of improved varieties and the level of demand for crops grown with quality seed of improved varieties.

Figure 42: **Optimal archetype classification.**



Source: Research team analysis (2016).

Rice: Private sector dominant archetype

- *Economic Value:* Marginal economic value of improved varieties is medium to high as the cost of production is low and the opportunity to increase seed prices is relatively high due to the processors greater willingness to pay for better quality production.
- *Demand:* Current high demand can increase further as growing numbers of local rice processors begin to rely on increased, reliable production of local rice.

Yam: Public sector dominant archetype

- *Economic Value:* The marginal economic value of improved varieties is low because of the absence of a formal market to supply high-quality seed yam and the lack of technology adoption to lower the costs of production. If emerging technologies from the YIIFSWA project are successful in decreasing production cost, there could be an opportunity to improve the economic value for yam seed production.
- *Demand*: Demand is currently low, but could increase with the development of a formal seed system that combines the production of clean, improved seed through high-

multiplication technologies with intensive agricultural education activities to inform farmers of the benefits of improved varieties versus landraces.

Hybrid Maize: Private-public collaboration archetype

- *Economic Value*: Although the potential for the marginal economic value of improved varieties is high, costs need to be reduced through a reduction in fixed and variable costs.
- *Demand*: Demand for hybrids is currently hampered by poor adaptation to the Humid Forest Ecology, the high cost of production versus OPVs, and the high collateral input requirements to unlock yield potential.

Soybean: Private-Public collaboration archetype

- *Economic Value:* Marginal economic value of improved varieties is medium to high, largely due to the low cost of production. However, economic value could increase if differential characteristics begin to command price premiums.
- *Demand:* Given that market demand is medium to high, many more improved varieties, particularly the rust-resistant types, must be promoted among farmer agricultural education efforts to increase the rate of adoption.

5.2 KEY CHALLENGES

In order to reach the identified optimal market archetypes for each respective crop, there are both crop-specific and cross-crop obstacles to overcome, which are outlined in Table 25.

Table 25: **Summary of key success factors and existing obstacles.**

	Ideal State	Current State				
	Key Factors	**Obstacles to Overcome**	**Rice**	**Yam**	**Hybrid Maize**	**Soybean**
Policy & Regulation	Fully funded national research and EGS production program	The NARIs and their seed production units lack funding to perform basic breeding and breeder seed production, including irrigation, and modern equipment.	✓	✓	✓	✓
	Established IP protection and enforcement	While there is a defined IP law in place, interviews suggest it is not being enforced.	✓	✓	✓	✓
	Clear and consistent import policies	Often-changing government policies regarding local production and import in the rice sector have created market uncertainty and discouraged private sector investment.	✓			
	Strict enforcement of counterfeit seed laws	There is a high prevalence of fake seed due to the lack of laws and enforcement mechanisms.	✓		✓	✓
	Simple and effective Quality Assurance system	A lengthy inspection and certification process extends commercialization timelines, increases costs, restricts supply of certified seed, and lacks clear documented standards.	✓		✓	✓
Technical & Mgmt. Capabilities	Strong national extension program	The extension program lacks sufficient funding at the state level to support farmer education programs.	✓	✓	✓	✓
	Adequate, trained staffing for certification and genetics labs	NASC lacks an adequate number of trained staff and infrastructure, which causes bottlenecks at the times of peak demand for certification. Failing to get certified also encourages fake seed sales.	✓	✓	✓	✓
Demand Creation & Market Linkages	High level of engagement with farmers to increase education	Extension services do not have the resources to implement programs and trials to increase adoption of improved varieties and educate farmers on agronomic best practices.	✓	✓	✓	✓
	Improved varieties adapted to perform in all key agro-ecological zones	A limited number of hybrids are adapted to Humid Forest Ecology			✓	
	Robust demonstration trial platform spurring grower adoption	Demonstration trials are constrained by seed availability, trained personnel, and number of plots.	✓	✓	✓	✓
	Accurate projections of annual demand for important varieties	There is no national system for collecting data on demand and sharing it with EGS producers to help them to plan and budget for annual production.	✓		✓	✓
Incentives & Access to Capital	Micro-financing loans available for farmers to afford high-quality inputs	Many farmers are unable to afford high-quality inputs needed to achieve the best yields and also need further education around best practices to utilize inputs correctly.	✓	✓	✓	✓
	Private sector incentives to invest in EGS infrastructure, personnel, and training	Private seed companies lack the business and technical know-how to operate profitably.	✓	✓	✓	✓
	Programs to increase adoption of equipment and mechanization	Farmers and agribusinesses lack the funds and credit to invest in high-quality equipment.	✓			

5.3 A PUBLIC-PRIVATE PARTNERSHIP MECHANISM AND OTHER SOLUTIONS

DEFINITION AND BACKGROUND

A PPP is commonly defined as a government service or private business venture that is operated and sometimes funded through a partnership between the public sector or government entity, private sector companies, NGOs, and other stakeholders. Accordingly, the public sector or government actor may provide support in a number of ways, including implementation of fiscal policy or the contribution of infrastructure or expert capabilities.

PPPs have increased in prevalence in recent decades, especially in the developing world. This has corresponded with the increase of private sector resources dedicated to developing countries. The Congressional Research Service notes that government development agencies such as USAID and the State Department are working with private sector entities in unprecedented ways to determine when and if such partnerships can lead to improved development results. As explained in the Obama Administration's 2010 Quadrennial Diplomacy and Development Review, "private sector partners can add value to our missions through their resources, their capacity to establish presence in places we cannot, through the technologies, networks, and contacts they can tap, and through their specialized expertise or knowledge." Modern PPPs, characterized by joint planning, joint contributions, and shared risk, are viewed by many development experts as an opportunity to leverage resources, mobilize industry expertise and networks, and bring fresh ideas to development projects. Partnering with the private sector is also widely believed to increase the likelihood that programs will continue after government aid has ended. From the private sector perspective, partnering with a government agency can bring development expertise and resources, access to government officials, credibility, and scale.

Among the benefits and disadvantages of PPPs are the following (IISD, 2011):

Potential Benefits

- Increased efficiency, expertise, and innovation from the private sector may contribute to better solutions and greater cost and time savings.
- Project risks are shared among the partners.
- Access to private sector finance allows increased investment.
- PPPs provide the private sector with access to reduced risk, secure, long-term investment opportunities that are in some sense sanctioned by the government.

Potential Disadvantages

- Accountability and transparency issues may be distorted under PPPs, as private sector financed components may fail to appear in public accounts and reports. Similarly, private sector data on profits, costs, or lessons learned may be considered commercially confidential, which makes objective evaluation more difficult.
- The inclusion of exclusivity agreements within PPP contracts can have the effect of awarding monopoly markets to private partners.
- Both public and private sector actors must provide PPP-specific capacity for implementation to be successful.

There are examples of successful PPPs within many sectors. An example from the Congressional Research Service of the Malawi Dairy Association Development Alliance is summarized in Table 24 below. Its objective was to build the capacity of small dairy farmers,

local milk processing plants, and farmer-owned milk bulking programs in order to improve production and profitability. The partners collaborated on improving the entire dairy value chain and included a loan program that enabled farmers to purchase new heifers and to improve feed and cattle health; loan guarantee programs for local milk-processing facilities; and training in improved milk bulking practices. The PPP provided rural dairy farmers, feed producers, and small and medium-size dairy processing facilities with the resources and tools needed for a successful dairy industry.

Table 26: **Partners, contributions, and motivations for Malawi dairy PPP.**

Partner	Contribution	Motivation
Land O'Lakes	Technical expertise, significant experience in Malawi, introduction of new cattle breeds	National visibility, social responsibility
Local milk producers/dairies	Investments in new practices and technology, capital for farmer loan programs	Higher, more predictable income
General Mills	Financing	National visibility, social responsibility
Monsanto	Soybean seeds and technical assistance. The mature beans are used for cattle feed	National visibility, social responsibility
USAID	Technical advice, financing, partner and alliance coordination	Economic growth
Government of Malawi	Extension agents that worked in the value chain, assistance with animal importation, assistance with processing paperwork quickly	Economic growth

Source: Congressional Research Service (2013).

RATIONALE

Building well-developed and sustainable EGS systems is very much in Nigeria's national interest. The most common problem facing the EGS systems in Nigeria is insufficient financial and technical support from the government to the NARIs, as well as low the Government's failure to adequately promote improved seeds to farmers. Supply and demand issues also affect the availability, quality, and best practices necessary to produce and deliver EGS. To resolve these problems, significant human, technical and financial resources need to be deployed. A key objective of the FGN's ATA is increasing adoption of improved varieties, but investments will be necessary to build well-developed and sustainable EGS systems.

Two of the four crops analyzed in this study—maize and soybean—would benefit from having a PPP aimed at improving their current EGS systems. Due to the similarities in the end use segments of animal feed and actors involved in soybean and maize, an EGS-PPP focused on both crops is recommended. Following the successful creation and implementation of an EGS-PPP for maize and soybean, the government would be able to redirect resources away from EGS production to further develop the national research program as well as to strengthen certification and extension services. These programs would help to ensure a sustainable supply of improved varieties for Nigerian farmers in the future.

An effective EGS-PPP would potentially eliminate government responsibility for the production of EGS for certain crops, as private sector assumes a more prominent role. This would allow the NARIs and government to redirect their resources away from EGS production and focus more on

support for research and extension activities to ensure a steady supply of improved varieties and to enable farmers to realize the benefits of the improved varieties.

MECHANISMS AND SOLUTIONS

The EGS-PPP would need to accomplish three key purposes:

- Produce enough EGS to meet current and future demand.
- Produce seed at the lowest possible cost while continuing to meet quality standards.
- Stimulate demand for quality seed at the farm level.

Increase EGS quantity: The approach to increasing EGS production can be divided into two parts: the breeder seed mechanism and the foundation seed mechanism. For breeder seed production, there is a need for more personnel; in particular, MSc and PhD trained researchers will be needed. In order to increase breeding activities, NARIs will also need funding to upgrade their equipment and staff training. Funding opportunities can be explored through partnerships between the government and donor organizations. In addition, the government in collaboration with the CBN could consider dedicating a special fund exclusively for varietal development and seed production.

Foundation seed production is currently done by private seed companies and the NARIs. Going forward, responsibility for foundation seed production should be vested in private seed companies, thereby allowing the NARIs to focus on breeder seed production, and existing seed companies to focus on certified seed production.

Lower production costs: Currently, foundation seed production is the responsibility of private seed companies. However, the majority of domestic seed companies do not have the technical know-how and capabilities to produce foundation seeds, leaving it instead to the NARIs to produce and sell to seed companies. The current EGS system in Nigeria is hampered by high labor costs for production, which includes breeders' salaries. In order to make the EGS production economically viable, NARIs could partner with IITA to access finished hybrid lines, which the seed units within the NARIs could multiply and also use in producing single-cross females. This could be accomplished primarily by personnel trained at the MSc level, rather than PhD-level breeders, thus reducing production costs by streamlining the number of breeders required to produce inbred lines and carry out testing. In addition, domestic seed companies could partner with the NARIs to obtain breeder seed, which they would multiply into foundation seed and subsequently, certified seed.

Improve quality standards: To ensure a strong quality assurance mechanism in the EGS-PPP, the technical capacity within NASC should be enhanced through training and hiring more personnel for field inspection and seed certification.

Stimulate demand for quality seed: Working collectively to stimulate demand for quality seed, participants within the EGS-PPP (i.e., large-scale processors, ADPs, NARIs, CGIAR organizations, and NGOs) could mount an improved seed awareness campaign by establishing on-farm demonstration trials using best agronomic practices to show the benefits of planting improved seeds. In addition, the EGS-PPP can play a central role in generating much-needed country-specific yield data on the value of planting improved versus saved seeds. The NARIs would play a key role in leading demonstration efforts and analyzing results for use by NGOs, ADPs, and seed companies.

OPERATING PRINCIPLES

The EGS-PPPs should be established under a legal structure that allows actors involved in the PPP to generate and retain their operating profits. One way to ensure the EGS-PPPs can meet their goals in the long term is to enable them to charge market prices for seed and use retained profits for continuing improvements to operations. This approach is preferable to tax expenditure approaches such as seed subsidies, PPP tax exemptions, etc., which could prove to be anti-competitive.

The NARI and university breeding programs would receive royalties on sales of EGS and potentially on the sales of certified or quality declared seed of varieties originating in their program. The basic concepts of the royalty program could be built into the formation documents, leaving specific royalty rates and terms to be determined on a case-by-case basis.

Private sector partners would expect to benefit financially from the operations of the EGS-PPPs. This could come in the form of royalties on sales of proprietary varieties or expanded market presence for private sector partners or a growing and assured supply of raw product for processing partners.

The EGS-PPPs should develop an effective system to forecast product demand. A major limitation of demand forecasting in the current seed system is the absence of real-time information on the specific varieties and quantities needed to meet market demands. The EGS-PPPs will be well placed to collect, analyze and disseminate demand information.

In addition to government agency buy-in, identifying and securing the right private sector partners is the crucial requirement for success. The Nigerian private seed sector is relatively well developed with respect to maize and can be a key private partner.

MAIZE AND SOYBEAN

Maize and soybean are two important crops in Nigeria with complementary end uses in food and animal feed. Poultry feed ration contains about 50-55% maize, which supplies carbohydrates, and 20% soybean[10], which supplies protein. The country's rapidly expanding poultry sector has led to increasing demand for both crops. Approximately 80-90% of maize is produced by smallholder farmers, with animal feed processors consuming up to 40-50%[11].

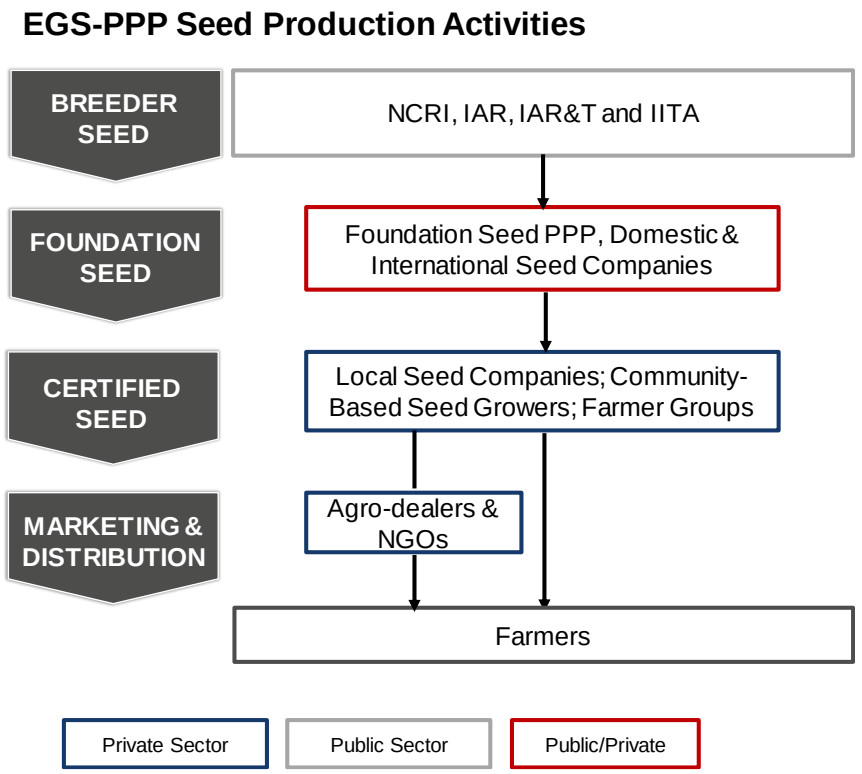
The common PPP for soybean and maize would need to involve crop-specific public partners, given that NCRI focuses on soybean, while IAR and IAR&T focus on maize. IITA has a mandate for both maize and soybean, and therefore, to achieve success in the PPP, all public partners—including NCRI, IAR, and IAR&T – should be involved for soybean and maize.

A PPP for maize and soybean markets would present an excellent opportunity to use germplasm from IITA to produce foundation seeds in adequate quantities for seed companies. Increased availability of foundation seed would allow seed companies to produce certified seeds of improved varieties that would in turn increase the supply of raw materials. To increase its market opportunity, the private companies within the PPP could also supply foundation seed to companies in neighboring countries. Since groundnut is an alternative source of protein in animal feed production, the PPP could potentially incorporate groundnut, which would create economies of scale and reduce production cost.

[10] Stakeholder interviews suggest that a few large-scale feed producers include up to 70% maize and 30% soybean in animal feed.
[11] Estimates include maize in feeding backyard poultry and production of feed for other livestock.

A unified PPP for maize and soybean would appeal to many private partners, given the crops' importance in food and feed processing. Apart from animal feed producers, a number of food processors, including Nestle, produce food and breakfast cereal that utilize both soybean and maize.

Figure 43: **Maize and soybean EGS-PPP seed production activities.**



Source: Research team analysis (2016).

Table 27: **Maize and soybean EGS-PPP potential stakeholder list.**

	Actors	Contribution	Motivation
Public	FMARD, NASC	Administrative support, quality assurance, financial support	Economic growth
	NCRI, IAR, IAR&T	Improved varieties, land for seed production, quality assurance know-how	Freed up resources, demand forecasting, increased revenue
	ADPs	Extension services, demonstration trial expertise	Improved smallholder livelihoods, economic growth
Private	Local and international seed companies, agro-dealers, farmer groups and associations	Land for seed production, marketing capabilities to generate demand, linkage with organized commercial growers, linkage to agro-processors, demonstration trial expertise	Access to improved varieties, business and technical training, increased revenue
	Agro-processors	Market information for processed products, consistent demand for premium products, export market linkages	Access to consistent and quality supply of improved raw materials such as soybean for oil and feed/food processing, and maize for poultry feed and cereal food production
	MFIs (private and NGOs), agricultural credit banks	Short-term loans or equity financing for smallholder farmer input purchases, and the PPP	Economic growth and high return on investment
NGOs	Babban Gona	Implementation expertise, partner coordination, technical advice, premium market linkage for smallholder farmers	Program benefits aligned with NGO objectives
CGIAR	IITA, HarvestPlus	Improved germplasm, high quality breeder seed, quality assurance know-how and expertise	Program benefits aligned with institutes' objectives

Source: Research team analysis (2016).

ESTABLISHING A MAIZE AND SOYBEAN EGS-PPP

In order to establish a successful EGS-PPP, it will be critical to employ an approach that resolves the complexities of partnering with a broad set of stakeholders. The Urban Land Institute outlined ten principles that might guide the development of a successful PPP. Although these principles were tailored to a proposed potato and common bean EGS-PPP in Rwanda, they provide guidelines for public and private sector actors involved in any PPP (Urban Land Institute, 2005).

1. **Prepare properly for a PPP**: The public sector would be led by the FMARD and NASC. Important national and international actors would include NARIs such as IAR and IAR&T; CGIARs such as IITA; HarvestPlus, IFPRI. It would likely be important for civil society to be represented by NGOs such as Babban Gona. Important private sector stakeholders would include seed companies (local and international), agro-dealers, farmers' groups, and cooperative representatives and key agro-processors. All of these stakeholders would need to participate in a series of meetings and interactions to jointly articulate goals, assess priorities and capabilities, identify real and potential obstacles (legislative, resource-based, etc.), develop timelines and expectations, establish feasibility, get to know the other partners, and establish the right team.
2. **Create a shared vision**: Within each PPP, the organizers would need to give all stakeholders and potential partners an opportunity to contribute to the vision, determine the best ways to sustain the vision through a detailed implementation strategy, selecting or incorporating specific partners, and a timeframe for achieving the vision.

3. **Understand the partners and key actors:** The FMARD, NASC, and ADPs should agree on the PPP's purpose, while private sector partners would provide technical know-how and funding.
4. **Be clear on the risks and rewards for all parties**: Each party needs to have a full understanding of the risks and rewards for their specific involvement.
5. **Establish a clear and rational decision-making process**: Partners need to develop a road map, define roles and responsibilities, and create appropriate checks and balances to ensure actions are taken in a timely manner and that every actor is accountable to the other actors for its performance.
6. **Make sure all parties do their homework**: Prior to entering into partnership agreements, all actors should complete their due diligence to their own level of satisfaction, ensure that information is shared openly and freely, adopt scenario planning, and pursue creative public/private financing plans.
7. **Secure consistent and coordinated leadership**: Selection of leaders should focus on qualities such as integrity, discernment, and awareness of the human spirit, courage, compassionate sense of humor, intellectual energy, and curiosity.
8. **Communicate early and often**: Both internal and external communication should clarify roles and responsibilities and ensure the PPP is transparent to all stakeholders. Communication will be critical to successfully align interests and to consistently share information across a diverse set of actors and organizations.
9. **Negotiate a fair deal structure**: General principles to reach a fair deal should include a detailed division of stakeholder responsibilities, agreement on outcomes, and objective performance measures.
10. **Build trust as a core value**: Building trust that endures throughout the partnership should be a priority for all stakeholders. As noted by the Urban Land Institute, "to endure, partnerships require a foundation of trust in each partner's commitment to the project and its objectives" (Urban Land Institute, 2005).

5.4 RECOMMENDATIONS

CROSS-CUTTING

Several EGS supply bottlenecks and demand constraints were common across all four crops assessed, and as such, the following recommendations are relevant for rice, yam, maize, and soybean.

Establish a National Seed Fund

The FMARD should support the establishment of a National Seed Fund focused on enabling Nigerian seed companies to produce and distribute new varieties of foundation and certified rice, maize, and soybean seeds and to actively promote these seeds in remote areas. The fund could be structured as a public entity in the form of a loan or challenge fund or matching grant to support qualified seed companies' specific targets in foundation and certified seed production and sales to farmers. Due to the high cost of production of foundation and certified seeds, private seed companies have generally focused on already established markets with popular varieties to reduce risk and realize quick returns. As a result, more remote agricultural areas have often been overlooked because of the high costs of farmer education and the limited number agro-dealers.

While many agriculture-related funds were outlined in Chapter 1, none is seed specific. Having a fund dedicated to supporting seed-related investment could help address many of the EGS

supply and demand issues identified in this study. In order to ensure the development of sustainable private sector seed businesses, FMARD should consider selecting a private sector fund manager to work closely with key stakeholders, including the Seed Council, the Agro-dealer Association, state governments, NIRSAL, and NSIA, as well as key private seed companies such as Premier Seed, Maslaha Seed, Da-Allgreen Seed, Maina Seed, Manoma Seed, and Samlak Seed.

Implement and enforce clear and strong IP policies

It is a common theme across all crops in Nigeria that research and EGS production is hampered by the low motivation of breeders due to the lack of strong IP policies and weak royalty sharing policies. By incentivizing breeders to develop and produce improved varieties, yields in Nigeria could improve and smallholder farmer incomes could increase.

NASC and FMARD should support the implementation of clear and strong IP policies that enable licensing agreements and support appropriate royalty sharing.[12] This would require a revision of sub-section 4.5.1 of the National Seed Policy on Control of Varieties and Varietal Ownership. In particular, a specific change to consider would be that any seed variety qualified for certification would be traced back to the institute that released it, so that royalties would be remitted before certification. The NARIs would need to work closely with NASC to share information with seed companies on licensed and released varieties to enable the enforcement of royalty payments.

Support the improvement of the quality assurance system

To ensure quality across all classes of seeds and increase the rate of adoption of improved seeds among farmers, FMARD and NASC would need to sponsor an initiative to 1) improve the quality assurance system and 2) implement a certification protocol for Quality Declared seeds in the informal system. A common problem in all crops is NASC's lack of sufficient personnel to certify fields. A significant increase in staff would be needed to have a minimally effective certification and Quality Declared system, i.e. a minimum of approximately 200 NASC-recruited field officers trained in modern seed certification methods. Furthermore, FMARD should publish new standards for the certification of informal sector-produced seeds and train about 2,000 community seed producers in selected states such as Kaduna, Kano, and Kebbi on best seed production practices.

Other stakeholders could help improve the quality assurance system by conducting in-house training workshops on seed certification best practices for recruited NASC field officers. These could include NGOs such as Catholic Relief Services and AGRA, CGIARs, the UK's FERA Science Limited, and regional organizations such as West and Central Africa Council for Agricultural Research and Development (CORAF/WECARD).

Suppress counterfeit seeds through the quick enactment of the New Seed Law

FMARD should work with the National House of Assembly to complete the review process, thereby accelerating the passage of the New Seed Law. According to interviews with NASC officials, there will likely be a third review, with a December 2016 target for signing of the law by the President. However, it will require the involvement of many stakeholders, including regional

[12] IP and plant variety protection policies should harmonize with West Africa standards from ECOWAS to include both the public and private sectors in royalty collection agreements.

policy development organizations such as AGRA and CORAF/WECARD to keep the review on track.

The new seed law will bring credibility to the seed system by placing more stringent and punitive sanctions on seed counterfeiters in both the formal and informal systems. Currently, fraudulent community-based seed sellers are packaging grains in the brand names of established seed companies, which erodes farmers' confidence in actual improved seeds and reduces the sales of registered seed companies.

FMARD and NASC could utilize tactics gleaned from other sectors that face similar kinds of fraud. For instance, the techniques used in tracking fake drugs in Nigeria could be adapted for tracking fake seeds, such as strict sanctions (e.g., more than two years' imprisonment and/or a N500,000 fine and licenses taken away from any seed company caught packaging and/or distributing uncertified seeds). NASC should also develop partnerships with media outlets to mount educational campaigns to raise public awareness about efforts to sanitize the Nigerian seed marketplace.

In addition, mobile text verification technology has been developed by mPedigree and Sproxit, both of which provide an SMS- or app-based verification service (called Mobile Product Authentication) to help consumers avoid purchasing counterfeit products. This technology is already in use by the National Agency for Food Drug Administration and Control, which ensures the quality of manufactured food, drugs, and other regulated products. This technology could be adapted to track authentic seeds, by requiring all accredited seed companies in Nigeria to register with mPedigree and/or Sproxit and by modifying bulk seed packaging in agro-sacks to polythene bags to accommodate PIN codes for checking quality.

These efforts would require partnerships between the seed companies, agro-dealers, and NASC. This recommendation could be implemented within a short-term time, given that the New Seed Law is under second review at the National Assembly.

MAIZE AND SOYBEAN

Establish a public - private partnership for maize and soybean

The PPP for maize and soybean is based on sharing similar objectives. These objectives include expanding and enhancing profitable EGS production capabilities to meet current and future demand, developing a cost-effective quality assurance system, and increasing farmer demand for improved, high-quality seed.

The PPP will require engagement of a broad set of private and public sector actors that span the maize and soybean value chains and include local and international private actors. FMARD, NASC, IITA, NCRI, IAR, and IAR&T will be crucial in executing the PPP and ensuring administrative hurdles are dealt with swiftly and effectively.

Domestic private seed companies will be crucial to the success of the PPP and must be strengthened to ensure best practices are shared. Additionally, international seed companies, including Syngenta and Monsanto, will be important partners. Processors of animal feed, complementary food, breakfast cereals, and vegetable oil will help in furthering the economic value of these crops. Furthermore, agro-dealers, farmer groups and associations, MFIs, and agribusiness fund providers should play major roles in the formation and design of the PPPs' operational procedures to ensure long-term economic sustainability.

All potential stakeholders will need to reach an agreement on structure, operational framework, final stakeholders, and roles. This initial group of stakeholders should include the widest range of possible actors to make sure all opinions are considered.

RICE

Rice demand is expected to remain high because of growing consumption, as evidenced by rising imports. Given the crop's appreciable marginal economical value, it should be attractive for full private sector participation. The priority objective for rice should be to stimulate sustainable private sector growth by removing policy barriers. These include inconsistent import policies and a lack of coherent government support for increasing local rice production and milling. The FGN should introduce clear policies such as creating input financing schemes for smallholder paddy growers, removing import tariffs on rice processing equipment and machinery for millers, and ensuring a strong border control system to enforce import duties. This would stimulate interest in local production and processing, and create a demand for improved seed. Also, as the reforms are implemented, the public sector could withdraw from producing foundation seed.

Establish a private processor-oriented rice seed system

Building on the Anchor Borrower's Program, the FGN should identify integrated rice processors who can partner with the NARIs and seed companies who would produce specific, high-yielding rice varieties for their out growers. Key rice processors such as Umza Rice, Miva Rice, and Labana Rice should be supported by the donors such as USAID to lead such a multi-stakeholder partnership. The objective of this would be to produce specific, high-yielding rice varieties that would ensure increased paddy production for local processing in key rice producing states, improve livelihoods of participating out growers, and lower Nigeria's dependency on rice imports.

The processor-oriented model can be used to execute on-farm demonstrations that show the yield benefits of using best agronomic practices with improved varieties compared with farmer-saved seeds. In order to finance smallholder farmers and out growers under this initiative, the government (through the Bank of Agriculture) should develop a purpose-built credit scheme to provide registered farmers with loans for quality inputs. This recommendation could motivate the Anchor Borrowers Program to enter other key rice producing states including Benue, Taraba, and Enugu. As previously mentioned in Chapter 3, low paddy production for local processing contributes to increasing brown rice imports by integrated processors, which not only limits processing capacities but also negatively impacts farmer incomes. Furthermore, the low quality of locally produced paddy increases the costs and decreases the efficiency of integrated rice processors.

Key stakeholders could include seed companies such as Premier, Maslaha, Da-Allgreen, Maina, Manoma, and Nagari Seeds, as well as State Ministries of Agriculture, ADPs, farmer cooperatives, associations, and MFIs. This would likely be a longer term recommendation because of the number of stakeholders and the need for integrated processors who are committed to buying paddy locally. Success is also highly dependent upon government policy to encourage the development of local rice production and processing and strong support for input financing for participating out growers.

YAM

Generally, the yam value chain in Nigeria is underdeveloped, receiving less attention from the government and development organizations. While it isn't exactly clear why this is the case, the lack of industrial opportunities as compared to cassava could be the reason why the FGN has not focused more on yam to date. Furthermore, while yam is an important crop in Nigeria, it is

not widely grown outside of Nigeria as compared to cassava. This could explain why donors have focused more on cassava as it is a key crop in many countries around the world.

Although the yam seed system currently falls under the public sector dominant archetype due to the low demand for higher yielding varieties and low economic value, it has the potential to be attractive to the private sector. The YIIFSWA program led by IITA has already formed a formal yam seed system through collaboration with private sector entities such as Biocrops Biotechnology Limited, a private laboratory committed to developing seed systems through the use of improved technologies, and other local seed companies. Once these technologies and business models are validated and demonstrate their value to the private sector, an EGS-PPP could be recommended. However, at this stage, recommendations should focus on establishing value chain linkages, demonstrating the benefits of adopting improved varieties at the farm level, and distribution of improved varieties.

Establish a strong National Yam Value Chain Association

IITA and NRCRI should lead the establishment of a strong National Yam Value Chain Association, with state chapters in four key production states (Oyo, Benue, Abia, and Niger), to increase collaboration and communication among stakeholders in the yam value chain in order to improve yields and create higher demand. The Association's efforts could result in much greater interest in a yam EGS system, and become a platform to advocate for government's support of the yam value chain.

Yam yields in Nigeria are very low, largely because seed yam quality in the informal system is poor, disease pressure is high, and farmers use limited amounts of fertilizer and crop protection. The development of a formal yam seed system is critical to improving yields, but it has lagged due to a lack of collaboration between the research community and processors, which has in turn discouraged farmers from investing in improved yam varieties.

The four selected state governments should establish commodity development committees under their Ministries of Agriculture that supports yam value chain actors to improve farmer access to inputs to improve yields, and to generate demand for high quality yam from processors and exporters. Meanwhile, processors should focus on innovations in new processed yam products by gleaning ideas from YIIFSWA's yam processing trials and from other countries such as Japan. Additionally, key actors in the yam value chain should develop a contact database of members and meet periodically to promote direct linkages among the research community and farmers and processors. The proposed association would also be well positioned to comprehensively address the critical issue of post-harvest loss, which spans the yam value chain.

In addition, IITA and NRCRI should work closely with stakeholders including state-based yam farmers' associations, yam processors and processor associations such as the National Association of Small and Medium Scale Enterprises (NASME) and National Association of Small Scale Industrialists (NASSI), state-based yam traders' associations, and the Nigerian Export Promotion Council (NEPC) to ensure strong communication and collaboration in the value chain.

Support the distribution of improved seed yam

NRCRI and IITA should support the distribution of improved seed yam by identifying and training community-based seed entrepreneurs in key production states such as Oyo, Benue, Niger, and Abia to promote farmers' adoption of new varieties of yam. Currently, seed yam distribution by public institutions such as NRCRI, RTEP, and ADPs has been unsuccessful on a large scale. Furthermore, government interventions to support seed yam multiplication and distribution have

been poorly funded, and the low seed multiplication rates of yam contributes to the high cost of seed yam production, making it an unattractive venture for private seed companies. New technologies such as temporary immersion bioreactors and aeroponics are costly, thus limiting their adoption by private seed companies.

However, some promising new distribution models are being developed and deployed, including the Sustainable Cassava Seed Systems (SCSS) project led by Catholic Relief Services and bio-fortified cassava stem distribution by HarvestPlus in Benue and Oyo states, both of which provide valuable learnings with respect to optimizing seed production models and implementing quality assurance systems. Additionally, YIIFSWA's high-ratio propagation technology for seed yam is an important opportunity to commercialize and facilitate partnerships with private seed companies.

In the short term (1-3 years), NRCRI and IITA should focus on effectively demonstrating benefits, and distribute improved seed yam to a minimum of 500 yam farmers in each of the focus states. Additionally, two foundation seed yam producing companies should be established (Green Gold, Romarey & Biocrops are already engaged with IITA's YIIFSWA program) to multiply breeder seed from IITA/NRCRI using aeroponics for foundation seed production by other seed companies. In the medium term (3-5 years), a minimum of 250 improved seed yam entrepreneurs in each focus state should be trained to accelerate the distribution of improved seed yam. In the long term, the sustainable production of yam foundation seed at reduced cost should be achieved. This recommendation will ensure adequate production of clean yam breeder seed by IITA/NRCRI, and subsequent multiplication into foundation and certified seeds by seed companies. This would increase the rate of production and multiplication of high-quality, disease-free seed yam for farmers.

MAIZE

The major barriers to the further development in hybrid maize are insufficient quantities of breeder seed, breaches in hybrid seed production agreements between seed companies and out-growers, and the limited availability of credit necessary for farmers to invest in higher cost hybrid seed and the necessary inputs to optimize yield.

A PPP focused on producing foundation seed from existing germplasm from IITA and the NARIs presents a great opportunity to develop a sustainable and economically attractive hybrid maize seed system. The PPP would supply foundation seeds to existing and emerging domestic and regional seed companies in Africa. Given the high cost of producing foundation seed of hybrid maize and soybean, as well as the complementarity of the two crops in the processing sector, the PPP would emphasize a foundation seed production system for hybrid maize, and include soybean to reduce the cost of production. This would bridge the sizeable supply-demand gap currently existing for both crops.

Accelerate the production and distribution of hybrids suited to the Humid Rain Forest agro-ecology zone

Currently, only a few hybrids adapted to the Humid Rain Forest agro-ecology zone are available, and the adoption rate remains low among farmers in key states such as Oyo, Ondo, Ogun, and Abia. IITA and IAR&T, in collaboration with the respective state governments, seed companies (e.g. Samlak and Nwabudo Seeds), the National Maize Farmers Association, state-based farmer associations such as Farmers Development Union (FADU), should support the production and distribution of adaptable hybrids such as Ife Maize hyb-5, Ife Maize hyb-6, Ife Maize hyb-8 and Ife Maize hyb-9.

This recommendation would require a robust farmer education program in the south on the benefits of existing hybrids. Farmers would need to work in close partnership with the maize farmers' association in order to generate the scale necessary to gain access to premium markets and processors.

SOYBEAN

The priority objective for soybean is to expand EGS production capacity to meet current and future demand through an EGS-PPP with maize. A strong EGS system would help resolve the significant local supply deficit stemming from increased demand in the poultry and aquaculture sectors, and position Nigeria to become self-sufficient in soybean production.

Increase the capability of NCRI substations

Currently, private companies that produce foundation and certified seed have difficulty in accessing soybean breeder seed material. FMARD should increase the breeder seed production capacity of established NCRI branches, which currently only have the seed volumes to conduct on-farm adaptive trials. In order to increase capacity, these branches require modern breeder seed multiplication technology as well as improved seed distribution processes to efficiently deliver seed to local seed companies.

This would likely take 3-5 years due to the intricacies of setting up breeder seed multiplication technology and recruiting and training state-based breeders.

Increase farmer and agro-dealer knowledge about the benefits of education of improved varieties

NCRI in collaboration with seed companies, ADPs, and initiatives such as USAID's MARKETS II should target farmer and agro-dealer education, extension support, and seed distribution support in Benue, Kaduna, Kano, and Taraba to introduce rust-resistant and low-shattering varieties. This collaboration will focus on agricultural education and develop communication strategies to reach farmers about improved varieties using demonstration trials, farmer field days, and the media. It would also include training extension agents to foster the distribution of improved varieties.

Most farmers currently grow the rust-susceptible TGX 1448-2E variety because they are unaware of rust-resistant varieties such as TGX 1951-3, NCRISOY 1 and NCRISOY 2. Educating farmers on the benefits of rust-resistant varieties is a "quick win" that could be implemented in a 1-2-year timeframe and could increase soybean output by 40%. It would require identifying existing soybean farmer groups, ensuring that sufficient quantities of rust-resistant varieties are produced and that there will be adequate resources from seed companies to advance farmer education efforts.

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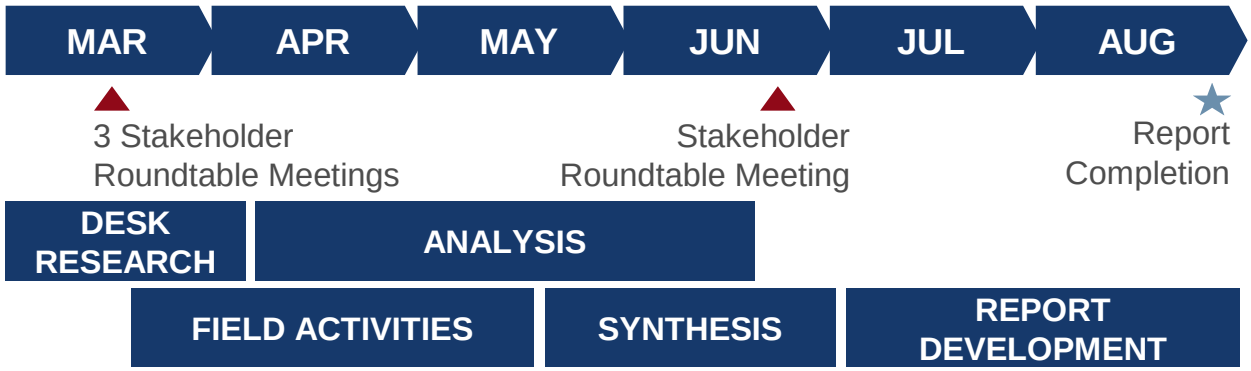
ANNEX A: STUDY TIMELINE



ANNEX B: FIELD RESEARCH TEAM

Nigeria Field Research Team

Sahel Capital: Ndidi Nwuneli, Temitope M. Adegoroye, Zika Ekenta

Field Consultants: Solomon Afuape, Shola Aribido, Millicent Lafe

Nigeria Stakeholders

USAID Nigeria: Melanie Edwards

FMARD, NARIs, NASC, ADPs, CGIARs, private seed companies, agro-dealers, NGOs, donors, associations, traders, processors, farmer groups, outgrowers

EGS Trainers & Advisors

Dave Westphal

Mark Walton

Project Management Team

Africa Lead/DAI: David Tardif-Douglin, Chuck Johnson
USAID: David Atwood, Mark Huisenga
Context: Mark Nelson, Rob Lowenthal, Dan Creagh

ANNEX C: STAKEHOLDER INTERVIEW LIST

NAME	ORGANIZATION	DESCRIPTION/ROLE
Public Sector		
Kabir Zaharadeen	NASC, Kano	Seed Certification Officer
Mohammed Ubandoma	NASC, Zaria, Kaduna State	Head, Regional Office
Dr Muyedeen Oyekunle	IAR, Ahmadu Bello University, Zaria, Kaduna State	Maize Breeder
Prof. Olakojo, S.A.	IAR&T, Ibadan	Maize Breeder
Benard Ehirim	NCRI, Baddegi, Niger State	Rice Breeder
Prof. L.L Bello	University of Agriculture, Makurdi, Benue	Soybean Seed Breeder & Director
Dr. Nwankwo, I.I.M.	NRCRI, Umudike	Yam Breeder
Dr. E.C. Nwachukwu	NRCRI, Umudike	Yam Breeder
Dr. Okalanwa, I.	NRCRI, Umudike	Yam Breeder
Alh. Bala Maito	Kano Agricultural & Rural Development Authority, Kano	Deputy Director Adaptive Research
Bawa Tauhidi Umar	Niger State Agricultural Development Program, Bida, Niger	Chief Agriculture Superintendent
Mr Pine Celestine	Benue State Agricultural & Rural Development Authority, Makurdi, Benue	Director Agriculture Services
Hilakaan H. Peter	Benue State Ministry of Agriculture, Makurdi, Benue	Agriculture Officer II, Training
Mr. Bato A. Onyemaobi	Abia State Ministry of Agriculture, Umuahia, Abia	Program Manager
Pastor Kenneth Kanu	Abia State ADP	Director, Extension Services
Mrs. Uche, C.	Abia State ADP	Director, Technical Services
Mrs. F.F. Akande	Oyo State ADP	Project Manager
Mr. Bola Adegbola	Oyo State ADP	Saki Extension Block Officer
Joyce Kagbu	NAERLS, ABU, Zaria, Kaduna State	Extension Specialist
Nma Moh'd Edojifu	Niger State Agricultural Development Program, Bida, Niger	Agriculture Extension Officer II
Alh Abubakar Gwadangaji	Kebbi State Agricultural Development Program, Birnin-Kebbi,	Agriculture Extension Officer
Lawal Gwadabe	Seed Project, Kano	Director
Dr. Nobert Maroya	IITA, YIIFSWA	Country Program Coordinator
Dr. Aighewi Beatrice	IITA, YIIFSWA	Seed System Specialist
NAME	**ORGANIZATION**	**DESCRIPTION/ROLE**
Private Sector		
Mr. Dickson Stephen	Olokoro, Ikwuano LGA	Agro-Dealer
Yashim J.U.	DA ALL Green Seed, Kaduna	Certified Seed Company
Alh. Abba Boman	Nagari Seed, Zaria, Kaduna State	Certified Seed Company
Ismail Musa	Green Spore Seeds, Kano	Certified Seed Company
Alh Balarabe Auwalu	Maina Seed, Kano, Kano State	Certified Seed Company
Mr Okere Richard	West African Cotton Limited (WACOT), Gboko, Benue State	Certified Seed Company
Mal Usman Rabilu Usman	Alfata Fadama cooperative Society, Beli, Kano	Chairman, Farmers Cooperative & Association

Honourable Owoade I. Jacob	All Farmers Association of Nigeria (AFAN), Saki Oyo State	Chairman
Umar Idris	Terratiga Limited, Kano, Kano State.	Commercial Farmer
Alh. Isah Mai Iri	Saidu Ventures, Sabongari - Zaria, Kaduna State	Community Based Seed Seller
Alhaji Mudasiru Salami	Farmer & Processor of yam flour, Saki	Farmer
Tihamiyu Opo (Baale Agbe)	Farmer, Saki, Oyo State	Farmer
Peter S. Ejembi	Labar Feeds & Grains, Samaru, Zaria.	Feed Processor
Mal. Bello Ahmed	Seed Producer & Distributor, Dawano Market, Kano	Maize & Soybean (Community Based) Seed Producer & Distributor
Ahmed Danjuma	Seed Producer & Distributor, Dawano Market, Kano	Maize & Soybean (Community Based) Seed Producer & Distributor
Usman Idris	Seed Producer & Distributor, Dawano Market, Kano	Maize & Soybean (Community Based) Seed Producer & Distributor
Alh. Sani Umar	Medium Scale Farmer, Makarfi, Kaduna State.	Maize & Soybean Farmer
Usman Mohammed	Smallholder Farmer, Bokani, Niger State	Maize & Soybean Farmer
Ndagi Nma	Smallholder Farmer, Kanko Wushishi L.G.A, Niger State	Maize & Soybean Farmer
Kudu Mohammed	Smallholder Farmer, Mokwa, Niger State	Maize & Soybean Farmer
Usman A. Usman	Smallholder Farmer, Rijau, Rijau L.G.A Niger State	Maize & Soybean Farmer
Tambaya K. Nomau	Medium Scale Farmer, Angwan Dan Kwaire, Kaduna State.	Maize & Soybean Out growers
Alh. Shehu M. Lawal	Smallholder Farmer, Sakadadi, Kaduna State.	Maize & Soybean Outgrower
Alh Jibril Audu	Smallholder Farmer, Kundun, Kaduna State	Maize Farmer
Alh Ibrahim Salisu	Smallholder Farmer, Gimi, Kaduna State	Maize Farmer
Alh. Aminu Saleh	Smallholder Farmer, Karau, Kaduna State	Maize Farmer
Alh Ali Karto	Smallholder Farmer, Angwan Ikara, Kaduna State	Maize Farmer
Alh Musa Saleh	Smallholder Farmer, Kauran Wali, Kaduna State	Maize Farmer
Yakubu K. Nomau	Smallholder Farmer, Angwan Dan Kwaire, Kaduna State	Maize Farmer
Rev. Ayuba Maikano	Smallholder Farmer, Angwan Tawakiri, Kaduna State	Maize Farmer
Alh Sanusi Gulya	Medium Scale Farmer, Kano, Kano State.	Maize Farmer
Saidu Musa Alaba	Medium Scale Farmer, Lapai, Niger State	Maize Farmer
Whenzun Gabriel	Smallholder Farmer, Aliade, Benue State	Maize Farmer
Ademeku Ajaver	Smallholder Farmer, Ajaver, Benue State	Maize Farmer
Ademeku Gabriel	Smallholder Farmer, Ajaver, Benue State	Maize Farmer
Beetseh Ukeyima	Smallholder Farmer, Ajaver, Benue State	Maize Farmer
Shaahan Ademeku	Smallholder Farmer, Ajaver, Benue State	Maize Farmer
Ahmed Isah Beli	Alfata Fadama cooperative Society, Beli, Kano	Maize Informal Seed Producer & Distributor
Usman Rabiu	Seed Producer & Distributor, Beli, Kano.	Maize Informal Seed Producer & Distributor
Kamilu Mohammed	Alfata Fadama cooperative Society, Beli, Kano	Maize Informal Seed Producer & Distributor
Mr. Dipo Oke	Samlak Industries Nigeria Limited, Oyo State	Maize Outgrower
Chief A.T. Salami	Samlak Industries Nigeria Limited, Oyo State	Maize Outgrower
Mr. Okedere, O.	Samlak Industries Nigeria Limited, Oyo State	Maize Outgrower
Deacon Olaoye	Samlak Industries Nigeria Limited, Oyo State	Maize Outgrower

Doson Nigeria Enterprises	Samlak Industries Nigeria Limited, Oyo State	Maize Outgrower
Chief Mrs. Iyabo Salami	Samlak Industries Nigeria Limited, Oyo State	Maize Outgrower
Samuel Tanko Chawai	Smallholder Farmer, Zaria, Kaduna State	Maize Outgrower
Jonathan Seriki	Smallholder Farmer, Zaria, Kaduna State	Maize Outgrower
Dahiru Abdul Beli	Smallholder Farmer, Beli, Kano State	Maize Outgrower
Sabiu Sani	Smallholder Farmer, Rogo, Kano State	Maize Outgrower
Abdullahi Hamza	Smallholder Farmer, Beli, Kano State	Maize Outgrower
Mr. Falowo Kayode	Samlak Industries Nigeria Limited, Oyo State	Maize Outgrower Coordinator
Mal. Garba Hamza	Seed Producer, Angwan Dan Kwaire, Kaduna State	Maize Seed (Community Based) Producer & Distributor
Mohammed Adamu	Seed Producer & Distributor, Dawano Market, Kano	Maize Seed (Community Based) Producer & Distributor
Alhaji Jimoh Ogunniyi	All Farmers Association of Nigeria (AFAN), Saki Oyo State	Member
Pa Yiusa Ayinde	All Farmers Association of Nigeria (AFAN), Saki Oyo State	Member
Mr. Oseni Taiwo	All Farmers Association of Nigeria (AFAN), Saki Oyo State	Member
Alhaja Saidat Musa	All Farmers Association of Nigeria (AFAN), Saki Oyo State	Member
Mrs. Bilikisu Lateef	All Farmers Association of Nigeria (AFAN), Saki Oyo State	Member
Mrs. Saidat Salami	All Farmers Association of Nigeria (AFAN), Saki Oyo State	Member
Mrs. Modinat Salami	All Farmers Association of Nigeria (AFAN), Saki Oyo State	Member
Alhaji Musa Lateef Oloyede	All Farmers Association of Nigeria (AFAN), Saki Oyo State	Member
Mr. Tijani Sulaimon	All Farmers Association of Nigeria (AFAN), Saki Oyo State	Member
Tijani Dauda Opo	Farmer	Member
Alfa Ganiyu Balogun	Farmer	Member
Mr. Samso Oladokun	Farmer	Member
Mr. Abraham Oladokun	Farmer	Member
Alhaji Ibrahim Mayasau	All Traders Association, Oyo State	President
Mariam Hassan	Smallholder Farmer, Kaduna State	Rice Farmer
Alh Rabiu Umar	Smallholder Farmer, Kaduna State	Rice Farmer
Mohammed Salisu	Smallholder Farmer, Kaduna State	Rice Farmer
Abdulkareem Garba	Smallholder Farmer, Niger State	Rice Farmer
umar Faruq	Smallholder Farmer, Niger State	Rice Farmer
Umar Jibrin	Smallholder Farmer, Niger State	Rice Farmer
Mohammed Inb Umar	Smallholder Farmer, Niger State	Rice Farmer
Hadiza Mohammed	Smallholder Farmer, Niger State	Rice Farmer
Isah Sarki	Smallholder Farmer, Kebbi State	Rice Farmer
Ali Tanikwara	Smallholder Farmer, Kebbi State	Rice Farmer
Alh Maman	Smallholder Farmer, Kebbi State	Rice Farmer
Tanimu Abdullahi	Smallholder Farmer, Kaduna State	Rice Farmer
Yusuf Ibrahim	Smallholder Farmer, Kaduna State	Rice Farmer
Hassan Umar	Emi Muazu cooperative society, Niger State	Rice Farmer Group
Dauda Zakari Audu	Edogifu Rice Farmers, Niger State	Rice Farmer Group
Muatapha Aminu	Yebogboloro Rice Cooperative Society, Niger State	Rice Farmer Group
Sani Buzu	Aminci Cooperative Society, Kebbi State	Rice Farmer Group
Wakili Bawa	Nasara Rice Farmers Association, Kebbi State	Rice Farmer Group

Alh Usman Yau Nagona	Private Informal Seed Producer, Kano State	Rice Informal Seed Producer
Alh Sani Umar	Private Informal Seed Producer, Kaduna State	Rice Informal Seed Producer
Mohammed Bello	Private Outgrower, Niger State	Rice Outgrower
Umar Mohammed	Private Outgrower, Niger State	Rice Outgrower
Husseini Usman	Private Outgrower, Niger State	Rice Outgrower
Hassan Usman	Private Outgrower, Niger State	Rice Outgrower
Aliyu Nuhu	Private Outgrower, Kebbi State	Rice Outgrower
Auwal Ibrahim	Private Outgrower, Kebbi State	Rice Outgrower
Salisu Y Jatau	Private Outgrower, Kebbi State	Rice Outgrower
Hudu Abubakar	Private Outgrower, Katsina State	Rice Outgrower
Alh Abaji Kawu	Yabcom Nigeria Limited, Niger State	Rice Processor
Mr Abdullahi Zuru	Labana Rice Mills, Kebbi State	Rice Processor
Alh Nura Attajiri	Attajiri Mills, Sokoto State	Rice Processor
Dauda Attah	Attah Agro, Kaduna State	Rice Seed Agro Dealer
Patrick Esogban	Esogban Agro allied, Niger State	Rice Seed Agro Dealer
Mariam Samaila	Dangi Agro, Niger State	Rice Seed Agro Dealer
Dr O. Agunbiade	Mercy Agro, Kaduna State	Rice Seed Agro Dealer
Abubakar Aliyu	Al-Ihsan Agrochemicals, Niger State	Rice Seed Agro Dealer
Dahiru Yusuf	Iliyasawa Agro, Kaduna State	Rice Seed Agro Dealer
Sagir Nura	Sagir Agrochemicals, Kaduna State	Rice Seed Agro Dealer
Shaffiulahi Umar	Shaffiu agro, Kaduna State	Rice Seed Agro Dealer
Musa Tanko	New Era Agro, Bida, Niger State.	Rice Seed Agro Dealer
Alh Umar D. Suleiman	Akon & Associates, Niger State	Rice Seed Company
Alh Bello Jega	Goro farms ltd, Kebbi State	Rice Seed Company
Wang Gxuemin	GAWAL, Kebbi State	Rice Seed Company
Amos Abbah	Manoma Seeds, Katsina State	Rice Seed Company
Afolabi Samson	Premier seeds, Kaduna State	Rice Seed Company
Subir. P.Dey	WACOT, Katsina state	Rice Seed Company
Olukosi Emmanuel	Jetan Agro solution, Bida, Niger State	Rice Seed Multiplication Org.
Sam Enejo	Baban Gona, Kaduna State	Rice Seed Multiplication Org.
Dauda Musa	ATTAH Agro venture, Makarfi, Kaduna State.	Seed Agro-dealer
Musa Mua'zu Gambo	Farmers Escort, Samaru - Zaria, Kaduna State.	Seed Agro-dealer
Samaila Adosa	Ado Alheri Agrochemicals, Sabongari-Kano, Kano State	Seed Agro-dealer
Haruna Samaila	De Alheri Agrochemicals, Sabongari-Kano, Kano State	Seed Agro-dealer
Alh. Danjuma Inusa	Sauki Agrochemicals, Sabongari-Kano, Kano State	Seed Agro-dealer
Alh. Bala Mohammed	Alfidaus Agro, Sabongari - Kano, Kano State.	Seed Agro-dealer
Awalu Abdulazeez	Awal Agro, Sabongari - Kano, Kano State.	Seed Agro-dealer
Alh Idris Ado Rogo	Rogo Agrochemicals, Rogo, Kano State	Seed Agro-dealer
Mal. Tanko Musa	New Era Agro, Bida, Niger State.	Seed Agro-dealer
Umar Ndako	Umar Agro, Bida, Niger State.	Seed Agro-dealer
Olukosi Segun Emmanuel	Jetan Agro Solution, Bida, Niger State	Seed Agro-dealer
Chief Patrick Esogban	North central Agro-Input Dealer Association (NOCAIDA), Bida Zone, Niger State	Seed Agro-dealer

Abraham Chukwu	Legend Global Limited, Bida, Niger State.	Seed Agro-dealer
Nonso Udechukwu	Nornitex Agro, Gboko, Benue State	Seed Agro-dealer
Chigozie Ezedo	Amingo & Sons Nigeria Limited, Gboko, Benue State	Seed Agro-dealer
Kwaghkar Yanongo Philip	Kwacksy Agrochemicals, Gboko, Benue State	Seed Agro-dealer
Mrs Lucey Nongu	Agri-Input Company, Gboko, Benue State	Seed Agro-dealer
Anongu Manasseh	MAKSON Agro, Gboko, Benue State	Seed Agro-dealer
Mustapha Ladan	Smallholder Farmer, Kauran Wali, Kaduna State	Soybean Farmer
Mohammed Sani	Smallholder Farmer, R&an Kudan, Kaduna State	Soybean Farmer
Mohammed Bargi	Smallholder Farmer, Bargi, Makarfi, Kaduna State	Soybean Farmer
Ashiru Aliyu	Smallholder Farmer, Angwan Gimi, Kaduna State	Soybean Farmer
Alh. Zubairu Saadu	Smallholder Farmer, R&an Kudan, Kaduna State	Soybean Farmer
Adamu Haruna	Smallholder Farmer, Dan Kwaire, Kaduna State	Soybean Farmer
Takure Abuja	Smallholder Farmer, Bayion Mbashua, Benue State	Soybean Farmer
Nongo Samuel	Smallholder Farmer, Bunde, Benue State	Soybean Farmer
Francis Hundu	Smallholder Farmer, Bunde, Benue State	Soybean Farmer
Saaondo Dza	Smallholder Farmer, Mbashua, Benue State	Soybean Farmer
Stephen Ben Azege	Smallholder Farmer, Bunde, Benue State	Soybean Farmer
Yar Akaa	Smallholder Farmer, Bunde, Benue State	Soybean Farmer
Mrs Gb&e Racheal Laadi	Smallholder Farmer, Bunde, Benue State	Soybean Farmer
Mrs Akua Scholarstical Tersoo	Smallholder Farmer, Bunde, Benue State	Soybean Farmer
Samuel Ato	Smallholder Farmer, Agi - Gboko, Benue State	Soybean Farmer
Moses Oroza Kortse	Smallholder Farmer, Aditogora, Benue State	Soybean Farmer
Mr Augustine Iwar	Smallholder Farmer, Aditogora, Benue State	Soybean Farmer
Peter Gbaguma	Smallholder Farmer, Orya, Benue State	Soybean Farmer
Veawua Timothy	Smallholder Farmer, Mbajuna, Benue State	Soybean Farmer
Laham Terhemba Levinus	Smallholder Farmer, Bunde, Benue State	Soybean Farmer
Aungwa John Orban	Smallholder Farmer, Aditogora, Benue State	Soybean Farmer
Najime Samuel Tyoshar	Smallholder Farmer, Bunde, Benue State	Soybean Informal Seed Producer & Distributor
Tyokighir David T.	HULE & Sons Nigeria Limited, Wannune, Tarka L.G.A, Benue	Soybean Oil Processor
Mohammed a. Sheshibikun	Smallholder Farmer, Sheshibikun, Niger State	Soybean, Maize, Yam Farmer
Alh Abubakar Gogata	Smallholder Farmer, Gogata, Niger State	Yam & Maize Farmer
Umar A. Pada	Smallholder Farmer, Gawu, Niger State	Yam & Maize Farmer
Ayuba Ahmed	Smallholder Farmer, Lambata, Niger State	Yam & Maize Farmer
Mr. Oklobia Iji	Ojuju Farmers' Association	Yam Farmer
Mr. Ochekwu Ogoye (J.P)	Ojuju Farmers' Association	Yam Farmer
Mrs. Ada James	Ojuju Farmers' Association	Yam Farmer
Mr. Gabriel Aboh	Ojuju Farmers' Association	Yam Farmer
Mr. Utaji Ichekpa	Ojuju Farmers' Association	Yam Farmer
Mrs. Onyechi Olofu	Ojuju Farmers' Association	Yam Farmer
Mrs. Kate Edoh	Ojuju Farmers' Association	Yam Farmer
Mr. Fidelis Kiorpinen	Yam Farmer, Gboko, Benue State	Yam Farmer
Mrs Elizabeth Kpam	Yam Farmer, Gboko, Benue State	Yam Farmer

Mr. Lawrence Amuku	Yam Farmer, Gboko, Benue State	Yam Farmer
Mr. Daniel Tyonongo	Yam Farmer, Gboko, Benue State	Yam Farmer
Mr. Cyprian Aondofa	Yam Farmer, Gboko, Benue State	Yam Farmer
Mr. Samuel Tar	Yam Farmer, Gboko, Benue State	Yam Farmer
Fidelis Mbatoghor	Smallholder Farmer, Otukpo, Benue State	Yam Farmer
Boniface Adams	Smallholder Farmer, Otukpo, Benue State	Yam Farmer
Mrs Ayiem Utiyere Abuja	Smallholder Farmer, Bayion Mbashua, Benue State	Yam Farmer
Alh Ibn Mohammed	Smallholder Farmer, Gogata, Niger State	Yam Farmer
Mallam Abdullahi Ndako	Smallholder Farmer, Gogata, Niger State	Yam Informal Seed Producer
Alh Jibril Tsegu	Smallholder Farmer, Gogata, Niger State	Yam Informal Seed Producer
Mr. Obisike Chukwuma	Akole-Imenyi, Abia	Yam Seed & Ware Farmer
Mr. Ndubuisi Kanu	Ahiaeke, Ikwuano LGA, Abia	Yam Seed & Ware Farmer
Mr. Miracle Eminike	Ubani-Ibeku Market, Abia	Yam Seed & Ware Farmer
Mr. Ephraim Dike	Ubani-Ibeku Market, Abia	Yam Seed & Ware Farmer
Mr. Emeka Chijioke (a.k.a. Emeka Yam)	Ubani-Ibeku Market, Abia	Yam Seed & Ware Farmer
Mrs. Florence Uzochukwu	Ubani-Ibeku Market, Abia	Yam Seed & Ware Farmer
Mrs. Ejuma Okodeje	Obalanda Market Association	Yam Seed & Ware Farmer
Madam Grace Daosa	Obalanda Market Association	Yam Seed & Ware Farmer
Mrs. Maroa Okodeje	Obalanda Market Association	Yam Seed & Ware Farmer
Mrs. Helen Obeka	Obalanda Market Association	Yam Seed & Ware Farmer
Mrs. Ene Edache	Obalanda Market Association	Yam Seed & Ware Farmer
Mrs. Titi Oche	Obalanda Market Association	Yam Seed & Ware Farmer
Mr. Moses Ugeri	Yogbo Farmers' Group, Benue State	Yam Seed Outgrower
Mrs. Kathryn Iorhemba	Yogbo Farmers' Group, Benue State	Yam Seed Outgrower
Terhemba Iornumbe	Yogbo Farmers' Group, Benue State	Yam Seed Outgrower
Mr. Asor Ordam	Yogbo Farmers' Group, Benue State	Yam Seed Outgrower
Tersur Osu	Yogbo Farmers' Group, Benue State	Yam Seed Outgrower
Mrs. Eunice Albert	Yogbo Farmers' Group, Benue State	Yam Seed Outgrower
Emmanuel Tortiv	Yogbo Farmers' Group, Benue State	Yam Seed Outgrower
Mr. James Ime	Yogbo Farmers' Group, Benue State	Yam Seed Outgrower
Elder Chibundu Monday	Ohanze Osaa Ukwu, Obingwa, Abia	Yam Seed Outgrower
Comrade Edozie Ikwunze	Afuruogiri Village	Yam Seed Outgrower
Rev. Ikem E. Uche	Umuchukwu Afare-Ohokobe, Abia	Yam Seed Outgrower
Mr. Ibekwe Samuel	Obi-Ngwa	Yam Seed Outgrower
Mr. E.E. Ajauruchukwu	Afugiri village, Abia	Yam Seed Outgrower
Mr. Obinna Imo	Amaba, Uziakoli	Yam Seed Outgrower
Mrs. Odiri Onyekwu	Apumiri, Abia	Yam Seed Trader
Mr. Ikenna Ngewedim	N/A	Yam Seed Trader
Terseer Aasegh	Yam Trader, Gboko, Benue State	Yam Trader
Lydia Apuu	Yam Trader, Gboko, Benue State	Yam Trader
Felicia M. Adumbu	Yam Trader, Gboko, Benue State	Yam Trader
Mbaher Gwambe	Yam Trader, Gboko, Benue State	Yam Trader

Mrs. Rhoda Sule	Yam Trader, Gboko, Benue State	Yam Trader
Mr. Omezuruike Sunday	Uziakoli, Abia	Yam Ware Farmer
Mr. Chiatulamiro Nwaonsara	Ngwu, Uziakoli, Abia	Yam Ware Farmer
Mr. Iroechonwu Onuka	Nkpa, Uziakoli, Abia	Yam Ware Farmer
Mr. Kanu Osisiogu A.	Akudi, Uziakoli, Abia	Yam Ware Farmer
Chief Feix I. Onwuasoanya	Ubani-Ibeku, Abia	Yam Ware Farmer
Mr. Prince Edwin Okezie	Ubani-Ibeku, Abia	Yam Ware Farmer
Mrs. Oluchi Orji	Ngwu, Uziakoli, Abia	Yam Ware Farmer
Mrs. Ijeoma Orji	Ngwu, Uziakoli, Abia	Yam Ware Farmer
Mrs. Nwaikpe Kanu	Ngwu, Uziakoli, Abia	Yam Ware Farmer
Mrs. Blessing Okoronkwo	Ngwu, Uziakoli, Abia	Yam Ware Farmer

ANNEX D: STAKEHOLDER ROUNDTABLE MEETING PARTICIPANTS

STAKEHOLDER ROUNDTABLE KICK-OFF MEETING – ABUJA

NAME	ORGANIZATION	ROLE
Public Sector		
Ayeni Olusegun	FMARD	Director
Efuntoye A. Titus	FMARD	Assistant Director, Project M&E
Dr. Hassan I. Ibrahim	Federal University Dutsin Ma	Head of Department of Agricultural Economics
Prof. Sola Ajayi	Obafemi Awolowo University, Ile Ife	Senior Lecturer/GIZ Consultant
Akinyode Patrick	Roots & Tubers Expansion Programme FMARD	Station Officer
Ehirim Bernard O.	NCRI Badeggi, Niger State	Seed Breeder
Usman Ndayako	NCRI Badeggi, Niger State	Seed Breeder
Dr. Sam Agboire	NCRI	Acting Executive Director
Professor Ahmed L. Ala	EGS Study – Usmanu Danfodiyo University Sokoto	Senior Lecturer
	Center for Nutrition and Health Development	Founder & Nutrition Specialist
Dr. Anuonye J. C.	FUT Minna	Seed Breeder/Senior Lecturer
Zidafamor E. J.	NASC	Deputy Director of Seed Production
Ishiak Khalid	NASC Abuja	Deputy Director, Seed Certification
Oladapo Folarin	NASC Abuja	Quality Seed Promotion Expert
Umar Umar Abdullahi	ARCN	Principal Agricultural Research Officer
Private Sector		
Tunji Adenola	Maize Association of Nigeria	National President
Faith Ishaya	SPRING/HKI	Nutrition Coordinator
Omofaye Asale	Propcom Maikarfi	
Ibidun Adesuyi Oyewo	Management Strategies for Africa (MSA)	Team Leader, Finance & Support Services
Donors, NGOs, CGIARS		
Godson Ononiwu	USAID/MARKETS II Nigeria	Director, External Relations & Capacity Building
Dr. Melanie Edwards	USAID/MARKETS II Nigeria	Agriculture Development Officer
Dr. Kofi Debrah	IFDC	Chief of Party, Nigeria Inputs
Dr. Stefan Kachelriess-Matthess	GIZ	CARI Programme Director
Oluwadara Adekunle	Technoserve	Entrepreneur & Development Consultant
Adetunji Oredipe	World Bank	Senior Agricultural Economist
Idowu Tolulope	World Bank	Project Officer

STAKEHOLDER ROUNDTABLE KICK-OFF MEETING – ZARIA

NAME	ORGANIZATION	ROLE
Public Sector		
Jamilu Mani	FMARD	Head of Agriculture
Issa F. Olayiwola	NAERLS/ABU	Extension Specialist
Shehu G. Ado	Al-Qalam University, Katsina State	Senior Lecturer
Akinola M. O.	Department of Agricultural Economics & Rural Sociology, IAR	Senior Researcher
Iyiola Tunji A. O.	NAERLS, ABU Zaria	Extension Specialist
Yusuf Malid Abdullahi	NAERLS	Extension Specialist
Dr. Hassan I. Ibrahim	Federal University of Dutsin, Katsina	Senior Lecturer & Head of Department, Agricultural Economics
Mohammed M. Lawal	NASC, Zaria	Technical Officer, North Central Regional Office
Ubandoma H. Moh'd	NASC, Zaria	Head of NASC, North Central Region
Professor Ahmed L. Ala	Usmanu Danfodiyo University Sokoto	Senior Lecturer
Joyce Hauwa Kagbu	NAERLS	Extension Specialist
Private Sector		
Engr. A. Lawal	Interproduct Seeds Limited	Managing Director
Millicent Lafe	Independent Agriculture Consultant	EGS Field Consultant, North
Alhaji Nura Attajiri	Attajiri Rice Mill	Managing Director/CEO
Muhammad Lawal Maidoki	Bakolori – Sokoto River Basin	Head of Station
Adamu Ali Wudil	Umza Rice, Kano	Farm Manager
Yashims J. U	Da-Allgreen Seeds	Representative of the Managing Director
Olorungbon Ronke	Premier Seeds	Representative of the Managing Director
Afolabi Samson	Premier Seeds	Representative of the Managing Director
Bello Lafe	AFEX Nigeria	Business Development Officer
Donors, NGOs, CGIARS		
Mainasara Shehu B.	IFAD-CBARDP	Coordinator of Improved Seeds to Rural Communities
Dr. Emmanuel Sangodele	IITA Kano	Country Coordinator, N2Africa-Nigeria, IITA, Kano station
Abikoye Joseph	IITA Kano	Research Officer

STAKEHOLDER ROUNDTABLE KICK-OFF MEETING – ABIA

NAME	ORGANIZATION	ROLE
Public Sector		
Dr. Shokalu Olumide	NCRI, Moor Plantation, Ibadan	Soybean Breeder and Head of NCRI Ibadan Station
Dr. Saul Etham	NCRI, Amakama, Anambra State	Soybean Breeder
Afuape Solomon	NRCRI, Umudike	Sweet Potato Breeder
Dr. Njoku Damian N.	NRCRI, Umudike	Cassava Breeder
Dr. Onunka N. A.	NRCRI, Umudike	Yam Breeder
Dr. E. C. Nwachukwu	NRCRI, Umudike	Yam Breeder
Sir Enyinnaya Elekwachi	Abia State ADP	Project Manager
Okalanwa R. Ike	NASC, Umudike	Head of South East Regional Office
Professor P. I. Okocha	Michael Okpara University, Umudike, Abia State	Senior Lecturer
Honourable Amanze Israel	Abia State Government	Special Adviser to Abia State Gov. on Agriculture/Manufacturing Association of Nigeria
Henry Nwachukwu	FMARD, Abia State	Director
Uma Ibem	FMARD, Abia State	Agriculture Development Officer
Akomas Ihuoma C.	FMARD, Abia State	Agriculture Development Officer
Awa C. Awa	FMARD, Abia State	Agriculture Development Officer
Okore Kalu Elem	FMARD, Abia State	Agriculture Development Officer
Dr. Dickson Ndukwe Agbai	Abia State Government	Senior Special Adviser to State Government on Agribusiness
Hon. Uzo Azubuike	Abia State Government	Commissioner for Agriculture, Abia State
Chinedu Nwogu	Abia State Government	Senior Special Advisor on Investment, Research, and Planning
Chime Asonye	Abia State Government	Senior Special Advisor to the Abia State Government on Sustainable Development Goals
Lawrence Odoemelem	Abia State Government	Senior Special Adviser on Investment Promotions
Dr. Kingsley C. Uzoma	Michael University of Agriculture, Umudike	Head of Department of Soil Science
Private Sector		
Usuwa Ifeanyi Godspower	NSM Foods Limited	Farm Manager
Mr. Martins Onuorah	Quality Agro-Inputs & Seed Company Limited	Managing Director
HRH Eze Chris	EN. Ajuzie Ginger Farmers, Abia State	Farmer
Onwusiribe Paul Kelechi	Izybest Integrated Services	Managing Director
Nwanevu Chris Nwabudo	Nwabudo Agro Seeds	Managing Director
Donors, NGOs, CGIARS		
Professor S.A. Olakojo	IAR&T, Ibadan	Maize Breeder
Dr. S. O. Ajala	IITA, Ibadan	Maize Breeder

STAKEHOLDER ROUNDTABLE FEEDBACK MEETING – ABUJA

NAME	ORGANIZATION	ROLE
Public Sector		
Osho-Lagunju Bankole	FMARD	Senior Agriculture Officer
Efuntoye A. Titus	FMARD	Assistant Director, Project Monitoring and Evaluation
Dada Olanrewaju	NASC	Head of Administrative Services
Dr Julian Anuonye	Federal University of Technology, Minna, Niger State	Soybean Research Programme
Dr. Muyedeen Oyekunle	IAR, Zaria	Maize Breeder
Dr. Olusegun Ojo	NASC	Director General
Mr Ishiak Khalid	NASC	Deputy Director, Seed Certification
Towolawi Oluwole	NASC	Deputy Director, Seed Information, Data Management & Capacity Building
Mr. Unior Patrick	NASC	Assistant Director
Dr. Umar Umar Abdullahi	Agricultural Research Council of Nigeria (ARCN)	Principal Agricultural Research Officer
Mr Muhammed Bashiru	NCRI, Badeggi	Seed Technologist
Mr. Pine Celestine	Benue State Agricultural and Rural Development Authority (BNARDA)	Director, Agric. Services
Private Sector		
Abba Amos	Manoma Seeds	Managing Director
Abubakr M Kangiwa	Kangiwa Global Incorporation	Managing Director
Adora Millicent Ekwegbara	BioCrops, Abuja	Representative of the Managing Director
Alh Bello Baidu	Goro Farms	Farmer
Doris E. Akhabue	BioCrops, Lagos	Representative of the Managing Director
Dr. (Mrs.) Omozoje Ohiokpehai	Center for Nutrition and Health Development (CEHEND)	Founder & Nutrition Specialist
Olanike Shamonda	Center for Nutrition and Health Development (CEHEND)	Nutrition Consultant
Garba Demba	Maina Seeds	Representative of the Managing Director
Millicent Lafe	Consultant	EGS Field Consultant (Rice Seed Systems)
Prof A. O. Ogungbile	Premier Seed Nigeria Ltd	Managing Director
Tambaya K. Nomau	Farmers' Association	Chairman, Farmers' Association
Yakubu Stephen Atar	Da-Allgreen Seeds Ltd	Managing Director
Donors, NGOs, CGIARS		
Faith Ishaya	SPRING/HKI	Nutrition Coordinator
Dr Melanie Edwards	USAID/MARKETS II Nigeria	Agriculture Development Officer
Godson Ononiwu	USAID/MARKETS II Nigeria	Director, External Relations & Capacity Building
Dr Sam Agboire	NCRI, Badeggi	Soybean Breeder
Dr. Beatrice Aighewi	IITA, Abuja	YIIFSWA Yam Seed Systems Expert
Dr. Morufat Balogun	IITA/YIIFSWA, Ibadan	Tissue Culture Specialist