VUNA

changing farming for a changing climate

Reaching More Farmers with High Quality Seed for Drought Tolerant Crops

Research Report commissioned by Vuna | 30 October 2016

Adam Smith International

UKaid from the British people

Please cite this publication as follows:

Agri Experience. 2016. Reaching More Farmers with High Quality Seed for Drought Tolerant Crops. Vuna Research Report. Pretoria: Vuna. Online: http://www.vuna-africa.com"

Project Team

Aline O'Connor Project	Team Leader
David Rohrbach	Quality Assurance
Mulemia Maina	Senior Researcher
Noel Templer	Researcher
Laura Crammer	Junior Researcher
Vimbai Chasi	Project Manager
Mark Essig	Editor

Date: 30 October 2016 | **Lead Author:** Agri Experience

Vuna is a DFID-funded regional Climate Smart Agriculture Programme. The British Government's Department for International Development (DFID) financed this work as part of the United Kingdom's aid programme. However, the views and recommendations contained in this report are those of the consultant, and DFID is not responsible for, or bound by the recommendations made. This material is not to be reproduced, altered, contents deleted or modified in any way without written permission from Vuna.

UKaid
from the British people

Sorghum

TABLE OF CONTENTS

List of Figures

List of Tables

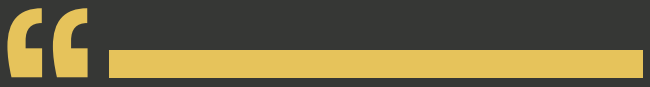
Acronyms

AECF	Africa Enterprise Challenge Fund
AGRA	Alliance for a Green Revolution in Africa
APPSA	Agricultural Productivity Program for Southern Africa
ASA	Agricultural Seed Agency (Tanzania)
ASI	Adam Smith International
ASSMAG	Association Smallholder Seed Multiplication Action Group
BDS	business development services
BIF	Business Innovation Facility (DFID)
BMGF	Bill & Melinda Gates Foundation
CGIAR	Consultative Group for International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Centre
COMESA	Common Market for Eastern and Southern Africa
DARS	Department of Agricultural Research (Malawi)
DFID	Department for International Development
DIIVA	Dissemination and Impact of Improved Variety Adoption
DNSA	National Directorate of Agrarian Services (Mozambique)
DTMA	Drought Tolerant Maize for Africa
EGS	early generation seed
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FIPS	Farm Inputs Promotion Systems
FISP	Farm Inputs Subsidy Program of Malawi
FISP	Farmer Input Support Programme (Zambia)
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IIAM	Institute of Agricultural Research of Mozambique
IITA	International Institute of Tropical Agriculture
INOVAGRO	Innovation for Agribusiness
ISF	International Seed Federation
ISPs	input subsidy programs
ISSD	Integrated Seed Sector Development
ISTA	International Seed Testing Association
M&E	monitoring and evaluation
MALF	Ministry of Agriculture, Livestock and Fisheries (Tanzania)
MISST	Malawi Improved Seed Systems and Technology project (USAID)
MT	metric tonnes
NAIVS	National Agriculture Input Voucher Scheme (Tanzania)
NASFAM	National Association for Smallholder Farmers of Malawi
NDA	National Designated Authority
NGO	non-governmental organisation
OECD	Organisation for Economic Cooperation and Development
OPV	open-pollinated variety
PASS	Program for Africa's Seed Systems (part of AGRA)
QDS	Quality Declared Seed
REC	Regional Economic Community
SCCI	Seed Control and Certification System (Zambia)
SEMEAR	Feed-the-Future Mozambique Improved Seeds for Better Agriculture
SHF	smallholder farmer
SME	Small and medium enterprise
SSA	Sub-Saharan Africa
SSI	Seed Services Institute (Zimbabwe)
SSPs	small seed packs
SSTP	Scaling Seeds and Technologies Partnership (USAID)
SSU	Seed Services Unit (Malawi)
STAM	Seed Trade Association of Malawi
TARI	Tanzanian Agricultural Research Institute
TASAI	The African Seed Access Index
TOSCI	Tanzania Official Seed Certification Institute
UNDP	United Nations Development Program
USAID	United States Agency for International Development
USEBA	Unit for Basic Seed (Mozambique)
VBSE	village-based seed enterprise
WEMA	Water Efficient Maize for Africa
ZARI	Zambia Agricultural Research Institute

Executive summary

Crop yields in Sub-Saharan Africa (SSA) are typically less than half of yields in the developed world. With growing populations, and with climate change already beginning to put downward pressure on crop yields, intervention is urgently needed to enable farmers in SSA to produce more food. A key first step is to ensure that farmers have greater, and more reliable, access to high-quality seed of the modern varieties of climate smart crops that will best equip them to both feed themselves and produce food for barter or sale.

In many cases, breeding work for new varieties has been done. Farmers, however, are unaware of the new varieties, or seed of these varieties is not reaching them at meaningful levels. As a result, potential farmer yield and overall production levels for the target crops are not realised. The opportunity cost associated with this is significant and, without intervention, will grow as the effects of climate change increase.



Crop yields in Sub-Saharan Africa (SSA) are typically less than half of yields in the developed world.

There have been many efforts to try to rectify this, but all too often results have been of limited scale or have not been sustainable over time. Key challenges include the following: low farmer awareness levels of the new varieties, weak enabling environments for seed systems, limited volumes of high-quality seed available to farmers, and poorly developed value chains for commercial offtake of excess production.

Efforts undertaken include numerous donor, government and Consultative Group for International Agricultural Research (CGIAR) centre projects, including subsidy programs (although subsidy programs have been primarily aimed at fertiliser and maize and legume seed, not seed for the target crops). Many of these projects provide valuable lessons, but they must be coordinated with other efforts, particularly those in the private sector, if widespread and sustainable results are to be achieved.

In the last decade there have been notable advances in seed delivery systems that provide a good foundation for future efforts. These include the growth of private-sector seed supply, subsidy programs that are becoming increasingly "smart," increasing commercial opportunities for crops such as groundnut and pigeonpea, and government policies in some countries that are increasingly responsive to the needs of the seed sector.

This study focuses on five countries in Eastern and Southern Africa—Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe—and explores how to best help farmers address climate change through improved access to seed of modern, drought-tolerant, open-pollinated crop varieties. The target crops for the study are cowpea, groundnut, open-pollinated variety (OPV) maize, pearl millet, pigeonpea, and sorghum. (Hybrid maize is not a focus of this study because there are numerous other efforts related to climate change—including Drought Tolerant Maize for Africa (DTMA) and Water Efficient Maize for Africa (WEMA)—for which hybrid maize seed is the focus.)

This study's extensive literature survey and in-country field work suggest that increased support for small and medium enterprise (SME) seed companies offers the greatest hope for increasing farmer adoption and access to seed of modern varieties for climate smart crops. Such support should be both directly targeted at individual, high-potential companies and focused on improving the enabling environment for them. To be successful and sustainable, however, this support must be rigorously viewed through the lens of overall seed-system development, and must also be carefully designed so as not to undermine or delay the strengthening and maturation of the very businesses it aims to help.

When investing in strengthening local private-sector seed companies, two key considerations should be taken into account: first, the sustainability of the long business cycle that is inherent in seed production, adoption, and dissemination, because seed supply cannot be turned on and off like a tap; and, second, the underlying profit motivation of the seed company. Strengthening the local private sector must also occur within an enabling environment for business. A good environment is one that offers opportunities to strengthen seed company operations, cash flow, and financing; ensures reliable access to high-quality early generation seed (EGS); employs smart subsidies to enhance early access to new varieties by smallholder farmers (SHF); clearly defines roles for certified, standard, and Quality Declared Seed (QDS); supports farmer awareness and adoption of new varieties; and offers harmonised approaches to importing and exporting seed.

An enabling environment for general sector development is also essential. At the margin, the most important areas of focus are accurately and transparently accounting for new varieties after release, improving coordination of donor and public investments, and improving seed-system information systems.

Preface

This study, *Comparative Assessment of Seed Delivery Systems for Drought Tolerant Crops*, aims to document and make recommendations to improve smallholder farmer access to seed of modern varieties of drought-tolerant crops in Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe. These are the focus countries for the sponsor of this study, Vuna, a climate smart agriculture programme which is funded by the United Kingdom's Department for International Development (DFID) and implemented by Adam Smith International (ASI). Vuna's primary focus is on drought-tolerant crops that will become increasingly important under a changing climate: sorghum, pearl millet, cowpea, pigeonpea, groundnut, and OPV maize (hereafter referred to collectively as "target crops").

The study is informed by a review of more than 70 relevant papers, both peer reviewed and grey literature, with the vast majority authored in the last 15 years. A full list of the papers reviewed for the study is included in Annex 1. Literature was selected for review based on whether it presented one or more of the following: (1) a review or evaluation of a relevant seed dissemination project, (2) review of secondary literature pertinent to the topic and a presentation of recommendations, (3) analysis of seed systems in the countries of focus, and (4) results of a study on seed adoption by farmers. Because seed systems are always evolving, literature older than 2002 was generally not included, although some exceptions were made for key documents.

Field visits to each country have also informed the study. Over 95 interviews with key informants from the public, private, and non-governmental organisation (NGO) sectors were conducted. In all instances where seed-system data was collected, a strong effort was made to obtain the most recent and robust information.

With regard to the work of the study, it is important to keep in mind several caveats:

1. There is a dearth of reliable seed-sector data that can be used for evidence-based decision-making. This is particularly true because seed of the target crops is recycled, a practice that makes it difficult to measure variety dissemination. In general, the lack of evidence is cause for real concern as we seek answers to how to better equip smallholder farmers to adapt to climate change.

2. The number of seed interventions by donors and NGOs has grown significantly in recent years. While field visits and the literature review revealed many of these, there are no doubt additional efforts—and related successes, failures, and lessons—that have not been uncovered given the timeframe and length of this study.

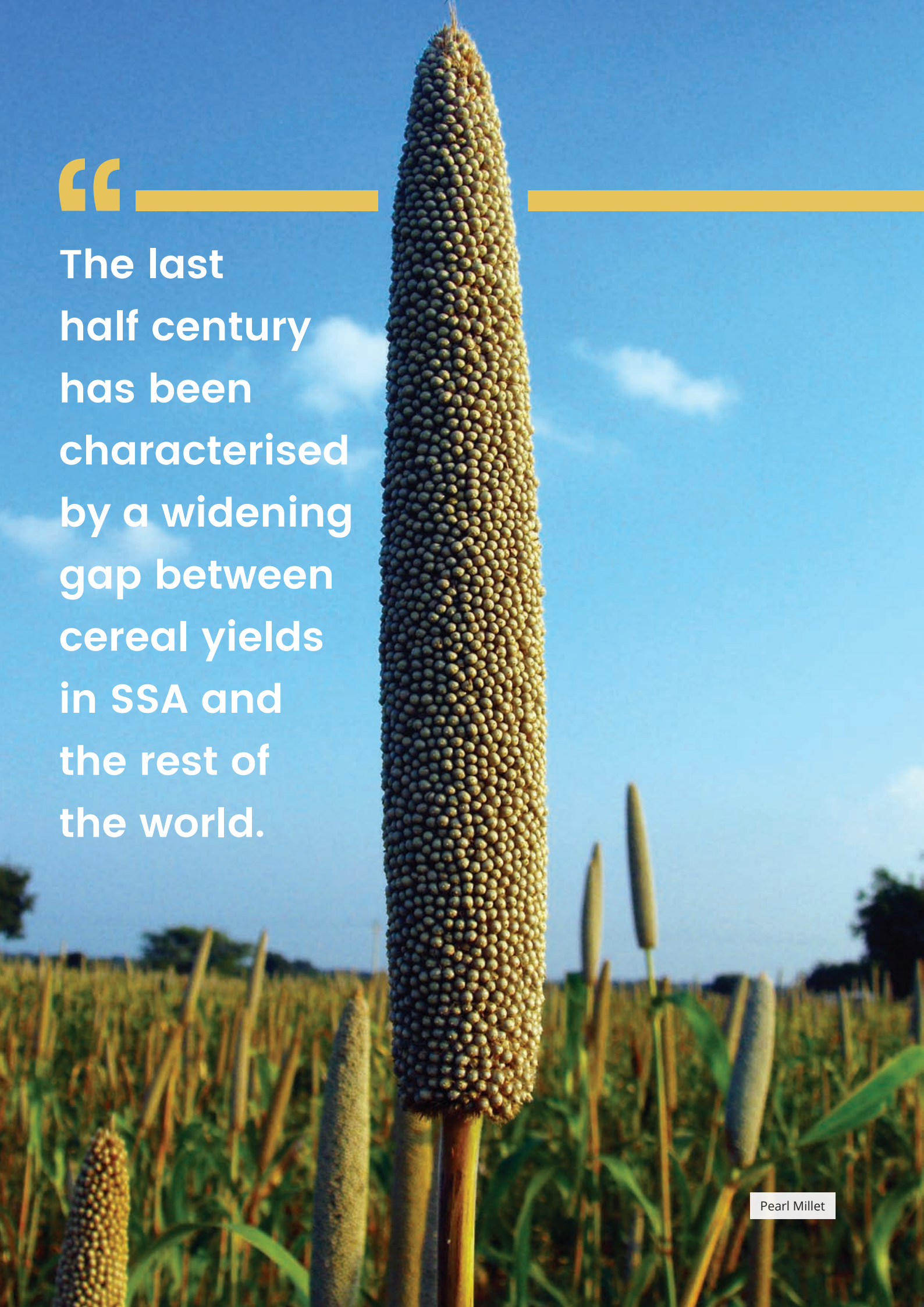
3. The authors of this report have extensive experience in both seed-business management and seed-system development. Their approach to the work is focused on gathering real-time information from sector participants, working to connect the dots by exploring what is working and not working, and triangulating information received with other informants as much as possible. Due to the long business cycle for seed and the difficulties encountered in generating and collecting data, information about seed systems is usually several years behind the reality on the ground. In light of this, the authors rely heavily on interviews with sector participants and focus on current realities and recent developments in drawing conclusions.

4. The terms of reference for this study were very broad: five countries, all but Malawi quite large; six crops; policy and regulatory environments; seed systems; donor activities; and government activities in the sector. The number of days allocated for the work was small relative to the scope, as the mandate was to develop a high-level overview based on a literature review and field visits. Given this, the report is intended to provide a high-level perspective; further work will be needed to determine specific entry points for future project proposals.

This report is structured as follows:

Section 1 explores the seed supply challenge, while Section 2 outlines seed supply systems and technical terminology. Recent advances in breeding, commercialisation, and dissemination are outlined in Section 3, although data and evidence collection in this area is challenging. Section 4 reviews recent public and donor investments in production, adoption, and distribution, highlighting those holding the most promise. In Section 5 the recommendation for incremental future investment is presented, and Section 6 expands upon this recommendation by identifying the key elements necessary to support the creation of an enabling environment for seed-sector growth. Section 7 presents high-level overviews of the current seed sector in each country. Conclusions are presented in Section 8.

The primary authors of this paper are Aline O'Connor and Mulemia Maina of Agri Experience, Limited, with strong support from Laura Cramer, who conducted much of the literature review and summarised the findings. David Rohrbach provided extensive input and feedback. The primary authors have over 42 years of combined experience in the seed sector, including both private-sector and development experience.



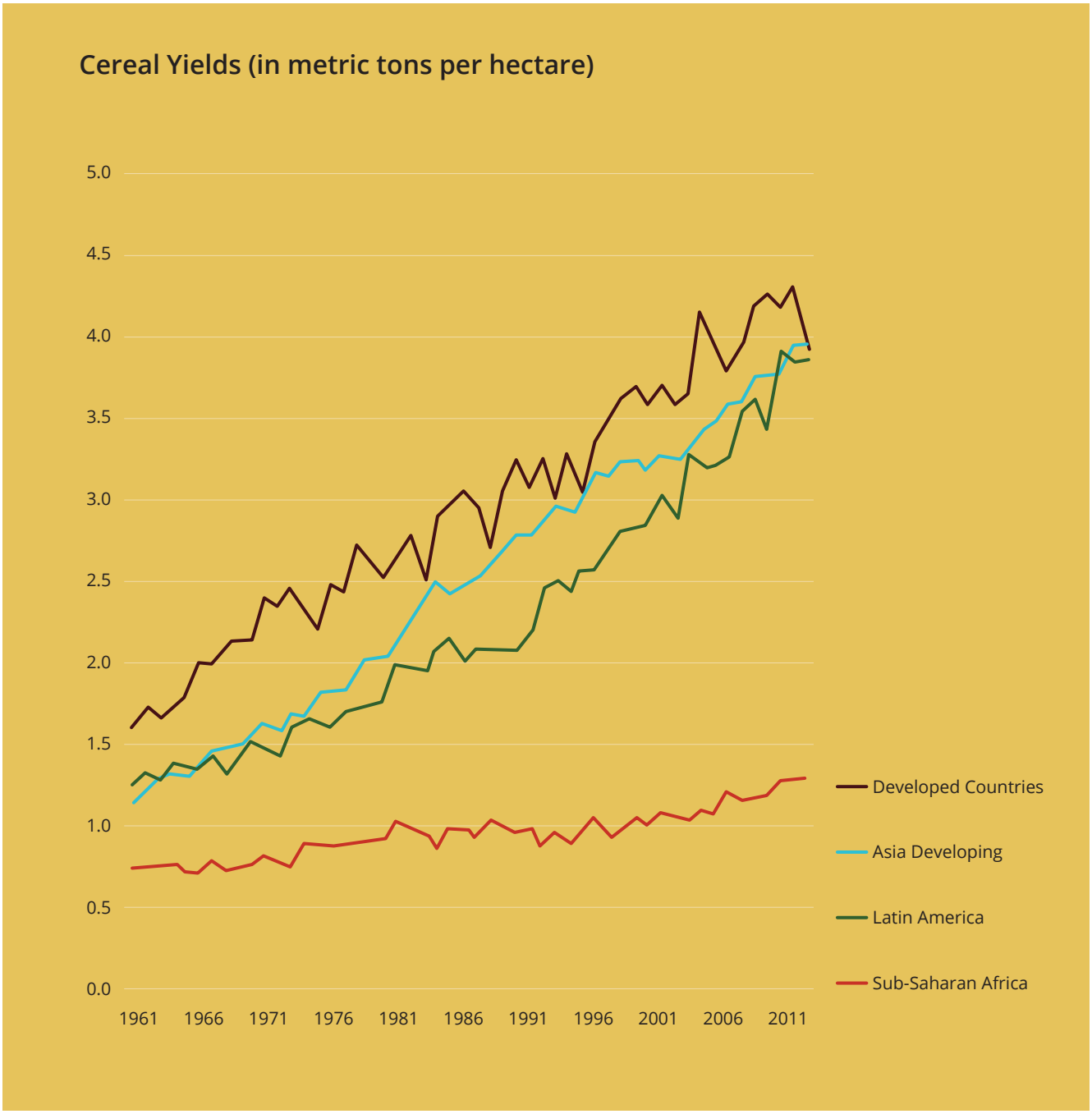
> The last half century has been characterised by a widening gap between cereal yields in SSA and the rest of the world.

Pearl Millet

Section 1:
Seed supply challenge

In the past 50 years, agricultural yields have increased significantly in industrialised economies and countries such as India that benefited from the Green Revolution. Crop yields in Africa, however, have remained stagnant or risen only slightly, and fall far below what has been achieved in other parts of the world (Tittonell and Giller, 2013). As illustrated in Figure 1, the last half century has been characterised by a widening gap between cereal yields in SSA and the rest of the world.

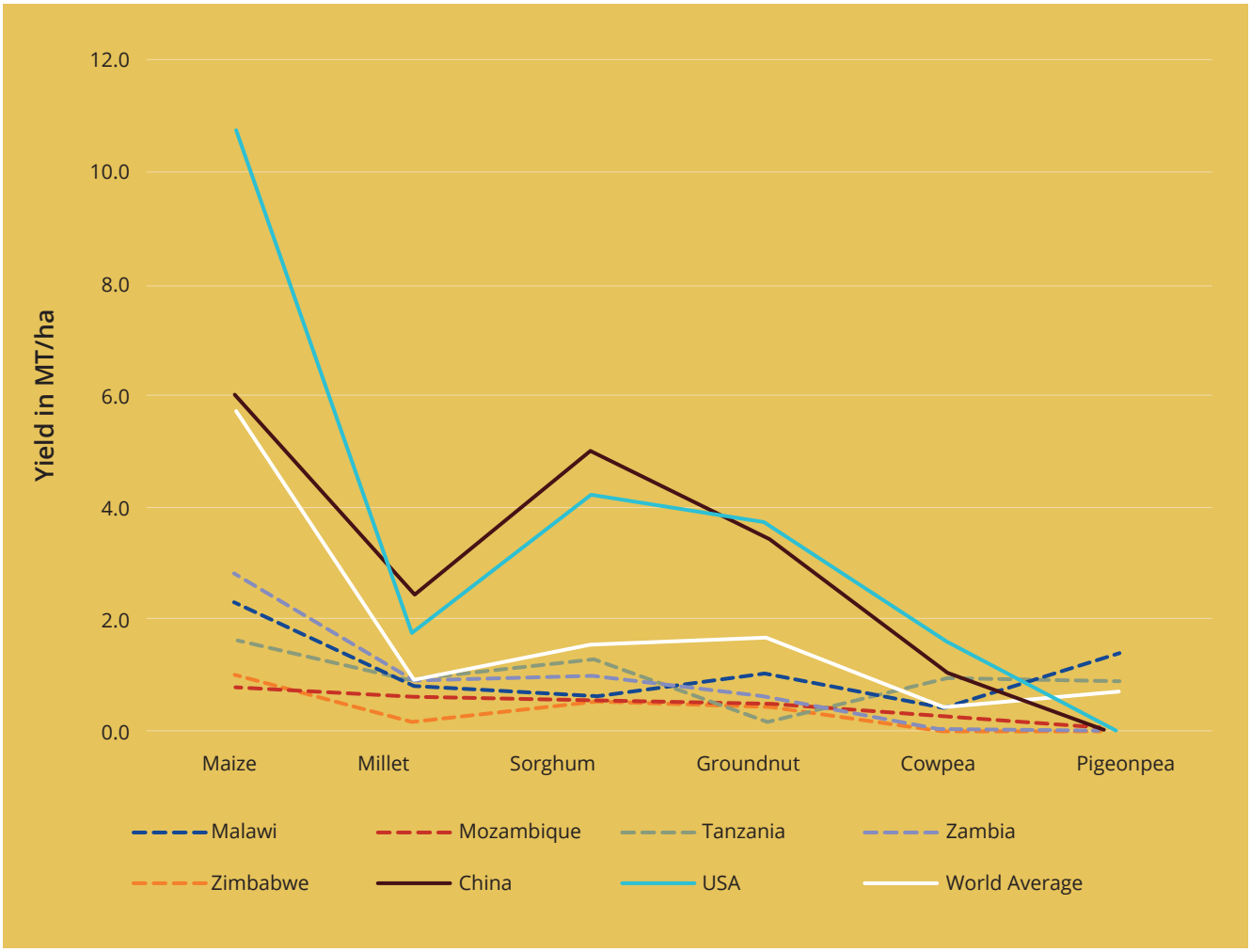
Figure 1: Cereal yields, 1961-2011 (MT/ha)



Source: *World Resources Institute, based on FAOSTAT data*

As of 2014, yields of most of the target crops in the focus countries fall far below yields realised in countries such as the United States and China, and are generally below global averages (Figure 2 and Table 1).

Figure 2: Yield of target crops in focus countries (2014)



Source: *FAOSTAT*

Table 1: Yield of target crops in focus countries, 2014

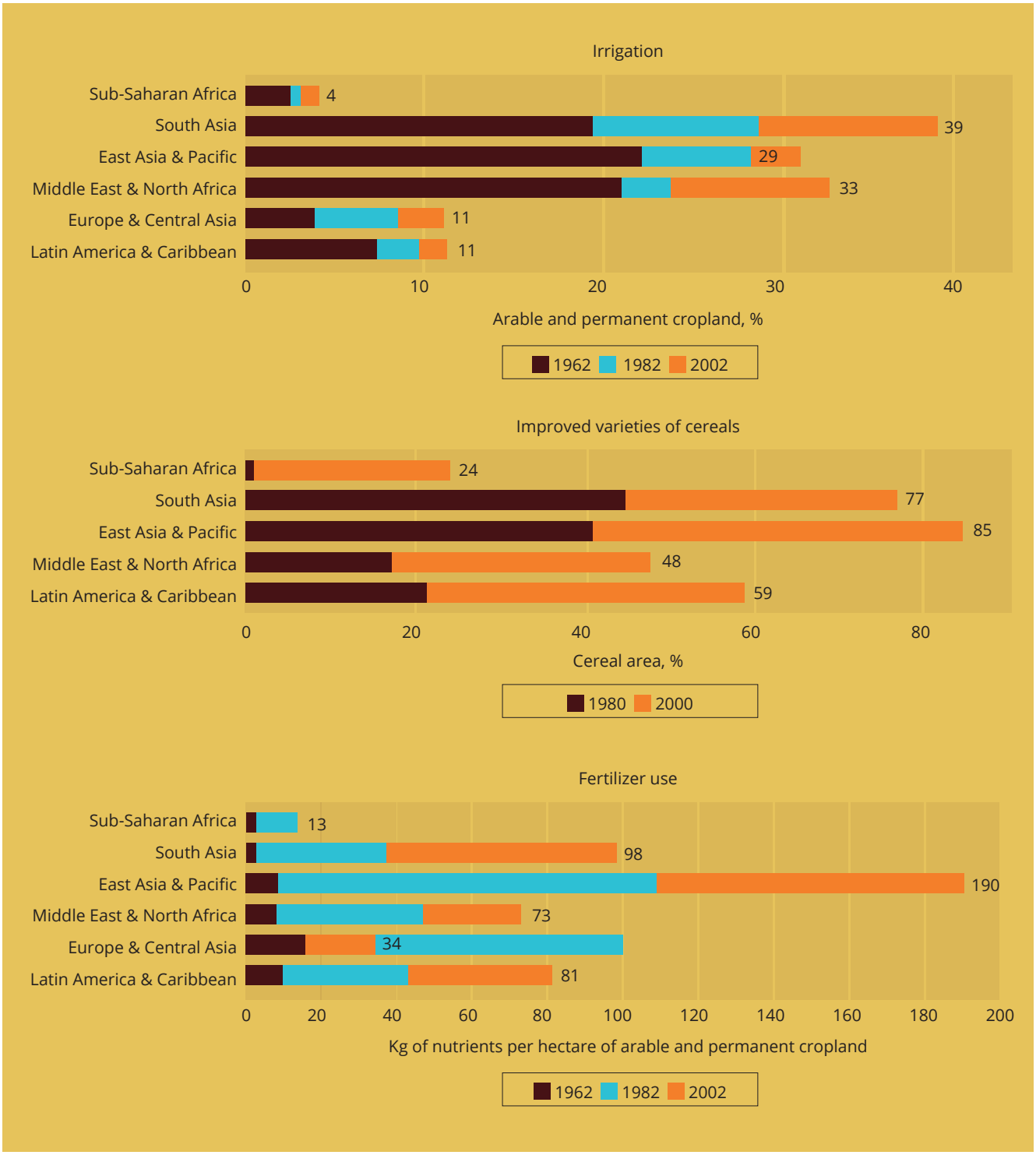
Crop	Malawi	Mozambique	Tanzania	Zambia	Zimbabwe	China	USA	World Average
Maize	2.3	0.8	1.6	2.8	1.0	*6.0*	*10.7*	*5.7*
Millet	0.8	0.6	0.9	0.9	0.2	*2.4*	*1.8*	*0.9*
Sorghum	0.6	0.6	1.3	1.0	0.5	*5.0*	*4.2*	*1.5*
Groundnuts	1.0	0.4	0.2	0.6	0.4	*3.5*	*3.7*	*1.7*
Cowpea	0.5	0.3	0.9	0	0	*1.0*	*1.7*	*0.4*
Pigeonpea	1.3	0	0.9	0	0	*0*	*0*	0.7

Source: *FAOSTAT*

This is particularly alarming in the face of climate change, as the combination of rising temperatures and increased variability of rainfall associated with climate change will put downward pressure on already low yields.

The causes behind the low yields are numerous. Rates of inorganic fertiliser use in Africa are the lowest in the world (with significant variation among African countries), and continuous cropping without external inputs and crop rotation are leading to losses in soil fertility. High dependence on rain-fed agriculture and a lack of irrigation capacity also contribute to low yields. Finally, lack of sufficient and reliable access to one of the most critical agricultural inputs—quality seed of modern varieties—continues to be a major constraint in many countries.

Figure 3: Irrigation, improved varieties of cereal, and fertiliser use by world region, 1962, 1982, and 2002



Source: *World Bank, World Development Report (2008)*

The effects of climate change are making the issues of access to inputs and the need to increase yields even more critical for food security in SSA. Most areas of Eastern and Southern Africa are predicted to experience decreased rainfall, increased temperatures, and shortened lengths of growing seasons in the coming decades. These changes will have a negative impact on food security in the region, as yields are expected to decrease in the absence of mitigation efforts, particularly in already marginal areas. Additional pressures will come from changing crop pest and disease patterns. A meta-analysis of future impacts of climate change reveals that 70% of research studies project crop-yield declines by the 2030s, with yield losses of 10-50% predicted in half of the studies (Challinor et al., 2014).

Farmers need to become more resilient to the changing climate, and solutions include adopting crops—and modern varieties of these crops—that are better adapted to deal with these stresses. Varieties with shorter (drought escaping) maturity periods better tolerance of heat, increased disease resistance, higher drought tolerance, and increased pest resistance will be critical to farmers. Shifting to different cropping patterns may also be crucial in some agro-ecologies. It

may be necessary for farmers who currently rely on maize and common beans to shift to more drought-tolerant cereals, such as pearl millet or sorghum, and alternative legumes that are more suited to the evolving production environment.

While this approach to enabling farmers to adapt to climate change is known, and already practiced in many countries, in SSA the seed-sector enabling environment is still evolving. As a result, there are often large gaps in seed availability relative to requirements. However, the available information about these gaps is deductive rather than based on facts.

A key challenge in working to develop seed systems is that there is generally no data or projections available regarding (1) seed available for sale at both present and future times, (2) seed demand, and (3) potential future seed demand. Instead, proxies such as volumes of seed certified, summaries of production volumes by project participants and production volumes by association members are used for both supply and demand. It is very rare to be able to access seed sale data. These approaches are highly inaccurate, as seed carryover, seed losses or obsolescence, tender purchases, production for export, and many other factors must all be considered in order to determine supply levels available to meet local demand. This type of data is largely non-existent.

Table 2, below, presents a 2016 Food and Agriculture Organisation (FAO) estimate of the supply and demand gap in four of the five focus countries for the target crops, as well as for hybrid maize. While it is possible to debate the nature of "requirements" in Table 2, and to question the accuracy or relevance of the availability data (much of the maize seed in Zambia, for example, is already earmarked for export outside of the region), the message is clear: there are large gaps between supply and demand for most of the target crops in most of the focus countries.

Table 2: FAO estimate of seed availability and demand for 2016-17 (MT)

Country		Maize	OPV Maize	Cowpea	Groundnut	Sorghum	Pigeonpea	Pearl millet
Malawi	Availability	17,130	N/A	325	2,106	N/A	605	N/A
	Requirements[1]	32,935	N/A	1,287	9,599	N/A	2,464	N/A
	Gap	**15,805**	**N/A**	**962**	**7,493**	**N/A**	**1,589**	**N/A**
Mozambique	Availability	1,330	N/A	84	78	2	82	N/A
	Requirements[2]	9,245	N/A	1,849	1,387	2,850	693	N/A
	Gap	**7,915**	**N/A**	**1,765**	**1,309**	**2,848**	**611**	**N/A**
Zambia	Availability	77,885	N/A	400	751	478	N/A	2
	Requirements[1]	27,465	N/A	108	17,836	233	N/A	537
	Gap	**0**[3]	**N/A**	**0**	**17,085**	**0**	**N/A**	**535**
Zimbabwe	Availability	44,152	N/A	310	110	1,300	N/A	120
	Requirements[4]	37,500	N/A	4,000	2,500	2,500	N/A	2,900
	Gap	**6,652**	**N/A**	**3,690**	**2,390**	**1,200**	**N/A**	**2,780**
Tanzania	Not included in FAO assessment							

Source: *FAO assessment on seed and other agricultural inputs in Lesotho, Madagascar, Malawi, Mozambique, Swaziland, Zambia and Zimbabwe, (2016)*

1 Requirements are based on five-year averages of area planted.

2 Requirements are based on the Ministry of Agriculture's projection.

3 Zambia produces maize seed for export.

4 Requirements are based on Government plans for the 2016/17 season.

Section 2:
Seed supply systems

In working with seed systems, there is a knowledge content factor that is very important. Development partners working in the seed sector need to be knowledgeable about the biology of seed because it is a fragile, living entity. They also must be knowledgeable about the systems required to supply seed to farmers. Working in the sector without the requisite knowledge and understanding can be costly to the development partner and harmful to the system.

The extreme interconnectedness of the many elements of the system, as well as the time required for the entire system to function—often encompassing many growing seasons—requires knowledgeable and collaborative partners. No one development partner can do it all, and donors who try to work in isolation frequently fail, or do harm to the potential sustainability of the system.

Seed systems include the activities and actors primarily focused on seed breeding or selection, production, and distribution, in addition to the various supporting activities such as regulatory oversight. Seed systems are a lengthy and complex supply chain. If the farmer is to be well served, all links in the chain must be strong.

Seed systems are generally classified into formal and informal systems. While the classifications are somewhat distinct, there are many points of intersection between them, as seed from the formal system regularly moves into the informal system for further multiplication and distribution.

The formal system is the system that breeds and produces seed of varieties with traceable genetic parentage, which has been produced to meet legally mandated standards, and is labelled as such. The informal system, very generally speaking, is everything else, including but not limited to farmer-selected and saved seed. Seed often moves from the formal system to the informal system as it is recycled. A mixed system, incorporating characteristics of both formal and informal, can be described as a semiformal system.

The informal system incorporates farmer-saved seed, whereby farmers save their own seed either for their own use or to be exchanged with other farmers on a barter or sometimes cash basis. These seeds can be local landraces, modern varieties that are open-pollinated, or even some variant of a modern variety. The informal system (but moving towards semiformal) also incorporates community-based seed multiplication and distribution, e.g. by community groups, farmer associations, and/or NGOs. Multiplication can include both local varieties and modern OPVs. If community-based seed production incorporates some level of quality control, such as some level of production inspection, it can be regarded as part of the continuum between informal and formal, or semiformal.

Many national seed regulatory bodies provide legal authorisation for some level of semiformal seed production. For example, if legally permitted within a given country, NGOs, community groups, and farmers' associations may produce QDS, which is not certified by a government agency but which adheres to certain specified quality standards and may even undergo some level of government inspection. An additional designation is Standard Seed, which is usually seed that has traceable parentage but may be of a generation too far removed to be considered certified seed (see below). Standard seed must generally meet minimum post-control and laboratory standards. Exact specifications for standard seed vary by country.

It should be noted that seed for the target crops of this study are primarily accessed by farmers through the informal system, especially through recycled seed.

The formal sector consists of seed that is produced and distributed according to specified national rules that determine whether or not seed qualifies as certified seed. These rules include production standards such as isolation of seed fields, mandated inspections, and laboratory tests for purity and germination, in addition to clear documentation of approved parental seed sources, and more. Certified seed is labelled according to specifications set by national regulations. It is generally sold commercially but may also be distributed under government subsidy programs, NGO projects, relief seed programs, or agribusiness entities such as edible oil producers.

The certification process varies by country. For example, Malawi, Mozambique, Tanzania, and Zimbabwe require some form of certification by a government agency for many crops, while Zambia has a deregulated system that allows for certification by licensed non-government inspectors. Some countries have mandatory certification requirements for specified crops, while countries such as South Africa do not require certification.

Producers in the formal sector are generally registered seed companies and can be categorised as local, national, regional, African or global multinational (usually referred to simply as multinational.) Government parastatals, including research organisations, can also be producers.

It is important to recognise that certified seed from the formal system does not always meet standards as labelled, potentially due to poor certification processes, problems with storage after the seed has been certified, or even fraudulent practices by registered or non-registered players. Conversely, if seed is not certified it does not automatically mean that seed quality is lower than it would be if the seed had been certified. Access to the right EGS and strong quality control during production, processing, and storage are critical elements of seed quality and can be practiced by producers of both certified and non-certified seed. Certification does, however, generally provide the user of the seed greater assurance that the seed has been produced to mandated standards, particularly in countries with effective certification systems. In light of all of the above, it is clear that planting seed—whether certified or not—is essentially an exercise in farmer trust, which is why a seed producer's reputation is so important. It also may shed light on why so many farmers, faced with weak formal seed systems in their own country, prefer to save and recycle seed for long periods of time, even if this locks them into low yields as varieties become outdated, or the seed loses purity, vigour, or viability.

A key challenge in trying to develop effective seed systems in SSA is that the landscape of African agriculture is immense—almost unimaginably so. Distances are huge, and seed, by its nature, is often produced in remote and isolated locations. There are no development partners or governments that can begin to address this immense landscape on their own. Good seed systems work because of the critical participation of various actors—a group that includes knowledgeable regulators and a large cadre of experienced players who understand and follow the rules, have access to the inputs they need to produce high-quality seed, and are motivated by private-sector profit motives to navigate the challenging seed production and distribution environment.

To fully understand seed, it is important to be conversant with the key terminology. Below are explanations of terms used throughout this report to describe the various classes of seed. These definitions draw extensively from the Kenya Early Generation Seed Study, Context Network, May 2016, sponsored by United States Agency for International Development (USAID) Bureau of Food Security.

SEED TERMINOLOGY

Breeder seed:

Breeder seed is produced by or under the direction of the plant breeder who created the variety, or the breeder's successor. During breeder seed production the breeder (or an official representative of the breeder) selects individual plants to harvest based on the phenotype (physical appearance) 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 level of seed multiplication between breeder and basic seed that is used to produce sufficient quantities of seed for basic seed production. It is generally the responsibility of the breeder to produce pre-basic seed, and production ideally occurs under very rigorous levels of genetic control.

Basic seed:

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

Foundation seed:

The term foundation seed is used in some countries to refer to pre-basic and basic classes of seed.

Early generation seed:

This phrase has grown in use in recent years as international development interventions have focused more heavily on the seed sector. It is used to refer to breeder, pre-basic and basic seed classes, in total.

Long before a farmer steps into an agro-dealer shop to buy a bag of seed or trades seed of a modern variety with her neighbour, a long chain of activities has taken place to produce specific crop varieties with certain traits and characteristics. This full chain of activities occurs over many years, and in some cases never reaches completion if a breeding project is abandoned, or a variety cannot be released or commercialised.

A diagram of this process, presented in Figure 4, covers: (1) variety research, selection, and approval; (2) maintenance and bulking; (3) production; and (4) marketing and distribution. This entire process can take as many as twelve years, assuming a variety can be bred in eight years. Variety release, EGS production, seed production, and promotion and distribution will often take four years, assuming there are no interruptions or delays.

> **Many projects target seed distribution to farmers without clearly understanding the necessary Early Generation Seed production, and ultimate seed production, that must precede distribution.**

As noted at the beginning of this section, a key takeaway from this generic diagram is the strong interconnectedness of the system, whether one is looking at the formal pathway or the informal. Many of the challenges related to seed supply in the focus countries stem from the fact that the entire system is not working well, although there may be specific elements of the system, such as breeding and variety release, that may function adequately.

The interconnectedness of the system is challenged when donor or government interventions target one element of the system without carefully considering the impact on the other elements of the system. For example, many projects target seed distribution to farmers without clearly understanding the necessary EGS production, and ultimate seed production, that must precede distribution. The knock-on effects from this type of non-systemic

ERMINOLOGY

Pearl Millet

Certified seed:

Certified seed is seed that has been officially approved by a certification agency as having met specified germination and purity standards, and being the progeny of known and approved parent seed. All certified seed undergoes multiple field inspections and specified levels of sampling and testing during growing, processing and packaging.

Standard Seed:

Seed of a known variety that meets minimum post-control and laboratory standards. Exact specifications for standard seed can vary by country, but are less restrictive than for certified seed.

Quality Declared Seed:

In 1993, 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 QDS system is a seed-producer implemented system for production of seed that meets at least a minimum standard of quality. The intent behind the QDS system is to provide farmers with the assurance of seed quality while reducing the burden on government agencies responsible for seed certification. QDS standards are generally lower than certified seed standards, but it is possible for QDS seed to be of equal quality to certified seed. QDS seed is sampled at lower levels than certified seed, often at 10%. The definition of QDS seed may vary by country.

Commercial seed:

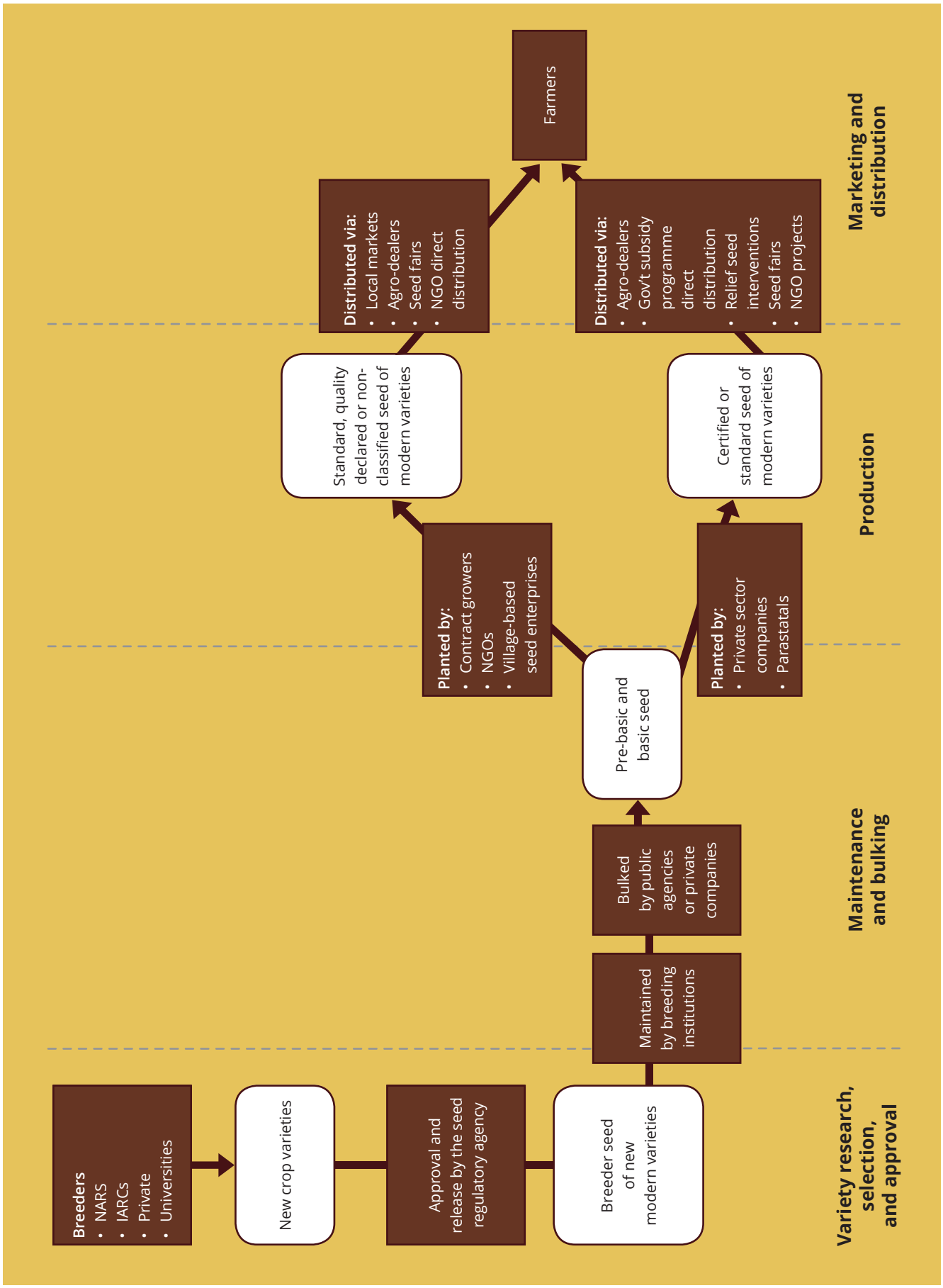
Any class of seed sold for the purpose of planting farmer fields.

Modern varieties versus landrace varieties:

Modern varieties are the product of formal breeding programs, and 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 a modern variety which has been selectively bred to conform to a particular standard of characteristics, and for which varietal purity and stability are maintained by the breeding organisation.

intervention can be devastating, potentially encouraging formal sector suppliers to abandon development of retail distribution channels as they focus more on tender offers, or encouraging opportunistic suppliers of low-quality or counterfeit seed to meet unmet demand.

Figure 4: Generic production and distribution chain for modern seed varieties



Section 3:
Breeding, commercialisation, and dissemination

For many decades, there has been extensive investment in the seed sector in SSA. Breeding, production, and distribution have all been the focus of multiple projects, programs, and subsidy efforts. There have been successes arising from these investments, many of which can be used as a strong foundation for future work. These successes include new varieties of the target crops, growing and sustainable production and distribution models and actors, and greater attempts to understand how varieties are disseminated through the informal sector.

3.1 Breeding advances

In recent decades we have seen increased emphasis on breeding and releasing new varieties of the target crops in an effort to improve yields and develop more climate-resilient varieties for farmers. Key contributors to these efforts have been CGIAR centres (most prominently the International Maize and Wheat Improvement Centre (CIMMYT) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) for the target crops), Alliance for a Green Revolution in Africa (AGRA) through support to national breeding programs, and the respective donors and government partners. As a result, many new varieties of the target crops have been released since 2000. As shown in Table 3, 284 varieties of the target crops have been released in the focus countries through 2015, as reported by the countries' regulatory bodies. (See Annex 2 for detailed lists of varieties released from 2000-2015.) Sorghum, OPV maize, and groundnut account for 74% of the total releases for the six target crops.

Table 3: Released varieties of target crops by focus country through 2015

	OPVMaize	Sorghum	Pearl millet	Cowpea	Groundnut	Pigeonpea	TOTAL
Malawi	5	2		3	13	8	31
Mozambique	17	11	3	15	12	4	62
Tanzania	24	16		8	10	7	65
Zambia	17	25	11	6	24	2	85
Zimbabwe	10	.Ll	1	1	10		41
TOTAL	**73**	**67**	**18**	**36**	**69**	**21**	**284**

Source: *Authors' analysis of data provided by each country*

The majority of breeding in the last decade has been conducted as farmer participatory breeding, with farmers working closely with breeders throughout the variety development process to ensure that breeders are meeting farmers' needs for variety characteristics such as maturity, disease tolerance/resistance, taste, and storability.

3.2 Commercialisation of modern varieties

As outlined earlier, modern varieties of the target crops initially enter the seed sector through formal systems. This occurs either as EGS (a collective term for breeder, pre-basic, and basic seed) from a research institution or an approved multiplier of EGS such as a private-sector company, or as certified seed from a seed company. Once the seed has entered the system, it can remain in the formal system, being further multiplied as certified seed, or move into the informal system, for example through community-based multipliers who are producing standard or QDS seed.

Once in the informal system, it can be further saved or shared by farmers, or sold commercially through informal market mechanisms.

For a variety to be commercialised, however, it must be licensed to an authorised seed production entity. These are usually private-sector or government entities, although there may be some instances when a variety is commercialised solely by a donor-funded project.

Table 4 shows that, of the 284 target crop varieties released in the focus countries, 135 (48%) are reported to have been commercialised at some level. Sorghum, OPV maize, and groundnut account for 81% of the commercialised varieties, with cowpea, pigeonpea, and pearl millet accounting for the remaining 19%. The lowest level of commercialisation is when the variety is simply licensed to a seed production entity. This information is generally recorded by the national research or regulatory entity, depending upon how the responsibilities are allocated in the focus countries. Once licensed, the variety can be fully commercialised—that is, produced and sold by the licensee. There is not, however, any existing data compilation on the level, or volume, of commercialisation.

For the varieties that have not been licensed at all, or have been licensed but then produced and sold only at low levels, the most likely reasons are: (1) lack of farmer demand; (2) lack of seed companies' capacity to expand their product portfolios; (3) lack of profitability related to producing and selling seed of the target crops; (4) that the variety has been released recently and is still being evaluated by potential licensees.

It is also possible that a variety was produced commercially at one time but is not any longer.

Table 4: Commercialised varieties of target crops by focus country through 2015

	OPVMaize	Sorghum	Pearl millet	Cowpea	Groundnut	Pigeonpea	TOTAL
Malawi	3	2	-	2	3	2	12
Mozambique	3	5	-	2	2	3	15
Tanzania	13	7	-	-	-	-	20
Zambia	12	21	8	4	17	2	64
Zimbabwe	9	9	-	3	3	-	24
TOTAL	**40**	**44**	**8**	**11**	**25**	**7**	**135**

Note: *Commercialised varieties do not include those disseminated solely through projects, due to lack of data*

Source: *Authors' analysis of data provided by each country*

Some donor-supported organisations began to address the gap between modern variety release and commercialisation. For example, AGRA, after beginning to fund both breeding and strengthening of local seed companies through its Program for Africa's Seed Systems (PASS) in 2007, determined in 2012 that commercialisation of new varieties was lagging. As a result, it appointed "commercialisation officers" to identify and resolve bottlenecks to private-sector uptake of new varieties. Emphasis was placed on linking breeders with seed companies for variety evaluation, supporting licensing efforts, addressing EGS challenges, and supporting adoption and awareness initiatives to increase farmer awareness of the new varieties. As a result, by the end of 2015, 13 of 18 PASS-supported varieties of the target crops in four of the focus countries, or 72%, had been commercialised (Table 5). As noted above, it is possible that the remaining varieties are still under evaluation by potential licensees.

Table 5: AGRA-supported varieties for target crops in four focus countries*

	Released	Commercialised	Not yet commercialised
MALAWI			
Pigeonpea	**2**	1	1
TOTAL	***2***	***1***	***1***
MOZAMBIQUE			
Groundnut	**1**	1	0
OPV Maize	**3**	3	0
Sorghum	**8**	4	4
TOTAL	***12***	***8***	***4***
TANZANIA			
TOTAL	***0***	***0***	***0***
ZAMBIA			
OPV Maize	**4**	4	0
TOTAL	***4***	***4***	***0***
GRAND TOTAL	***18***	***13***	***5***
Groundnut	1	1	0
OPV Maize	7	7	0
Pigeonpea	2	1	1
Sorghum	8	4	4

**AGRA does not work in Zimbabwe.*

Source: *AGRA data, through 2015.*

3.3 Variety dissemination

Dissemination through either the formal or informal sector is difficult to determine. In the formal sector, seed companies generally do not share data on sales by variety, unless requested to do so by a donor project that is supporting them. They will, however, share general information about varieties that are increasing in popularity with farmers. In the informal sector, dissemination through sharing and informal market sales cannot be accurately tracked as it unfolds. The best way to estimate dissemination through informal systems is by household surveys, which can be informative but are also costly and limited in scope. That said, many CGIAR projects include household survey information on variety dissemination. A recent compilation that includes some of the target crops in focus countries is provided in Monyo and Varshney (2016). However, it must be noted that some of the data presented in this report is either too recent to be reflected in figures provided by the relevant governments, or does not align with government figures provided. Without making any judgements about the veracity of data provided by either projects or governments, it is important to point at that this disparity highlights, once again, the need for reliable data and information upon which to base decisions about seed system development.

One of the few datasets that sheds light on the extent of dissemination is CGIAR's Dissemination and Impact of Improved Variety Adoption (DIIVA) project. Table 6 presents the DIIVA data available for the target crops and focus countries. It should be noted that most of this data was collected using the expert elicitation method for estimating adoption, with some use of farm household surveys. The reliability of these approaches has not been verified, so the accuracy is of the estimates is unknown (Maredia and Reyes, 2015). However, in the absence of other data, or reliable efforts to collect this data, DIIVA may present directionally correct indications of dissemination.

DIIVA defines a modern variety as any variety released after 1970—a broad definition that covers close to half a century. However, using this timeframe, the overall crop area DIIVA estimates to be under cultivation with modern varieties is presented in Table 6.

Table 6: Estimated area devoted to modern varieties for all crops, 2006-10 average

Malawi	35.5%
Mozambique	22.5%
Tanzania	23.7%
Zambia	54.5%
Zimbabwe	63.5%

Source: *CGIAR DIIVA, 2014*

Table 7 presents data for the target crops. OPV maize is not tracked separately, so the figures below include both OPV and hybrid maize.

Table 7: Estimated area planted with modern varieties for target crops

Malawi	Cowpea:	10%
	Groundnut:	58%
	Maize:	43%
	Pigeonpea:	50%
	Sorghum:	N/A
Mozambique	Cowpea:	11%
	Groundnut:	N/A
	Maize:	10%
	Pigeonpea:	N/A
	Sorghum:	N/A
Tanzania	Cowpea:	31%
	Groundnut:	32%
	Maize:	35%
	Pigeonpea:	50%
	Sorghum:	38%
Zambia	Cowpea:	17%
	Groundnut:	57%
	Maize:	81%
	Pigeonpea:	N/A
	Sorghum:	N/A
Zimbabwe	Cowpea:	45%
	Groundnut:	N/A
	Maize:	93%
	Pigeonpea:	N/A
	Sorghum:	N/A

Source: *CGIAR DIIVA, 2014*

For the purposes of this study, it is modern varieties released in the year 2000 or later that are of interest. As is shown later in the report, it is modern varieties from prior to 2000 that dominate the DIIVA areas of noted success, with adoption of newer varieties lagging.

Seed of the target crops is generally not available to farmers as certified seed, for two reasons. First, most seed companies do not produce seed for the target crops, or produce at low volumes, for reasons highlighted later in the report. Second, if seed companies do produce seed for these crops it is very often sold through tenders to the government or NGOs, and not openly availed to farmers who might wish to purchase it.

For the focus countries, a common pattern exists: maize seed dominates the formal commercial sector, and formal-sector seed production for the other target crops can cover only a small proportion of the land planted to those crops, or can support community-based efforts to produce QDS or standard seed for these crops only at low levels. As a result, seed supply in focus countries for the target crops is low, and overall seed systems are not as strong as they need to be. This threatens farmers' ability to adapt to climate change

Table 8 presents recent data, obtained through field visits to the focus countries, for certified seed production of the target crops. These are the volumes of certified seed available for sale to smallholder, larger-scale, or commercial farmers through tenders to projects that will then multiply the seed through the informal system and through other tenders such as those for relief seed. The relatively low volumes support the conclusion that seed systems are not working well enough to support farmers with adequate access to drought-tolerant crops and varieties as they prepare to adapt to climate change.

Table 8: Certified seed volumes of focus crops per country (MT)

MALAWI	2014-15	2015-16
Maize (OPV)	3,055	3,431
Sorghum	-	-
Cowpea	65	306
Pigeonpea	230	386
Groundnut	4,375	2,855
Pearl millet	-	-

Source: *Seed Trade Association of Malawi*

MOZAMBIQUE	2013-14*
Maize (OPV) **	N/A
Sorghum	-
Cowpea	-
Pigeonpea	-
Groundnut	410
Pearl millet	-

**** Note:*** *Earlier season data; later years not available*

***** Note:*** *No distinction made between OPV and hybrid maize; total maize volume was 5,092.*

Source: *National Directorate of Agriculture Services (DNSA)*

TANZANIA	2014-15	2015-16
OPV maize	N/A *	N/A *
Sorghum	654	575
Cowpea	16	2
Pigeonpea	60	27
Groundnut	0 .01	-
Pearl millet	-	-

Source: *Ministry of Agriculture, Livestock, Fisheries (MALF)*

ZAMBIA	2014-15	2015-16
Maize (OPV)	1,686	1,943
Sorghum (OPV)	632	336
Cowpea	422	1,215
Pigeonpea	6	40
Groundnut	2,361	1,610
Pearl millet	99	42

Source: *Seed Control and Certification Institute (SCCI)*

ZIMBABWE	2014-15	2015-16
Maize (OPV)*	N/A	4,202
Sorghum	N/A	1,945
Cowpea	N/A	250
Pigeonpea	N/A	-
Groundnut	N/A	175
Pearl millet	N/A	-

Source: *Zimbabwe Seed Trade Association*

It is extremely difficult to determine from the available data exactly how much progress has been made, or at what cost to donors, both government and private sector.

Data Challenges

A good example of the type of contradictory data that we see is illustrated by the case of groundnut seed production in Tanzania. A donor-funded project reports that they achieved 25,575 MT of certified and QDS groundnut seed production in Tanzania from 2008-14 (Monyo and Varshney, 2016), while data supplied by Tanzania's Ministry of Agriculture, Livestock and Fisheries reports QDS seed production of 25.4 MT for the same period, plus private sector importation of 0.01 MT of certified seed in 2014/15. (Earlier years of data from the private sector were not availed by the Ministry, but the disparity in the figures cannot be explained by the missing data, as private sector production during that period was not significant.) AGRA data shows that its grantees, which cover most but not all of the local private sector companies, produced no groundnut seed during the period from 2008-2014.

FAOSTAT data shows that the area under production increased fairly significantly during the period, but that yields remained relatively constant at about one-tenth of the global average.

This example is not intended to question the accuracy of any particular set of data, but to illustrate the vast differences between various datasets.

Data Challenges

For both the formal and informal systems, there is a significant lack of data to illuminate how much seed of specific crops and varieties flows through a given channel, or how much of a specific variety is planted by farmers. In addition, when data is present, it may be contradicted by data from another source.

This dearth of reliable data makes it challenging to determine with certainty which channels (formal, semiformal, informal) are efficient and cost-effective in reaching smallholder farmers with modern varieties of drought-tolerant crops, although we do know that modern varieties of the target crops are initially produced through formal systems, and then further produced and shared through semiformal and informal channels.

By linking DIIVA estimates with additional information, such as date of variety release, provided through field visits to the focus countries, it is possible to begin to look at adoption of varieties released in more recent years than 1970, the DIIVA cut-off point. The results are potentially discouraging, as it appears that in several key instances, older (pre-2000) varieties still maintain strong positions relative to newer varieties. However, it is certainly possible that the data collection has not caught up with the reality in the field, and that cultivation of post-2000 varieties is simply not yet fully reflected in the data.

Table 9: Varieties of target crops included in DIIVA study that are grown on more than 20% of crop area

Country/crop/variety	Release date of variety	DIIVA estimate of crop area
Malawi		
Groundnut		
ICGV 83708	1990	30%
ICGV-SM 90704	2000	20%
Pigeonpea		
ICP9145	N/A	25%
ICEAP 00040	N/A	20%
Mozambique		
None		
Tanzania		
Pigeonpea		
ICEAP 00040	2002	30.6%
Sorghum		
Macia (SDS 3220)	1999	20.8%
Zambia		
Groundnut		
MGV 4	1990	23%
Zimbabwe		
Cowpea		
IT18	2004	45%

Source: *DIIVA. Date of release supplied by individual countries (see Annex 2).*

Section 4:
Public and donor investment in production, adoption, and distribution

Donors have a long history of involvement in the seed sector in SSA, working with the private and civil sectors, as well as with governments. Virtually all elements of the sector have been touched by donor support: breeding, variety release, testing, EGS production, commercial seed production and processing, infrastructure, certification, policy and regulatory development, irrigation, relief seed, seed fairs, subsidies, agrodealer development, promotion, farmer adoption, extension, capacity-building at technical/diploma/BS/MSc/PhD levels, and more.

A review of both peer reviewed and grey literature, along with extensive in-country key informant interviews within the countries of interest, revealed some efforts toward improving production, adoption and distribution volumes of modern varieties that have been successful, although it is generally not possible to determine how cost-effective these efforts have been. Sustainability after donor support is also generally hard to determine, particularly for recent initiatives. The interventions summarised below highlight what has worked and what has not worked, based on the literature review and field interviews.

4.1 Development of national and regional private sector

Studies have shown that farmers are willing to pay for seed when it is available (Sperling and McGuire, 2016; Audi et al., 2015). However, for seed of the target crops, all too often the only seed that can be accessed by farmers is through the informal sector, and modern variety options are limited. Farmers are not given a range of choices.

Great effort has been made on a number of fronts to support the development of national and, increasingly, regional competitive seed businesses. Programs such as AGRA/PASS, Africa Enterprise Challenge Fund (AECF), various input subsidy programs (ISPs), DTMA, WEMA, Tropical Legumes (most recently the ICRISAT project known as TLII), and more, have included formal private-sector support and/or strengthening activities. Programs such as Integrated Seed Sector Development (ISSD) have focused on developing farmer choice through the establishment of local seed businesses, which are technically semiformal but are nonetheless private sector and may grow into formal private-sector businesses.

As a result of these efforts, as well as other important factors such as sector liberalisation, there are many new registered private-sector seed companies operating in the focus countries. Annex 4 provides a full list of the companies as provided by official entities in the focus countries. Table 10, below, summarizes the number by category and country.

Table 10: Number of private-sector seed companies operating in focus countries

	Primarily national seed companies	Regional & multinational companies	Total
Malawi	18	4	**22**
Mozambique	39	3	**42**
Tanzania	58	5	**63**
Zambia	10	11	**21**
Zimbabwe	23	8	**31**
Total	**148**	**31**	**179**

Source: *Authors' compilation based on field visits, industry lists in Annex 4, and expert consultation.*

Of the 148 national and 31 regional and multinational seed companies, approximately 66 and 11, respectively, are estimated to be selling one or more of the target crops at present, for an estimated 77 private-sector companies.

AGRA/PASS results show that support for competitive national (and sometimes regional) formal private-sector seed companies may be one of the most sustainable ways to increase smallholder farmers' access to certified seed of the target crops. It may also be one of the most cost effective, although a formal study of this has not been undertaken. (AGRA grants to seed companies generally total $180,000 over a period of two years. In addition, technical capacity-building opportunities and industry linkages are provided.)

As can be seen in Table 11, AGRA-supported companies in four of the five focus countries (AGRA does not operate in Zimbabwe) produced over 74,000 metric tonnes of certified seed from 2007-2015, and of this total approximately 11,600 metric tonnes was certified seed of cowpea, groundnut, pearl millet, pigeonpea, and sorghum. (It was not possible to separate OPV maize from hybrid maize, so maize is not included in the aforementioned total, although the figure is probably significant.)

Table 11: AGRA/PASS Certified seed production for focus countries and target crops, 2007-15

AGRA/PASS DATA ANALYSIS FOR FOCUS COUNTRIES AND TARGET CROPS -- V2 WITH MM EDITS

	#of seed company grantees and affiliates	Total seed produced 2007-2015	Maize seed produced 2007-2015	Non-maize seed produced 2007-2015	Cowpea seed produced 2007-2015	Groundnut seed produced 2007-2015	Millet seed produced 2007-2015	Pigeonpea seed produced 2007-2015	Sorghum seed produced 2007-2015	Total seed produced for non- maize target crops 2007-2015
Malawi	5	16,609	9,254	7,356	1,121	2,391	0	101	1	3,614
Mozambique	8	12,862	5,793	7,068	634	1,294	0	27	248	2,203
Tanzania	16	34,103	23,144	10,959	38	0	0	565	2,794	3,397
Zambia	3	10,817	6,450	4,368	706	1,007	1	22	642	2,378
Zimbabwe (Not an AGRA country)	*N/A*	*N/A*	*N/A*	*N/A*	N/A	N/A	N/A	N/A	N/A	-
TOTAL	**32**	**74,391**	**44,640**	**29,751**	**2,499**	**4,692**	**1**	**715**	**3,685**	**11,592**
Average per year (weighted average)		16,531	9,920	6,611	555	1,043	0	159	819	2,576
Average per grantee affiliate		2,325	1,395	930	78	147	0	22	115	362
Average per grantee/ affiliate per year (weighted average)		517	310	207	17	33	0	5	26	81
Percent of total seed					3.4%	6.3%	0.0%	1.0%	5.0%	**15.6%**
Percent of non-maize seed					8.4%	15.8%	0.0%	2.4%	12.4%	**39.0%**

Source: *AGRA/PASS data through 2015*

Grantee/affiliate averages assume that all companies produce seed of all crops, but in reality they do not, so the averages understate individual company production.

The average tenure of an AGRA grant is two years. However, the average length of time for which production was measured was 4.5 years, reflecting production that is sustained beyond the period of grant support, and the addition of grantees and affiliates over time.

Affiliates are companies that do not receive grants but receive training, coaching, linkages for commercialisation, production advice, support from AGRA-supported breeders, networking opportunities, business development services (BDS), and other non-grant forms of support.

In many if not most instances, AGRA-supported companies have benefited from government and donor support apart from AGRA, although the amounts can range from small to large, and the support may be direct or indirect. For example, the Malawi Farm Inputs Subsidy Program (FISP) included seed for target and other crops, and this benefited Malawian seed companies participating in the subsidy program. Other companies have received AECF grant funding to improve infrastructure.

In addition to direct sales to farmers, the formal sector is also a key source of EGS for both the formal and informal sectors, for relief seed, for seed for agribusiness value chain projects, and more. Importantly for the target crops that are the focus of this report, formal sector seed production provides the critical handover generation of target crop seed that is then multiplied and shared through the informal sector.

There is a further benefit to supporting national and regional private-sector companies: the target crops and other crops that are critical for adaptation to climate change are generally considered low-value crops by multinational companies. Local SME seed companies show greater willingness to partner with an international agricultural research centre or national agricultural research institute to produce and market the target crops, particularly if a profit opportunity exists.

Clearly there is strong potential for ongoing, sustained production in the private sector if incentives are aligned with the needs of the private sector. A key question for future researchers to consider is whether support to the formal private sector is more cost-effective, and more sustainable, in improving farmers' access to seed of modern varieties than support for donor projects that are not strongly connected to this sector.

4.2 Input subsidy programs for seed

There has been a resurgence of large-scale farm input subsidy programs in SSA over the past decade. These programs are designed to raise adoption rates of fertilisers and modern seed, usually by providing farmers who meet certain criteria with input vouchers they can redeem at shops or government distribution centres.

All of the focus countries have utilised some form of government and donor seed subsidy in recent years. Seed subsidies are generally tied to specific crops, usually including maize, and farmers are given choices of the variety they wish to purchase and plant. In the absence of specific directives from the government or donor, the selection of which varieties—as well as the volumes of each—to sell through a program rests largely with the formal-sector providers of seed to the program.

While there has been fairly strong analysis of fertiliser subsidy programs, there appears to be no comprehensive research on the costs and benefits of seed subsidy programs, or on their contribution to modern variety adoption. As noted by Spielman and Smale, "Despite a burgeoning literature on the impacts of fertiliser subsidies in Africa and Asia, there is little research on the impacts of seed subsidies on varietal turnover. We know of no published analysis about (1) whether and how specific seed varieties are selected for inclusion in a given subsidy program, or (2) how input subsidies influence variety choice—let alone whether the subsidies had an impact on the turnover of specific varieties.... Evidence about their (seed input subsidies') direct impact on variety choice, varietal turnover, and the spatial and temporal diversification of varieties is virtually non-existent." (Spielman and Smale, 2016, pp. 17 and 20).

Malawi has been the most studied, but data on the results, costs and benefits of the seed subsidy activities, specifically, is not available. Table 12 presents the data that is available—on subsidy volumes, as well as percentage of "available seed" (assumed to be production plus carryover seed) that was sold through the subsidy program. In addition, for maize seed, the percentage of FISP sales to total sales is given.

Table 12: Estimated data on seed in Malawi

Estimated Seed Availability in Malawi

	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Maize Hybrid	13,100	14,151	N/A	20,275	21,959	20,107	17,273
Maize OPV	2,210	3,178	N/A	4,400	5,140	3,055	3,461
Subtotal	**15,310**	**17,329**	**NIA**	**24,675**	**27,099**	**23,162**	**20,734**
Beans	427	352	N/A	705	2,027	1,300	2,661
Groundnuts	756	2,043	N/A	2,752	4,412	4,375	2,345
Soyabean	703	1,259	N/A	1,441	4,152	3,910	2,541
Cowpea	6	4	N/A	62	112	65	264
Piqeon pea	22	30	N/A	83	631	230	749

Estimated Seed Sales in Malawi (Planting Year)

	2009	2010	2011	2012	2013	2014	2015
FISP Maize	8,652	10,650	8,244	8,644	8,268	8,433	7,135
Commercial	3,798	3,689	3,533	3,705	3,543	3,614	3,058
Subtotal	**12,450**	**14,339**	**11,777**	**12,349**	**11,811**	**12,047**	**10,193**
FISP Beans	341	317	340	682	476	1,039	1,345
FISP Groundnuts	557	2,030	1,579	1,894	2,152	943	753
FISP Soya	645	376	596	368	384	867	531
FISP Cowpea	6	2	1	41	15	47	32
FISP Pigeonpea	1	5	46	48	18	131	164
Subtotal	**1,551**	**2,730**	**2,562**	**3,033**	**3,045**	**3,027**	**2,825**

FISP Sales as a %age of Estimated Availability

	2009	2010	2011	2012	2013	2014	2015
Maize	57%	61%	N/A	35%	31%	36%	34%
Beans	80%	90%	N/A	97%	23%	80%	51%
Groundnuts	74%	99%	N/A	69%	49%	22%	32%
Soyabean	92%	30%	N/A	26%	9%	22%	21%
Cowpea	107%	41%	N/A	66%	13%	72%	12%
Piqeon pea	6%	17%	N/A	58%	3%	57%	22%

FISP Maize Seed Sales as a %age of Total Estimated Maize Seed Sales

Maize	69%	74%	70%	70%	70%	70%	70%

Source: *Seed Trade Association of Malawi*

The data shows that maize has been the main focus of the program, but that beans and groundnut FISP sales have, in specific years, significantly exceeded averages for the full period of FISP implementation. It is not possible, however, to draw meaningful conclusions from the data.

The Tanzanian government has also posted information about its subsidy program on its website. Detail is minimal, however, as shown in Table 13, below. The government of Tanzania estimated that the 2009-10 subsidy volume covered 5% of total crop land (MALF, n.d.).

Table 13: Supply of food-crop seed under the Tanzania input voucher system subsidy programme, 2006-07 to 2009-10

	Maize seed (MT)	Paddy seed (MT)	Sorghum seed (MT)	Sunflower seed (MT)
2006/07	814	N/A	N/A	N/A
2007/08	1,071	N/A	N/A	N/A
2008/09	7,180	N/A	N/A	N/A
2009/10	14,700	450	290	85

Source: *Tanzania MALF*

There is much to be gained from analysis of the costs and benefits of seed subsidy programs. While there are mixed reviews on their overall impact on sustained farmer adoption of improved technologies over the long run, if well designed they may prove to be a good tool to drive near-term smallholder farmer access to, and adoption of, modern varieties for the target crops, such as occurred in Malawian farmers' increased adoption of drought-tolerant maize varieties (Spielman and Smale, 2016).

There is also some evidence that significantly boosting certified seed production can be achieved through partnerships between private companies and the subsidy programmes. This has been successful in Malawi, where the International Centre for Tropical Agriculture (CIAT), the Malawi National Bean Programme, and a private company called Demeter Agricultural Limited worked together to produce bean seed for distribution through FISP, ultimately driving supply of 2,559 metric tonnes of bean seed between 2009 and 2012, achieving significant scale (Rubyogo et al., 2016). Demeter has continued to produce bean seed beyond the life of the project, demonstrating strong sustainability, and other private-sector companies have crowded in as well. In Malawi, a key contribution to FISP was the regular involvement of the seed companies in both the planning of the program and the interpretation of results. Much of this effort was focused on solving the challenge of consistent and reliable supply of legume seed.

4.3 Quality declared and standard seed production

For the target crops, formal sector companies can produce certified, and sometimes standard, seed, while registered community groups, if permitted by local seed regulations, can produce quality-declared seed. Specific rules for all three categories of seed vary by country. If seed is to be exported it generally must always be certified and as well as labelled with an orange certificate as meeting export standards.

Seed of the target crops generally has a low profit margin for formal-sector seed companies, especially because they are often competing with community-based producers. Such seed also is characterised by variable annual demand due to farmer recycling and sharing. Costly and/or unreliable access to EGS compounds the challenge. As a result, formal-sector seed companies, which have the ability to produce and distribute at scale, are often not attracted to producing seed for the target crops.

Community-based groups, on the other hand, have lower cost structures and can be attracted to seed production for the target crops if there is a local market. However, if the community-based group is good, they generally want to expand beyond the local area—but such expansion is frequently prohibited because the QDS scheme, as initially designed by FAO, mandates that distribution should be strictly local to preserve farmer trust in the system. In addition, community groups often are not able to access capital for expansion or do not have the organisational capacity to manage growth.

The target crops, therefore, present a conundrum: the companies that can scale are often not interested, and the groups that are interested often cannot scale.

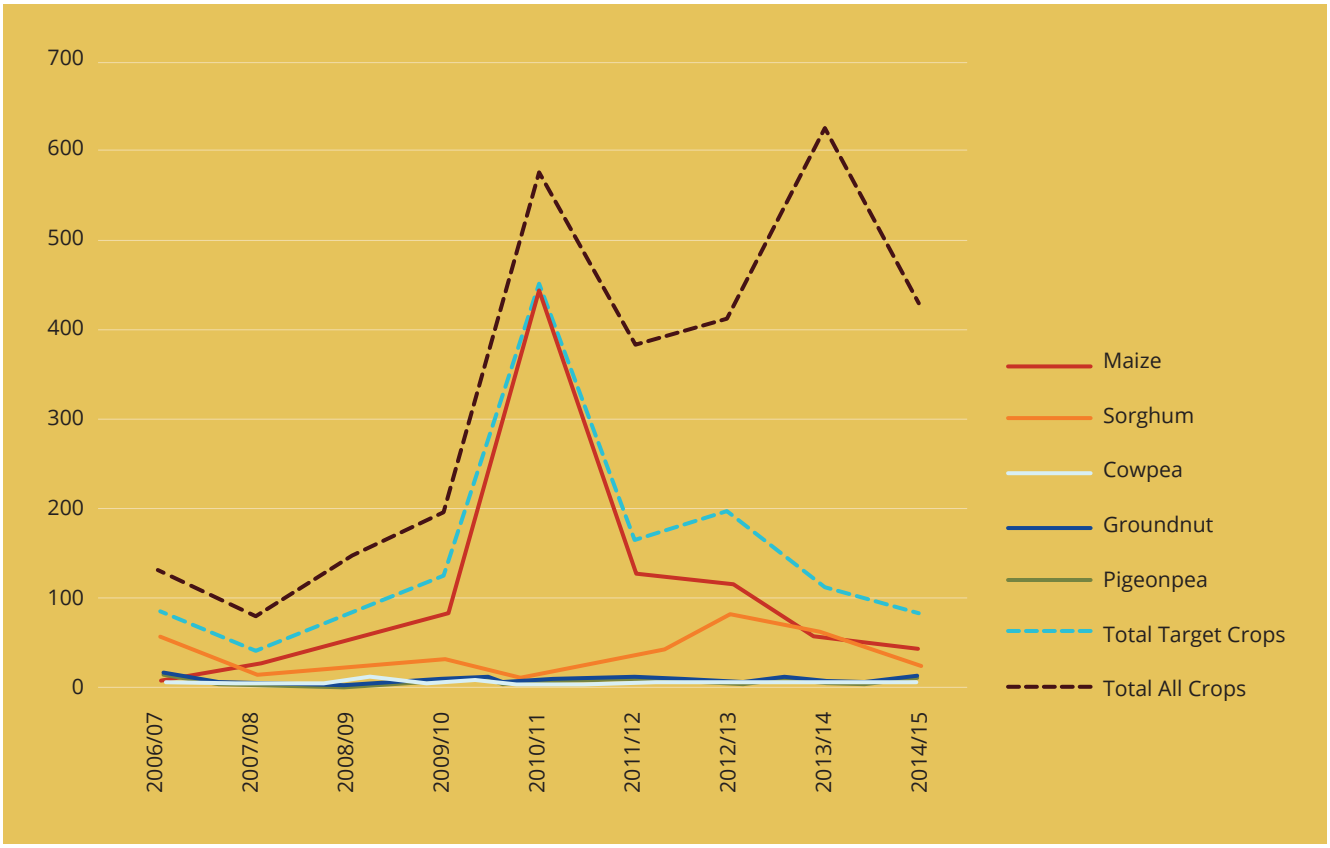
There is quite a bit of project-based information related to seed production by community-based groups, but in the absence of a sizable donor funding, the volumes reported are generally small relative to private-sector volumes, and

do not seem to be very sustainable beyond the project without some kind of ongoing support, or a transition to formal private-sector activity. The project costs associated with producing the seed volumes may also be high, although it is hard to ascertain this as the costs are usually components of much larger projects, such as CGIAR projects that also include breeding, household surveys, etc.

There is little data on QDS reported by focus countries that offers hope for major impact—particularly in the face of climate change—coming from provision of QDS seed. For example, from 2006-7 to 2014-15, Tanzania reported the following average annual production of QDS seed for the target crops: OPV maize, 103 metric tonnes; sorghum, 36 metric tonnes; cowpea, 5 MT; groundnut, 4 metric tonnes; and pigeonpea, 3 metric tonnes (data supplied by the Ministry of Agriculture, Livestock and Fisheries, or MALF). This is an average total of 150 metric tonnes per year, with no discernible improvement in volume from the beginning of the period to the end, although there are spikes within the period, as shown in Figure 5.

The spikes in total production are due to high maize seed production in 2010-11 and high rice and sunflower seed production in subsequent years. Aside from these spikes, QDS seed production for other crops and years is relatively modest.

Figure 5: Total production of QDS seed, Tanzania, 2006-07 to 2014-15



Source: *MALF*[5]

Considering that there is some level of inspection and oversight, as well as provision of EGS, associated with QDS, one has to question whether the support for the target crops would be better focused on formal-sector companies, or another form of semiformal business such as the category called local seed business that is proposed by ISSD. The limitation on QDS of only marketing within the local administrative ward, which is a relatively small area, is a constraint, and many believe that the boundary should be expanded (ASARECA/KIT, 2014). It was reported during field visits that Tanzania may be considering this.

5 When ICRISAT (Nairobi) reviewed the data behind this chart, they stated that it was incorrect and that data needed to be collected from each agricultural region individually to get a true picture. They did not have data of their own to share, nor did they know why the MALF would not be reporting significantly higher figures. Irrespective of who is correct about the data, the difference in perspective illuminates an opportunity for better government and donor collaboration in data collection efforts, to lay a better foundation for assessing either government or ICRISAT-sponsored QDS impact.

Malawi has a strong history of village-based seed production. The Association Smallholder Seed Multiplication Action Group (ASSMAG) and the National Association for Smallholder Farmers of Malawi (NASFAM) are well-established models that subsequently moved into certified seed production, although volumes appear to be largely project-driven. In Malawi, village-based seed enterprises (VBSEs) are often better able to handle "low-value" crops than large commercial companies and can make such seed varieties available to farmers in remote areas (Banda et al., 2013).

Zambia has a QDS system for all open-pollinated crops. In Zambia's case, however, QDS involves certification, which makes it is more like standard seed, and seed companies are allowed to produce seed under this system. Sampling is carried out on all outgrowers' fields and all seed lots are tested in the laboratory, but field inspections are done at a 10% level. The Zambian system uses lead farmer outgrowers who are trained to monitor incidences of disease outbreak or any other concerns. This has enabled some of the companies producing crops under QDS to export to neighbouring countries, with labels clearly indicating the seed's QDS status. Shiferaw et al. (2008) found that lack of access to EGS has constrained the success of QDS. It was discovered in the 2016 field visits that lack of EGS and working capital constraints are the main concerns for seed companies producing seed of the target crops.

A key concern about QDS seed is that the infrastructure to support quality seed production, processing and storage is largely non-existent, as it does not make economic sense given limits on marketing areas and prices that are often not much higher than the grain or legume price. Stock management for seed is a major undertaking, particularly once volumes begin to grow. Dry and pest-free warehouses, vehicles for distribution, and even harvesting and bulk storage containers, are often absent in QDS operations unless supplied by a donor project. As a result, many seed sector observers view QDS as a stepping stone solution, as farmers move from long-term recycling of seed to consideration of formal sector seed purchases through a retail network.

4.4 Small seed packs

The availability of small seed packs (SSPs) is a key driver for improving access to seed for smallholders. When new seed varieties are available in packs less than 5 kilogram, and possibly as small as 0.5 kilogram, farmers are able to try a new variety at an affordable price (McGuire and Sperling, 2016). Underscoring the importance of affordable small packs for farmers—and perhaps most importantly for women farmers—the availability of SSPs has been included as an indicator in the recently created The African Seed Access Index (TASAI) (Mabaya, 2012).

After a program in Tanzania promoted modern varieties and SSPs during field days for farmers, a follow-up survey found that 74% of farmers who purchased SSPs had not planted those varieties previously. The survey further showed that 73% of farmers who bought SSPs had travelled more than 5 kilometres to do so, demonstrating that farmers are willing to pay for a new seed variety once they have received trustworthy information on its benefits (Audi et al., 2015). Additional data provided by Farm Inputs Promotion Systems (FIPS) on Kenyan smallholder farmers' preferences for package sizes when trying a new bean variety showed that 97% of over 1,000 farmers at a field day bought a package of 400 grams or less, with over 80% wanting only a 75-gram package.

4.5 Extension and agronomic training to maximise production

New crops and varieties often bring new and unknown production challenges. For example some modern cowpea and pigeonpea varieties with high yield potential require pest control approaches that may be unfamiliar to farmers. Other modern varieties will fail to reach their potential if faced with deficiencies of key micronutrients. Extension support is needed to train farmers how to realise the full yield potential of modern varieties—support that is often missing in the focus countries due to causes including economic hardship (Zimbabwe) or the vast geographical coverage (Tanzania). Donor projects to provide support for improved agronomic practices for the target crops, such as ICRISAT's work with groundnut seed farmers in Malawi, offer the potential to build much-needed capacity with local farmers.

A deceptively simple truth about extension is that *it works best when there is something to extend.* Seed of modern varieties valued by farmers hold high potential to be this "something."

Thus, while dissemination of modern varieties is partially dependent upon functioning and viable extension systems, new crop varieties may also hold the potential to revitalise extension systems by catalysing action around farmer awareness of these new varieties and how to benefit from them.

4.6 Output market-led seed demand

Demand for seed is driven primarily by two main forces: crop production for commercial purposes, whether by small-holder farmers or larger commercial farmers, and crop production to meet family food requirements. For commercial production, most farmers want to maximise yield, or are focused on growing a particular crop variety valued in the output market, and will therefore invest in high-quality seed.

In all of the focus countries, there is growing awareness by farmers of potential output markets and the commercial opportunities associated with them. Donors, government officials, and private-sector participants all highlighted, repeatedly, the commercial opportunities that are of increasing interest to farmers. Pigeonpea, groundnut, and sorghum are the most frequently mentioned crops—pigeonpea for export to India and groundnut for local and regional commercial opportunities. Tanzania, Mozambique, and Malawi already have export channels to India for pigeonpea, and are not coming close to meeting demand.

Some donors are focused on value-chain projects to provide output market opportunities to farmers. The seed most valued for commercial production is certified and standard seed. Shortages of both groundnut seed and pigeonpea seed were mentioned repeatedly during field interviews.

The presence of a viable commercial market can clearly stimulate demand for quality inputs. Supporting demand-led grain and legume markets can help to pull technology adoption through the system, providing an alternative to using the push approach from the research side. Furthermore, ICRISAT reports that demand from the output market also serves to increase farmer demand for the same crops for food security. According to ICRISAT, only 40% of the pigeonpea currently grown in Tanzania is exported, with the rest consumed locally.

4.7 Demonstration plots

It is well known that farmers need to see and experience the performance of a new variety to fully believe in its potential. They will try a small amount, sight unseen, but full adoption is generally tied to their own positive experience with the variety, or the experience of someone they know and trust. Demonstration plots have long been an effective tool used by donors to increase farmer knowledge of new varieties. By their nature, demonstration plots are local, so scaling requires many locations and often logistical challenges. Approaches such as mother-baby trials, frequently used by CIMMYT for new maize varieties, and the agrodealer-led approaches that are currently being implemented by Kenya Markets Trust in Kenya, hold great promise for changing farmer behaviour. Agrodealer-led demonstrations also hold potential for sustainability, because many good agrodealers continue the practice independently once they are introduced to it, obtaining the required inputs for free from their suppliers.

Groundnut

Section 5:
Recommendation for incremental investment

Thus far this paper has examined what has been accomplished to date, with a focus on donor, government, and private-sector efforts related to production, adoption, and distribution. A great deal has been accomplished since 2000: breeding and release of hundreds of new varieties of the target crops; commercialisation of a significant percentage of these varieties (although it is not possible to determine volume levels); the emergence of many national and regional seed businesses focused on serving local farmers, meeting tender offers, and feeding parent seed into informal production systems; and the rise of regional and international commercial markets for farmers, although value chains often remain weak.

The question to be addressed now is, what next? The common thread that runs through all of the opportunities, as well as the key dissemination bottlenecks, is the need for increased private-sector scale if modern varieties of the target crops are to reach more farmers. More, and larger, companies are needed to attain better geographic coverage and to meet local demand from farmers as well as tender demand from government, NGOs, and increasingly agribusinesses, as well as to improve competitiveness in the markets.

Enhanced private-sector profitability related to the target crops is also an issue, allowing companies to invest in customer education and support, market expansion, and product-line expansion.

While there has not been a comparative cost/benefit analysis of various donor projects focused on increasing seed supply, it is clear that investments to date to enhance the capacity of private-sector seed enterprises have delivered results and appear to have exhibited levels of sustainability that exceed other types of donor investment.

The key recommendation of this study is, therefore, to invest in:

1. increasing the enabling environment for formal private-sector seed supply and distribution; and
2. increasing formal private-sector seed company capacity, particularly among local and regional companies that offer the best opportunity for production and distribution of either the target crops or EGS for the target crops for further multiplication in the semiformal or informal systems.

This recommendation is not made in ignorance of the important roles played by non-private-sector players, private-sector actors in semiformal and informal systems, and government. The key logic behind the recommendation is that, at the margin, the greatest returns in the near future will come from increasing formal private-sector capacity and the enabling environment in which it operates.

In the current level of development of formal sector seed supply in SSA, crops such as the target crops of this study must "compete" for seed companies' attention with hybrid maize. Demand, supply, and use of hybrid maize seed has risen dramatically in SSA since 2000, and often provides the profit engine for young national seed companies. However, as the sector matures, and a competitive supply environment for hybrid maize becomes more established, companies will develop greater interest in other types of seed, as has been seen in more mature markets around the world. In many countries in SSA, we are already seeing increased interest by seed companies in providing rotation crop opportunities for their contract growers, and ultimately supplying their customers with seed for rotation crops. Improving soil nutrition and health and breaking disease cycles will increase in importance in the face of climate change, and more varied crop seed options will be needed to accomplish this.

At this point in the development of the seed sector in SSA, the critical issues to be addressed are seed quality, efficiency to drive affordability, ability to scale, customer focus, and ability to reliably serve emerging agribusinesses that are dependent upon seed supply. If these issues are not addressed, food security and economic growth will be threatened. A common theme that emerged strongly from all categories of interviewees in the focus countries is that increasing private-sector capacity offers great potential for addressing these issues. The fieldwork uncovered many instances of

both government and donor actors collaborating with private-sector players in new and visionary ways, and yielding strong results.

This recommendation is not based on any sense of private-sector superiority: entrepreneurs and their teams have major challenges and can make colossal mistakes. However, industry competition puts companies on the path to improvement and excellence. Dr. Jim Yong Kim stated this well:

> "I think market forces are critical here. And sometimes people say, "Well, you know, the private sector does everything better." And I don't know that that's really the case so much as the private-sector entities that did it poorly no longer exist, right? Because they go out of business. And public-sector entities can stay in business for a very long time no matter how poor their performance is. (Kim, 2015)

The following section outlines specific areas of focus related to creating a better enabling environment for private-sector growth and maturation. However, to further understand the context underlying private-sector involvement in seed systems, it is important to first understand sustainability in seed production systems, and seed company profitability.

5.1 Sustainability in seed production systems

Sustainability is a key consideration in donor investments and is particularly relevant in the seed sector. Seed availability cannot be turned on and off like a tap.

The length of time from the onset of breeding a new variety to its eventual uptake by farmers often stretches as long as twelve years. Even when a variety already exists, getting from variety release to large-scale adoption usually takes more than four years and entails activities such as evaluating the variety for agroecological suitability and farmer acceptance, bulking EGS for several generations, planting the crop of certified seed, processing, storing, fumigating and testing the seed to be sold, building awareness, and getting the seed through the distribution channels. This process is repeated over multiple seasons or years, with constant quality control, until farmer awareness and adoption reach a commercially viable level, as determined by individual companies. (What is viable for a large multinational corporation is different from what may be viable for a smaller local company.) This process should not vary whether the seed production and dissemination effort is being carried out by an NGO, a government, or a private-sector company.

Problems in the system, however, are often caused by NGOs, government entities, or companies that do not methodically go through these steps, due to the short-term nature of intervention programmes and/or the tendency to address part of the chain while leaving out a potential critical component. This is arguably the key reason why the focus countries do not have sufficiently large and sustainable seed production and distribution systems for the target crops in place, despite many years of donor support.

As outlined earlier in the report, Figure 4 gives an overview of the full set of activities, from breeding to distribution, encompassing many stakeholders and seasons. Annex 5 takes a closer look at the minimum of four years needed for a company or NGO to take a variety from initial evaluation to full commercialisation, with a significant number of farmers valuing and planting the variety. This timeframe is realistic but on the aggressive side. Any disruptions, such as delayed variety release or weather challenges, will extend the timeframe. In addition, the schematic presented is based on two production cycles a year and the high multiplication rates (25) for maize. If there is only one annual production cycle, and/or lower multiplication rates such as those for legumes, the timeframe will be longer.

In addition to the long timeframe, a further challenge is the very linear nature of seed production, with the ultimate result only being as good as the most poorly implemented step in this linear chain. Running a seed operation requires dozens of steps to be implemented extremely well, and implementing all of them in the face of weather and other risks. If 50 steps are completed well but then a key one is missed (e.g., effective fumigation), the seed crop can be severely damaged or even lost.

These realities in the seed sector are exactly what make entrepreneurial or private-sector players well suited to do seed production and dissemination on a sustainable basis: the profit motive can drive high levels of watchfulness and rigor, and low quality players will be driven out by better players in even a moderately developed sector. However, as with any industry, when the sector is not competitive (i.e., with few players) or when revenue is driven by large tenders rather than by end-user value, unethical and/or cash-strapped companies may take shortcuts. Creating an enabling environment for a high-quality formal seed sector in SSA will require bringing more (1) capacity for long business cycles, and (2) transparency to issues of seed quality. This will help drive sustainability through increased farmer trust and competitive innovation.

5.2 Seed company profitability

Seed companies are already key players in the focus countries for the target crops. However, their ability to grow volume and offer additional services and knowledge to their customers is severely limited by a number of factors:

- For local companies, and often for regional companies, profit margins are very often too low to support growth
- Working capital needs are high, because the business cycle for seed is long, and expense timing is highly mismatched with revenue timing. In addition, capital investment needs compete with working capital needs. Interest rates are high in all focus countries; many companies will not borrow because financing costs are too high to make business sense.
- Governments often believe, incorrectly, that seed companies are highly profitable and easily able to bear greater expenses, fees, charges, payment delays, etc.
- Drought increases overall production costs in the long run.
- Late payment and non-payment, by both government and agrodealers, constrict a company's ability to engage in continuous production.

The need for private-sector participants to make a reasonable profit may sound obvious, but it is of critical importance if seed companies are to be able to grow to play the role in seed systems in Africa that they are playing in other parts of the world such as India. In the seed sector—with its high capital requirements, long business cycle, and unforgiving working capital requirements, especially to pay contract growers —profit margins are essential but also difficult to attain.

All too often in SSA, local seed companies wish to produce and sell seed of secondary crops only to discover that margins are too low and they must focus first on hybrid maize, which has more predictable demand characteristics as fresh seed must be purchased by farmers each year if high yields are to be maintained. Upon shifting the focus to hybrid maize, a company's profitability may start to improve. However, as a country's seed sector matures these local businesses must then compete head to head with larger multinationals—companies that often have larger promotion and distribution budgets, but focus almost exclusively on hybrid maize. As a result, in countries with multinationals and without strong local seed businesses, the profit margins from multinational sales of hybrid maize seed are generally not used to support seed production, promotion and distribution for the target crops.

A profitable, well-managed, local-crop seed company will generally make approximately 10-15% (of revenue) in earnings before interest, taxes, and depreciation (i.e., operating profit). That figure is low, especially given the demand on profits from working and investment capital and the need to use operating profit to pay interest and taxes. Many local crop seed companies either are not sufficiently well managed to achieve the 10%, particularly if they are still young, or they

have not yet reached the breakeven point. They may be surviving mainly on start-up capital, grants and/or on serving the NGO market.

SeedCo, which is a large, 75-year old multinational with over $95 million in revenue reported in 2015, achieved operating profit of 17.6% that year. SeedCo operates in multiple countries, has a long-serving and very experienced team of senior managers, has built up sizable production assets, and benefits from economies of scale. Local crop seed businesses do not enjoy these advantages—at least not yet.

It must be noted that SeedCo in recent years, unlike most non-African multinationals, has been diversifying sales in many countries where it operates, adding sorghum and other non-maize crops to national seed product portfolios. During field interviews, SeedCo expressed interest in doing more to bring seed of the target crops to farmers through their existing distribution systems if the economics make sense.

If local companies hold the greatest promise or managing the risks inherent in the seed industry, and either raising or earning the capital required to produce and sell seed for the target crops, it is critical that there be a profit incentive for them. This factor will impact all seed sector intervention points for the target crops, from acquisition of EGS to variety promotion.

Support for these companies could be provided by: (1) licensing the varieties royalty-free; (2) receiving rebates on parent seed based on certified seed sales; (3) providing low-cost working capital to stimulate production of seed for the target crops; and/or (4) giving grants to promote the varieties via vernacular radio and small packs. Agrodealers should also be considered for their role in promoting these focus crops to farmers. With the right training, agro-dealers could step in and fill the gap that is seen in many countries that have weak extension systems.

Profitability and sustainability should be key considerations for donors and those designing projects in the seed sector, to encourage capable, ethical entrepreneurs to become key players in supplying seed for the target crops, as is seen in many other countries that experienced green revolutions in recent decades. Without fully addressing the importance of both, seed systems in SSA will continue to be largely a donor- and government-driven tap, and one which does not reliably supply high-quality product to smallholder farmers.

Sorghum

Section 6:
Creating an enabling environment

To truly unlock the potential for local and regional private-sector seed companies, creating and strengthening an enabling environment for private-sector operators is essential. There is much good work already underway to accomplish this, and it can certainly be argued that it may be time to further increase such work. Efforts include, but are not limited to, capacity-building in seed-business management, production backstopping, efforts to strengthen seed company access to high-quality EGS, and provision of affordable seed company investment and working capital.

This section proposes an initial list of the most important areas of focus for creating an enabling environment, although it is important to note that there are many elements that are not included in the list but are still very important.

This section does not, however, critique or make recommendations about countries' legal and regulatory frameworks. There is strong near-term upside to better implementation within existing frameworks, although in the longer term regulatory and legislative reform may prove to be vital.

The recommendations below fall into two broad categories: (1) strengthening seed-company operations, profitability, and financing; and (2) improving seed sector coordination and information.

6.1 Strengthening seed company operations, profitability and financing

6.1.1 Ensuring reliable provision of high-quality EGS

Seed company managers understand well that if high-quality EGS is reliably available, a significant portion of the seed production challenge is solved. For the target crops, four of the crops require very careful bulking of EGS; with pigeonpea, millet, sorghum, and OPV maize, there is potential for loss of purity through cross-pollination. As a result, some degree of breeder oversight is optimal, especially in the early years of a seed production entity's life.

For the target crops, however, it is often not clear where sufficient volumes of EGS are to come from, and there is often little transparency around provision of EGS to seed-production entities by government or donors involved in breeding. Frequently donor projects are simply competing with one another for EGS, often on short notice prior to the planting season, or breeding organisations are producing EGS on a speculative basis. Most formal-sector companies, as they mature and if they can afford to run a foundation seed farm and operations, prefer to produce and manage EGS themselves, as this is the best way to assure availability when needed, and to be confident in the quality of the EGS. In the early stages of producing EGS, however, most companies need technical assistance and support.

In addition, companies often need assistance in cash-flowing EGS production, as the payoff date is usually several seasons after the bulking process begins. For example, a Malawian been seed producing company, Demeter, was provided with 200 kilogrammes of basic bean seed by CIAT in 2006, and produced its first commercial crop—of 395 metric tonnes—in 2009-10 (Rubyogo et al., 2016).

USAID and the Bill & Melinda Gates Foundation (BMGF) have recently engaged in an effort to work with stakeholders in a number of countries in SSA to propose solutions to the lack of reliable supply of high-quality EGS. The focus is on the two or three most important crops in a country, as identified by the stakeholders. This is a very commendable effort, and it will be important to observe which solutions emerge and what may develop on the implementation front.

Although the scale may be much smaller, it is essential to address the same issue for the target crops of this study, as most of them will not rank as among the two or three most important crops in a country but are nonetheless critical for food security in the face of climate change. Challenges with reliable access to EGS were universally cited during field interviews as one of the main bottlenecks for both private-sector and QDS production.

With the advent of output market demand creating demand for the required seed inputs, the issue of provision of EGS becomes even more timely. Whether for an edible-oil-producing agribusiness, a legume exporter, or a brewery, the supply chain starts with the seed that farmers are able to access and plant. With increasingly stable markets on the output side, farmers will be increasingly willing to invest in the quality inputs they need to increase their yield.

Finally, it is important to develop a clear understanding of the optimal role of the relevant CGIAR centres in provision of EGS, particularly in the early stages of the development of a local formal sector. The CIMMYT approach to supporting provision of hybrid maize EGS, particularly in the early years of variety introduction, has clearly sped the production and dissemination of these new varieties in many countries. The optimal, or even possible, EGS role of the relevant CGIAR centres focused on the target crops, outside of specific project parameters, is not clear. Even within project parameters, it is recommended that the lens of private-sector development be applied to all project activities, to assess whether projects are crowding in, or crowding out, the private sector.

6.1.2 Providing affordable working capital, tied to performance

Providers of working capital in SSA generally view agriculture as high risk, and much less attractive than their other lending options, for example telecom, hospitality, real estate development, and IT. From a banking perspective, this may be logical. However, agricultural development has proven to be a key driver of any developing economy, and providing affordable financing for it is essential.

Working capital for seed companies needs to be affordable, given the relatively modest profit margins, and it also needs to be scalable if a company is performing well. Seed company growth is nearly impossible without access to working capital at levels commensurate with growth.

In developed banking sectors, growing companies are able to access working capital lines of credit. These lines are tied to performance measures and loan covenants. For higher performing seed production companies in SSA, it is time to bring some of these banking practices to the seed sector, ideally tying them to low-cost financing options. Strengthening working capital provision and partnerships will go a long way to ensuring growth in the seed supply.

6.1.3 Continuing to make subsidies smart, and to "do no harm"

Increased awareness of the qualities of smart subsidies should underpin efforts to support the private sector in large-scale dissemination of modern varieties of the target crops. With the move to farmer choice in subsidy purchases, for both crop and variety, the foundation has been laid for seed companies to assess and work to meet farmer demand for target crops—if these crops are included in subsidy programs. As noted earlier, the body of research on seed subsidies has not yet been created. A key element of research should be exploring the economic argument for subsidising initial dissemination of formal-sector seed of modern varieties for the target crops.

In addition to understanding how subsidy programs can support private-sector activity and volumes, subsidy programs must also be examined through the lens of potential harm to local and regional businesses. Subsidy design elements that crowd out the private sector, and implementation practices such as late payments—which have the potential to derail a company's production cycle—must be closely monitored and their effects mitigated. The timing of subsidy payments is a key consideration here. Many companies reported that they are not able to obtain bank financing using delayed government subsidy payments as promise of future repayment.

6.1.4 Maintaining seed companies' business identities

In a sector that has a very high rate of donor involvement, the lines between donors and businesses can begin to blur: NGOs begin to operate as quasi-businesses, potentially crowding out real local businesses that are dependent upon customer revenue for their continued survival, and businesses begin to operate as quasi-NGOs, looking for donor money to support them and focusing on project timeframes rather than the longer horizon work of building sustainable retail channels. Farmers lose in the long term when this happens, as the development of solid market-based systems is delayed, and the systems that do emerge are often distorted. These distortions can show up as seed companies continuing to engage with agrodealers that do not pay them on time since cash flow is coming from donor projects; as seed companies diverting seed volumes intended for retail channels to donor tender offers; or as seed companies failing to diversify their product lines because donors are supporting them to grow volume of seed for a particular crop.

If seed companies are to be viewed as key suppliers for donor projects, informal seed sector multiplication efforts, and subsidy programs, or as partners for donor projects, these transactions should be carried out as true business transactions, with underlying contracts and terms of performance, in order to both preserve and enhance the

commercial nature of the businesses. One of the best ways to become a good businessperson is to do business—to experience the ups and downs, challenges and successes. In SSA, we risk encouraging the emergence of businesspeople who are not good at running a business but very good at connecting with donors. To avoid this, we must engage them through real business practices and partnerships. Clear contracts, quality-control checks, sufficient and timely payments to enable performance, and flexible contract terms are all essential elements of engaging seed production and distribution entities as businesses.

6.1.5 Clarifying appropriate roles for certified, standard, and QDS seed

Certified, standard, and QDS seed all carry varying levels of quality-control costs and, presumably, benefits to the farmer. There are also varying regulations related to who is able to engage in production of each class of seed, and in the case of QDS seed where they are allowed to sell it. These categorisations may have made sense in the early stages of seed sector development in focus countries, but in some countries it may be time for these categorisations to be updated.

Across SSA we see highly varied approaches to certified, standard, and QDS seed. In South Africa, for example, certification is not mandatory for local sales, and the formal sector is permitted to produce and sell seed that would be labelled as standard or QDS in other countries. Seed volumes are high and gaps in supply are not cited as constraints. In Kenya, on the other hand, certification is mandatory for a very long list of crops, and there is no QDS system. Anything labelled as seed must be produced in the formal sector, according to existing regulations. Not unsurprisingly, volumes for seed other than maize are low.

Particularly for the target crops for this study, restricting formal sector producers to certified or standard seed, and asking them to compete against QDS providers who may not even be regulated in terms of how they package their seed, most likely slows the flow of formal-sector seed volume in the system. In parallel, however, asking a QDS provider who has developed good expertise and is located in a favourable seed production environment to restrict its sales to a relatively small geography also slows the flow of semiformal and informal seed volume in the system. In light of the advances in development of a local private sector, it is time to explore new approaches and new models to scale seed availability, with a view to maximising seed quality and sustainability of supply.

Seed under microscope

Tractor spraying soybean fields

6.1.6 Supporting awareness and adoption of new varieties

The seed sector in SSA operates in a relatively high-cost environment: primarily rain-fed seed production, weak extension support, low levels of experienced management and production talent available for hire, small package sizes, and more. The challenges are well known. In the early stages of the development of a seed industry, it is not realistic to also expect young national and regional seed companies to invest heavily in increasing awareness and driving adoption of new varieties based on their retained earnings. This is an area where donor and government support is very valuable, but only if strongly linked to private-sector seed production volumes and distribution channels. For successful companies, this investment capacity changes over time, but the reality is that marketing investment will always compete with infrastructure investment and working capital needs in the first eight to ten years of a company's life, in the absence of high levels of start-up capital.

Some of the most effective approaches are employed by deep-pocketed multinationals when marketing hybrid maize and sometimes seed for other crops. Vernacular radio advertising is a particularly effective way to make farmers aware of new varieties, but it is often unaffordable for smaller seed companies. Additional effective—but relatively expensive for a young company when scaled—approaches are small pack dissemination, demonstrations, field days, and agrodealer development. These are areas where donor and government support can play important roles. Again, this support should be viewed through the lens of a sustainable local private sector that will continue to supply seed for the target crops when donor support for the project ends, with donor projects focusing on viable handover and exit strategies, as well as capacity-building in local companies.

6.1.7 Implementing harmonisation

Implementation of seed trade harmonisation regulations within the Regional Economic Communities (RECs) has been underway for many years, with the process receiving even more urgent attention from the Common Market for Eastern and Southern Africa (COMESA) following the global food crisis of 2008. When completed, harmonisation will set the stage to remove trade barriers and expand geographic markets for improved seed, with the goal of increasing seed choices and improving yields for smallholder farmers. Other potential benefits may include increased capacity for quality assurance among National Designated Authorities (NDAs), leading to a more competitive agricultural sector through commercialisation of smallholder activities arising from increased opportunities. Harmonisation may also allow for the ability to trade more freely in cross-border breeder, pre-basic, and basic seed, while the potentially faster releases of varieties across member countries would allow for more timely responses to emerging disease, pest, and other pressures.

At present these benefits are largely envisioned rather than realised, although cross-border seed trade has increased in the last decade. Implementation has started, however, and includes activities such as preparing work plans for member states, capacity enhancement of NDAs, development of seed databases, in-country establishment of technical working groups, and developing monitoring and evaluation (M&E) frameworks. Already countries (such as Mozambique and Tanzania) are preparing for International Seed Testing Association (ISTA) accreditation.

The completion of this complex harmonisation process will probably take a few years, necessitated by differences among individual countries' legal frameworks, capacity of NDAs, farmer needs and awareness, structure and capacity of the private sector, and the increased costs of regional harmonisation such as catalogue and variety maintenance fees.

Harmonisation is the central dynamic because it holds the key—if implemented well—to increasing overall competition, expanding market opportunities for high-quality seed producers, and allowing high-potential seed production areas in the focus countries to become sources of imported seed for the other countries.

6.1.8 Improving seed sector coordination and information

As highlighted early in this study, getting modern varieties of seed of the target crops to farmers happens through relatively complex systems—formal, semiformal, and informal. The key word here is *systems* and, as with any system, a seed system works best with good information, coordination, feedback loops, knowledgeable participants and operators, and an enlightened perspective regarding the impact of one part of the system (and its participants) on other parts of the system (and its participants).

As seed systems evolve and mature in SSA, coordination, understanding, and mutual cooperation are essential. There are excellent examples of where these critical elements are beginning to emerge: for example, the involvement of private-sector players in the Malawi subsidy design, and the strong focus on enabling the private sector within the seed certification approach in Zambia. However, much work remains to be done in most of the focus countries. The development of reporting mechanisms, collaborative working groups, and meaningful information platforms can go a long way toward catalysing the type of coordination that any system needs in order to thrive.

6.1.9 Accounting for varieties and seed after variety release

As stated earlier in this report, 48% of the more than 200 varieties of the target crops released in the focus countries through 2015 have been commercialised. However, little is known about commercialisation levels, farmer adoption or satisfaction, or whether there have been varieties that have been licensed but not produced and sold. Little is also known about the reasons why varieties have not been licensed or commercialised. Given the significant amounts of donor and government funding that support breeding, a clearer understanding of what happens to varieties, and seed of the varieties, after release is warranted. A further reason for such tracking is that variety maintenance can be costly, and it is unrealistic to assume that a variety will be maintained in perpetuity in the absence of farmer or seed company interest.

A related but somewhat controversial question can be raised related to deregistering varieties. Developing stronger practices around tracking variety introduction and acceptance, or lack of acceptance, may inform national programs about varieties that no longer need to be maintained, or that should be phased out in favour of newer, better varieties. Multinational seed companies regularly phase out varieties, as do certain countries such as South Korea, where the seed sector is centrally controlled by government.

6.1.10 Improving coordination of donor and public investments

Given the high level of donor involvement in the crop-seed sector in SSA, a question demands attention: why is the sector, other than for maize, still so undeveloped?

One answer is that donors have frequently worked at cross purposes, particularly in production and distribution activities, which are the focus of this section. There are concrete examples of burgeoning young local companies, supported by a donor, that have invested for several seasons to bulk and produce a commercial crop of seed and finally go to market with it—only to discover that another donor is funding free, or highly discounted, seed. It is also common to find that a company, with donor support for expansion, will spend several seasons bulking parent seed and producing a certified seed crop, only to ultimately respond to a tender offer from another donor because it is cash-constrained, rather than building local retail distribution for the seed. The tender seed often goes to another country or region, and the opportunity to supply product through local distribution channels, for local customers, is lost. As noted earlier, there are also numerous examples of well-intentioned subsidy programs, designed and funded in part by a donor but implemented by government, that pay seed companies extremely late (or not at all), thus paralysing the company, which

has been supported over multiple years through coaching, training, and financial support by other donors. In these ways, and many others, sustainable progress is stymied. Lack of coordination among donors, governments, and the private sector has been slowing, and sometimes preventing, meaningful progress.

Another answer is that sometimes donor involvement is not underpinned by deep knowledge of seed science and systems. A key example of this when donors believer that seed can be made available on short notice to meet tender offers. In season, or even prior to season, donor tender offers for seed are hugely disruptive to the development of reliable market channels for local distribution, and also encourage fake and low-quality seed practices. In Zambia, for example, no fewer than six separate informants spoke in September about the tender for 150 metric tonnes of groundnut seed that had just been floated by a donor for November planting. Available seed was already committed, with the result that the tender would go unfilled. In a country with a less-developed seed sector, the tender most likely would have been filled through questionable means.

Any future seed-sector activities in the focus countries should be based on full knowledge of the programs and projects already operating there, to avoid either duplication or cancelling out. This will require openness and collaboration.

A partial list of current and recent projects mentioned during the field visits and in the literature review is given in Table 14 below. Further intensive research would be needed in each country to develop a comprehensive list and full understanding of the focus and operations of each project.

Table 14: Partial list of donor programmes with a crop-seed element operating in focus countries

Malawi	Mozambique	Tanzania	Zambia	Zimbabwe
AGRA-PASS	AGRA-PASS	AGRA-PASS	AGRA-PASS	FAO
SSTP/USAID	SSTP/USAID	ISSD	DTMA	ISSD (proposed)
DTMA, WEMA ICRISAT, CIAT	DTMA, WEMA SEMEAR- USAID	CIAT	WEMA	ICRISAT
MISST-USAID	CARE, SNV	SSTP/USAID	APPSA	Swiss Dev't
APPSA, Irish Aid, EU, DFID-BIF, SEMEAR-USAID	InovAgro	DTMA	UNDP	CIMMYT
	FAO	WEMA		Seeds and Markets Project/ Palladium
		ICRISAT		AECF
				DTMA
				WEMA

Source: *Authors' partial compilation from field interviews*

6.1.11 Making community seed supply an option for farmers, not the option

For the target crops, all too often the only option available to farmers when they wish to access fresh seed of a modern variety, sometimes a variety they have never tried before, is a community-based seed production scheme, often organised as part of a donor project. Most often, if the seed is allowed to be produced as QDS, it is produced and sold locally by community-based farmers; seed companies are generally not permitted to produce QDS.

Limiting registered seed companies to only the certified and, when permitted, standard seed segments reduces farmer choice, prevents an open and competitive market which would increase overall seed quality, and severely limits a seed company's ability to expand its product portfolio. Seed companies in more mature markets move from simply being suppliers of maize seed to delivering broader product lines to the customers they serve, and they are also keenly interested in producing non-maize seed as a rotation or isolation crop for maize. We are beginning to see this type of interest in national and regional seed companies in SSA.

In addition, it is very easy for fake and low-quality seed to permeate the QDS market. A key source of low-quality QDS seed is produced from parental seed that is no longer pure or disease-free. As the number of viable local seed companies has increased in many of the focus countries, the overall categorisation of seed classes—certified, standard, and quality-declared—should be reviewed for seed of the target crops with a view to maximising farmer options and overall competition and seed quality.

In India, the Truthful Label approach has been successfully employed to farmers' benefit. Seed companies do not need to certify seed, but they do need to stand behind the representations made on the seed package label, which must meet or exceed minimum standards set by the government. Seed companies that do not comply with the Truthful Label

approach risk losing their license in the states where they are found to be misrepresenting the quality of their products. Farmers come to know and trust brands that label truthfully.

In South Africa, companies can choose to certify, or not certify, their seed, and there are several levels of certification offered, for which the cost to customers will vary. It is estimated that approximately 70% of all seed produced in South Africa is certified, with the rest being sold to farmers who understand that they are buying uncertified seed. Both of these approaches effectively open up options of producing the equivalent of standard or quality-declared seed to the formal sector, and as a result farmers have greater choice, and benefit from a competitive seed sector driving higher seed quality. These approaches also allow seed producers who would be considered informal sector players in SSA to become formal sector players, as long as their quality meets minimum standards. Again, farmer choices and competitiveness are increased.

6.1.12 Improving seed information systems

A major challenge in developing strategies and approaches to improve seed availability to farmers is the lack of usable information to inform decisions. Figures tend to be outdated, not presented consistently (or at all) over time, contradicted by other data (sometimes from the same source), too aggregated to be useful, and/or available only upon a personal meeting with the compiler (and even then, often only in hard copy or pdf format.)

Furthermore, there is a great deal of useful data that is not even collected. For example, a dataset that would be extremely useful to determine the status and growth of a country's seed sector, if collected on a regular basis, is given below. This data focuses on consolidated sales data, as opposed to production data, which is generally what is collected, albeit inconsistently. Sales information could easily be collected on a confidential basis shortly after year-end by a trusted third party, consolidated, and used to inform policy decisions, determine the effectiveness of sector development activities such as subsidies, and provide information for private-sector investment decisions. The Seed Trade Association of Kenya is currently undertaking this exercise for the first time through Deloitte.

Table 15: Illustrative example of useful sector data

YEAR:	Maize							
	Hybrid	OPV	Cowpea	Ground-nut	Millet	Pigeon Pea	Red Sorghum	White Sorghum
Sales								
Total MT sold to farmers through AD or direct								
Total MT sold to public sector								
Total MT sold to NGO's								
Total MT exported								
Total MT sold								
Seedprice (currency=)								
2 kg package								
10 kg package								
Other (specify)								
Seed package size (MT sold per category)								
1 kg package								
2 kg package								
5 kg package								
10 kg package								
Recommended seeding rates (kg/ha)								

Source: *Authors.*

Additional levels of detail, such as seed sold through subsidy programs, or seed of climate smart varieties sold, could be added.

Lack of good, usable seed sector data is not unique to the focus countries or target crops. Even countries like Kenya, which are viewed as having relatively mature sectors, have not historically had easily accessible information on varieties or sources of seed. However, this is beginning to change in a few countries. Web-based platforms and apps are beginning to appear. Three key examples are the Seed Sector Platform KENYA (www.seedsectorplatformkenya.com), Uganda's Agricultural Inputs Platform (www.agricinputsuganda.com), and Kenya's MbeguChoice crop seed variety recommendation site and app (www.mbeguchoice.com). *(Disclosure: Agri Experience partnered with donors, government and private sector to develop these information platforms.)* An example of the type of information provided to users of MbeguChoice is provided in Annex 6. MbeguChoice incorporates climate smart filters, which allow users to search for varieties by climate smart attributes such as maturity or resistance to pest and disease.

As highlighted earlier, one area for which robust information is extremely difficult to obtain is variety dissemination. This gap is particularly important for this study as all of the target crops can be recycled, and thus dissemination occurs outside the initial sale.

An important recent development has been the establishment of a seed sector index, TASAI, which measures the enabling environment for farmer access to seed by calibrating more than 15 variables. TASAI (www.tasai.org) is currently in the process of adding Mozambique, Malawi and Tanzania to the pilot countries (which included Zimbabwe) in the index. Results should be available in early 2017 at the latest.

Despite these good, early efforts to gather data and evidence, however, there are still important gaps in seed systems data and information. In addition to the almost complete absence of reliable information about seed sales volumes by country, primary among these gaps is the lack of data in the following areas: (1) subsidy volumes; (2) variety dissemination; (3) agrodealer volumes and capabilities; (4) EGS seed requirements; 5) and actual grain market needs and potential seed requirements to meet these needs.

Difficulty in collecting consistent, easily accessed, easily analysed data was a constraint for this study. This has resulted in a less-than-ideal foundation for understanding the key issues and making recommendations. However, this also offers an opportunity for donor support and research, as experts interviewed in all five focus countries cited the lack of access to meaningful data as a key impediment to sector development.

Pearl Millet

Section 7:
Country overviews

7.1 Malawi

7.1.1 Background

Malawi has a relatively well-developed formal seed structure and a parallel informal seed system. The Ministry of Agriculture's Department of Agricultural Research (DARS) has been carrying out research for improved varieties of the focus crops and has released several improved varieties (see Annex 2). However, releases of OPV maize varieties have slowed down recently, with the last releases made in 2009. CGIAR centres such as ICRISAT, CIAT, CIMMYT, and the International Institute of Tropical Agriculture (IITA) have a strong presence. ICRISAT Malawi is strongly involved in research and EGS production of pigeonpea and groundnut, not only for Malawi but also for other countries within the region.

There were 22 registered seed producing companies in 2016, of which four are multinational companies producing mainly hybrid maize seed, although some of these are now venturing into other high-value crops such as groundnut, beans, and pigeonpea. Several of the local seed companies produce seed of groundnut, pigeonpea, cowpea, and OPV maize. A new seed company has produced certified sorghum seed only in the last season and has not yet made it available to farmers. There is no commercial production of pearl millet yet.

Malawi also has an informal seed sector, with many organised farmers' groups, cooperatives, and associations. Some of these, such as NASFAM and ASSMAG, are fairly large and strong, and have graduated to the formal system, having won tenders in the past to produce certified seed for the FISP program, other large donor initiatives, and the export market. Malawi has several large grain market actors such as the Agricultural Commodity Exchange, Auction Holdings, and Export Trading Group.

7.1.2 Market context

The FISP, which has been running for eleven years, is an initiative that focuses on seed technology dissemination, and is the largest off-taker of improved seed from producers. The program is unpredictable, however, because changes to the format are made every year, and it is very inefficient in terms of deliveries made by public-sector players. Payments to suppliers are always delayed, and the situation has grown worse since 2013-14 season. Major changes were made in the 2015-16 FISP program, including expansion of private-sector retailing in selected districts, which was more efficient than public-sector delivery, increased farmer contribution and random selection of beneficiaries.

The FISP program is still the main buyer of seed (USAID/ICRISAT seed supply workshop, August 2016), although this year only 900,000 farmers are targeted, down from 1,500,000 last year. The program allows for flexibility in legume crop options. Packet size will also be flexible, and farmers can top up to obtain the amount of seed they wish to have, above the prescribed 4 kilogrammes for hybrid maize, 5 kilogrammes for OPV maize and 2 kilogrammes for legume seed. A number of private companies are cautious about tying their capital in FISP due to long delays in payment.

There is general focus on hybrid maize both by FISP and private companies. OPVs were introduced into the FISP when legumes were incorporated. Although a small niche for OPVs exists in very dry areas such as Southern Malawi (Shire Valley), farmers are generally aware of the merits of hybrid technology and seem willing to purchase hybrids. This year, the FISP program limited the choice of maize per company to either hybrids or OPVs, and not both as was the case in previous years. Most companies opted for hybrids. This has led to a shortage of varieties such as ZM309.

Groundnut is the leading legume both in production and consumption, and is a commercial crop in addition to a food security crop, so there is high demand for seed. Seed supply is far below estimated demand. ICRISAT has been running a well-documented project for groundnut seed in Malawi, which entails introducing new varieties, training and contracting growers, taking back the seed from the growers, and driving further dissemination.

One seed company has started production of certified sorghum seed. FISP has also included sorghum in its list of cereal seed. Sorghum is a staple of the Shire Valley, but it is hardly consumed in other parts of the country. In recent years, it has become difficult to produce maize in this area due to little rainfall.

Discussions are underway between the government of Malawi and the Indian government to sign an agreement for the supply of large volumes of pigeonpea to India. Investments in pigeonpea seed by private-sector companies are increasing. Malawi released some improved pigeonpea varieties in recent years, but adoption has been low as the new varieties are highly susceptible to insect pests, requiring application of insecticides. Farm gate prices may not be sufficiently attractive to drive large-scale adoption of certified seed.

At least four companies produce cowpea seed, mainly targeting the FISP market, albeit in small quantities. The most common varieties are IT82E-16 and Sudan 1. A few agrodealers are stocking cowpea seed, but this is relatively new.

Pearl millet is also consumed mainly in the Shire Valley for domestic purposes, and is not a commercial crop. One seed company plans to venture into certified seed production, although currently there is no certified pearl millet seed on the market.

7.1.3 Seed system enabling environment

The national designated authority for seed quality oversight is the Seed Services Unit (SSU), which is accredited by ISTA. SSU, however, faces capacity challenges, especially for seed inspections (a situation that sometimes compromises seed quality), and has recently received support from USAID's Feed the Future to increase the number of seed inspectors. The Seed Trade Association of Malawi (STAM) has also trained inspectors within companies and works closely with SSU to monitor quality. A new Seed Act currently under review proposes to transform SSU into an autonomous entity called the National Seed Authority, which will be able to accredit private inspectors within seed companies.

7.1.4 Recent developments

Malawi's seed sector is awakening to the fact that FISP will not last forever and that other seed distribution channels are important. Due to the high number of farmer groups, new variety promotion is possible through cooperatives and farmer associations. While such groups are often somewhat dependent upon donor and project funds, they can serve as an entry point for new variety introduction.

AGRA has previously supported breeding, seed production, SME seed company management, strengthening of agrodealer networks, and market strengthening through warehouse receipts. During the 2015-16 planting season, the Seed Trade Association of Malawi, through AGRA support, conducted a massive, countrywide awareness creation effort to sensitise farmers on the importance of using improved varieties and buying certified seed. Most local seed companies acknowledge that they are seeing greater demand for certified seed, especially for newer varieties. More agro dealerships are also emerging as a result of the increased demand for certified seed.

Irish Aid has just commenced second-phase funding for the Malawi Seed Industry Development Project, promising €17 million over five years, with a focus on common beans, pigeonpea, groundnut, sorghum, pearl millet, and rice. Beans have been newly incorporated into this second phase of the project due to the importance of the crop for food security, nutrition, and commercial purposes. Several interviewees felt that beans would be a useful addition into the list of focus crops for Malawi.

Another initiative for seed production and dissemination is the Malawi Improved Seed Systems and Technology Project (MISST), focusing on drought-tolerant hybrid and OPV maize, sorghum, pearl millet, groundnut, pigeonpea, soybean, and orange-fleshed sweet potato. The MISST program has a quality seed production component for smallholder farmers where the focus is ensuring adequate supply of breeder and basic seed to serve the commercial market. They are engaged in building capacity for SSU as well as contract farmers, and encouraging technology adoption through use of demonstrations.

7.2 Mozambique

7.2.1 Background

The Mozambican seed system is composed of informal, NGO and farmer organisation channels as well as a weak formal seed system. There are 42 registered seed companies in Mozambique, including three multinationals, but volumes are very low and many companies are still in their infancy or have become largely inactive. Several nascent companies are involved in production of the focus crops, including Ikuru, Klein Karoo, Oluwera, Phoenix, Nzara ya Pela, GNB, Zembe, and Emilia. Farmer cooperatives such as Helveticas are also involved with different seed production and dissemination projects.

Generally, there is very low farmer purchasing power. Availability of complementary inputs such as fertilisers and crop chemicals is a challenge that in turn impacts negatively on the adoption of new varieties that may need additional inputs, such as insecticide for some pigeonpea varieties.

Mozambique has an emergency seed relief program which is not a FISP program. Ironically however, due to perennial climatic disasters (either floods or drought, both often occurring in the same cropping season in different parts of the country), the emergency program has been running each year for more than a decade. This has become the main seed distribution mechanism, and seed producers often aggregate seed from other sources to meet the large volumes required. Quality is not carefully scrutinised, and some of the seed delivered through this channel may be of poor quality. The distribution is done under a universal government package, which gives very little incentive for private companies to differentiate their products on the basis of quality. OPV maize, cowpea, and sorghum are among crops distributed in the relief seed efforts. The government is facing a challenge of introducing new maize varieties as farmers still ask for the OPV variety "Matuba."

Development partner projects and NGOs are another large off-taker of seed. Seed is also distributed through community-based distribution systems, where lead farmers act as village-based distributors. Some seed producers are using this as a mechanism of marketing their seed. It must be noted that due to the large number of donor interventions and limited private-sector players, many companies handle several donor projects at the same time.

Mozambique has consistently been experiencing climatic challenges. Last season, for example, the central and southern regions were hit by floods and severe drought, respectively, which caused a few of the seed producers in that region to suffer complete crop failure.

7.2.2 Market context

The formal seed sector in Mozambique is very small. Maize seed is available, and OPV maize is popular, but, because government figures do not separate hybrid and OPV maize seed, it is not possible to determine volumes. OPV maize is, however, a dominant crop, although farmers still prefer Matuba to newer varieties. There currently is a huge shortage of Matuba. CIMMYT Harare is supporting popularisation and basic seed multiplication of drought-tolerant varieties through nine companies.

Formal sector seed production for seed of the other target crops has generally been small, but often boosted when there is project funding available. Lack of reliable supply of EGS seed is a big problem, and disruptive for seed production.

Only one company so far is commercialising sorghum seed. However, ten to fifteen hybrid sorghum varieties will be put forward to the release committee by the Institute of Agricultural Research of Mozambique (IIAM) in the near future. It is not clear, though, that there is good production capacity in the country for hybrid sorghum. Sorghum has been added to the relief program and there is increasing demand in the north. Of the eight currently released varieties. Macia, which was released prior in Mozambique in 1989, is still the most popular variety due to its early maturity (60 days) and high yield.

Pigeonpea seed demand is increasing, as commodity production has been growing steadily driven by the Asian market. The government of Mozambique signed an MoU with the government of India in 2016 for pigeonpea grain exports of 200,000 metric tonnes annually, which would mean at least a doubling of current production. Two processing plants have been installed in Beira and Nacala, and a smaller one in Gurue. The Ministry of Agriculture is preparing a promotional campaign among smallholders for production for the export market. IIAM has also released two medium-term and two long-term varieties, but adoption is very low, due to the fact that the new varieties, especially the medium-term ones, are highly susceptible to insect pests. IIAM has calculated that at a seeding rate of 10 kilogrammes per hectare, at least 2,000 metric tonnes of certified seed will be required to meet the pigeonpea volume in the MoU, given a yield of 1 metric tonne per hectare and a seeding rate of 10 kilogrammes per hectare. Hybrid pigeonpea seed from India will be evaluated in the next season for performance.

7.2.3 Seed system enabling environment

The seed sector is characterised by a very weak certification system, very few private seed companies, and a sparse agrodealer network. Perennial seed shortages do not entice agrodealers to stay in the business. Low buying power among farmers does not entice growth in the private sector. Notably, Mozambique has seen probably the highest proportion of failed start-up seed companies in the region. The National Directorate of Agrarian Services (DNSA) is responsible for seed inspections leading to certification and quality control, but is very poorly staffed, with only three inspectors serving the Nampula corridor. Costs of inspection are relatively high. This has been recognised as a key challenge, and efforts to increase this capacity are being supported. Unidade de Semente Basica (Unit for Basic Seed—USEBA), the institution

charged with production of basic seed for public varieties, has had a long history of inefficient and poor-quality basic seed supply, leading to scarcity and mistrust of EGS. The national research institute, IIAM, has released several varieties (see Annex 2), but commercialisation is still a challenge. IIAM is also underfunded in several activities, such as production of breeder seed and seed storage. Collectively, these challenges discourage private investment in the seed sector, which results in a very fragile system.

7.2.4 Recent developments

In the last decade, Mozambique has had a fair share of investments in the seed sector by organisations such as AGRA in capacity-building, research, and seed production. A new USAID-funded initiative known as SEMEAR is looking at disseminating improved varieties of cowpea, pigeonpea, groundnut, common beans, sesame, and soybean in Nampula, Zambezia, Manhica, and Tete Provinces. SEMEAR is a five-year project led by IITA but also involving CGIAR centres such as ICRISAT and CIAT. The aim is to enhance production of breeder and pre-basic seed, and to multiply basic seed for supply to seed producers. The project will be promoting adoption through farmer training, demos, field days, and use of radio programs. Distribution will be done through a network of seed companies, agrodealers, farmer associations, and seed growers. This project is in the early stages.

SNV is implementing a project working in nine out of the ten provinces for food and nutrition security. In Tete Province, it is carrying out integrated soil fertility management interventions on maize and pigeonpea intercrop. However, there is scarcity of pigeonpea seeds, which had to be sourced from ICRISAT Malawi. INOVAGRO, another project currently in its second phase, looks at pigeonpea, groundnut, maize, soybean, and sesame value chains. Interventions include access and use of quality seed, increased extension support, use of mechanisation services, and access to output markets, with a target of reaching 17,000 smallholders by 2017. A third phase for 2018-23 is currently at design stage.

FAO has initiated a voucher program, which since 2014 has had a seed component targeting awareness creation through demonstrations in five districts of four maize varieties, including two hybrids, two cowpea varieties, two bean varieties, and rice. Initially, EGS of some varieties was not available, making it necessary to support production and maintenance of pre-basic and basic seed through an MoU with IIAM. FAO also supported the installation of a cold storage facility at IIAM Maputo. The aim of the program is to ensure availability of both seed and other inputs for both subsistence and emergent farmers (i.e., those who sell part of their produce). This is scheduled to move into a flexible program to include groundnut and pigeonpea, among other crops. An e-voucher program was started last season in Manhica province and will expand to Sofala, Nampula, and Zambezia provinces.

The National Dialogue for Seed Sector was formed three years ago to address policy and other issues related to seed availability. It has recently been registered as a legal entity and has developed its first strategic plan. There are challenges with funding, however, and it is not very effective. APROSE is an association of industry players that has been formed to push for minimal reforms in policies for agricultural inputs, and it seems to be gaining momentum.

There was consensus among interviewees that farmers are likely to adopt new varieties that offer market opportunities. This has happened in the past with paprika and sesame.

7.3 Tanzania

7.3.1 Background

Tanzania's seed sector has shown great change since 1989, when the government launched the National Seed Industry Development Program to diversity the seed industry, moving away from complete government production. There are currently 58 national seed companies and five regional and multinational seed companies producing increasing volumes of certified seed for a variety of crops. Local certified seed production volumes for all crops for both the 2014-15 and 2015-16 seasons totalled approximately 21,000 metric tonnes, with a further 15,000 metric tonnes of certified seed being imported. Maize is the dominant crop, and seed is sold through an extensive network of agrodealers.

While overall usage of modern varieties is estimated to be fairly modest in Tanzania, with DIIVA estimates placing it at 23.7%. Use of certified seed is increasing, however, and farmer awareness of the benefits of high-quality seed of modern varieties is rising. As with the other focus countries, maize is the dominant crop. Tanzanian farmers are increasingly adopting hybrid maize, but OPV maize still plays an important role, particularly in coastal areas.

The private sector contains both multinational and local seed companies. Several of the local companies (Meru Agro, IFFA, Namburi Agriculture Co.) are viewed as high-potential and well-managed, and are growing. The multinational companies' volume of seed for food crops is almost exclusively hybrid maize.

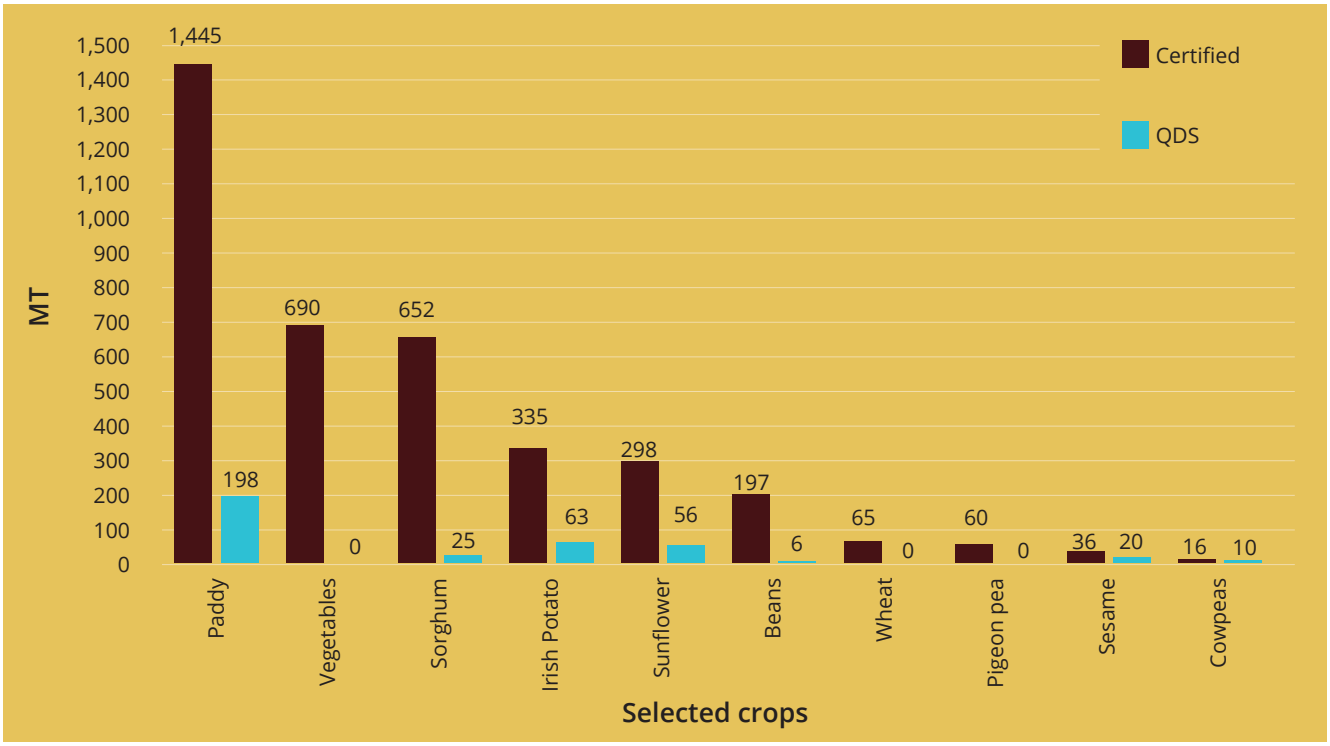
Tanzania has a network of agrodealers, but for the most part they sell seed only for maize and vegetables. Both government and seed companies highlight opportunities to improve the agrodealer distribution system by strengthening seed knowledge, business capacity, and overall professionalism.

Tanzania also has a QDS production system, which was established with the support of DANIDA around the turn of the century. QDS figures reported by the Ministry of Agriculture, Livestock, and Fisheries place QDS seed volume for all crops at an average of 330 metric tonnes per year over the last nine years. (These figures are disputed by some donor project coordinators, including ICRISAT, as noted earlier in the report.)

Tanzanian regulations also recognise standard seed, but this is limited to relief use only, when approved by the MALF.

Figure 6 below illustrates 2014-15 volumes for both certified and QDS seed for crops other than maize.

Figure 6: Certified and QDS non-maize seed produced in Tanzania, 2014-15 (MT)



Source: *MALF (As noted earlier, ICRISAT disagrees with the QDS volumes)*

The QDS volumes as reported by the government are quite modest, but do contribute to overall volumes. (As noted earlier in the study, data from various donor projects is not in line with figures supplied by the government. No representation is intended to be made here regarding the accuracy of any particular data set; the disparity is simply noted.)

In 2006-07 the government started a subsidy voucher program to provide inputs for 1 acre for targeted farmers. The voucher covered maize or paddy seed, as well as fertiliser for use at planting time and also for later top dressing. This program subsequently became known as the National Agriculture Input Voucher Scheme (NAIVS). It continued until 2013-14 but then ceased due to funding challenges. The government then urged banks to give credit to farmers, and farmers to take credit, but the response was low on both ends. Some seed companies experienced late or non-payment, which created challenges in continuing with seed production, with some companies struggling to stay afloat.

As reported by MALF, the government stated that it was going to bring back NAIVS for 2015-16, and it rolled out a program. There were numerous challenges, largely tied to late or non-payments for inputs. There are plans to implement NAIVS again in 2016-17, but the source of money to fund the program is unclear.

NAIVS volume is reported to be low, relative to overall certified seed volumes, possibly indicating that NAIVS has played a key role in assisting farmers to access new varieties but has not evolved into a subsidy that is distorting the seed sector or propping it up on an ongoing basis. At present, many seed companies are increasingly focused on selling seed outside of the subsidy program.

7.3.2 Market context

Cash crops are becoming increasingly important in Tanzania and driving demand for seed. In the past, there have been examples of commercial markets that drove both demand and supply for modern seed varieties; the two most notable are sesame and sunflower. There is a strong sense that a commercial market for groundnut exists, and value-chain work is currently underway as part of the TLIII project. Another crop that is currently experiencing increased demand for seed is pigeonpea, driven by the export market to India. ICRISAT reports that local consumption of pigeonpea has grown as the commercial export market has grown. Sorghum is grown in Tanzania, largely but not exclusively for the brewing industry. However, Nyamburi Seed Company reports that sorghum has recently been prioritised by MALF as a food security crop in Tanzania, and sorghum seed has been added to the list of crops eligible for subsidy.

7.3.3 Seed system enabling environment

The seed system enabling environment has continued to improve since the sector was first liberalised. At present, there are myriad opportunities for continuing the progress, building upon the recent gains, and increasing the professionalism of the sector.

Tanzania Official Seed Certification Institute (TOSCI) is the official entity in Tanzania. While sector participants are generally satisfied with TOSCI for certification, sampling, and testing, there was a clear sense that TOSCI would benefit from decentralisation to improve efficiency and enable it to reach more seed production areas on a timely basis, as well as from improved laboratory capabilities, including ISTA-accredited labs. TOSCI is currently in the process of applying for ISTA accreditation for its lab. One opportunity cited was to establish several labs, whether government or independent, in different regions of the country to more easily provide quality-control services to seed producers. TOSCI plays a key role in supporting the production of quality seed, and sector participants advocated for adequate resources to carry out this important mandate.

On the legislative and regulatory front, concern was expressed over the delay in recent years in finalising the seed-sector regulations. It is anticipated that finalising the regulations will bring additional professionalism and clarity. To some extent, the delay may be tied to discussions (ongoing since 2007) around revising the seed legislation. This situation is not unique to Tanzania. In other countries, such as neighbouring Kenya, sector participants struggle to keep both the legislation and regulations up to date in a rapidly evolving sector.

Most EGS for locally bred varieties, as well as for all QDS seed, is supposed to come from the Agricultural Seed Agency (ASA). However, there are myriad opportunities to improve ASA operations and capacity, because EGS provision through ASA appears to be relatively low, according to experts interviewed. (Data was requested but not provided.) These opportunities include EGS forecasting with seed companies and improved quality control of EGS. At present, absent a strong flow of high-quality EGS from ASA, many seed companies are migrating towards CGIAR-bred varieties for which they can obtain EGS from the relevant CGIAR centre, which risks side-lining commercialisation of valuable locally bred varieties.

ASA has significant land holdings in Tanzania, and to improve cash flow in recent years it has started to lease farms to projects such as the Clinton Foundation's Anchor Farm Project near Iringa, and to seed companies, which use the land for commercial seed production. The seed companies interviewed were very positive about the opportunity to access good land, at scale, for seed production.

For EGS for the target crops, ASA is to access breeder seed from the relevant MALF station researchers, as ASA does not employ its own breeders, and is relatively thinly staffed. There is an opportunity for increased transparency around this process, and a clear understanding of the bulking process undertaken by ASA to meet EGS demand both from seed companies and from QDS producers.

7.3.4 Recent developments

Key recent developments include a project under TLIII that aims to increase groundnut production and is working with over 240 farmers and farmer groups. As the project is still relatively new, it is too early to judge results.

Tanzania is a key focus country for both BMGF and AGRA. AGRA is currently developing a new strategy for Tanzania, after the ten-year PASS program and other AGRA programs drew to a close. It is anticipated that the new strategy will focus on market-led change but will continue to provide some level of support for seed production and distribution, and potentially for EGS and breeding. The USAID-funded SSTP (Scaling Seeds and Technologies Partnership) is also active in Tanzania and supporting several seed-related projects.

At present, seed is handled by a department of MALF. However, it is expected that soon the department will become part of a newly formulated TARI, the Tanzanian Agricultural Research Institute.

The aforementioned 2016-17 subsidy will be worth watching, as there is great uncertainty around if and how it will work. There is a fair amount of reluctance to participate by some private-sector players due to previous non-payment.

Finally, there is a recently released draft study on EGS in Tanzania, supported by USAID and AGRA. This study focused on only four crops, including two—maize and sorghum—that are among the target crops for this study (although the maize most likely was hybrid). The final proposal has not yet been put forth, but it is expected to include meaningful solutions to EGS challenges such as support for government production or for the establishment of private foundation seed companies.

7.4 Zambia

7.4.1 Background

Zambia's formal seed system is fairly advanced compared with most countries in East and Southern Africa. Zambia decentralised seed certification and allowed for private seed certification in 1991. This move gave rise to a competitive seed sector that includes twelve multinational seed companies, five local seed companies, NGOs, farmers' associations, cooperatives, seed projects, and research organisations. However, Zambia's seed sector encompasses a large export segment, which means that about half of the overall production volume is not availed to local farmers.

In addition, the crop seed sector in Zambia is heavily skewed toward hybrid maize. Production levels for other crops are extremely low, especially for the target crops. A further challenge is that distribution distances in the country are very large. Despite this, Zambia has great potential for seed production of crops other than maize, with experienced commercial farmers and 752,618 km² square kilometres of land with potential for irrigation.

7.4.2 Market context

There is increased investment in agriculture by smallholders resulting from a decline in the mining sector in the recent past. Seed prices have almost doubled in the last two seasons. Approximately 80,000 metric tonnes of seed are certified annually, of which 35,000 metric tonnes are used locally and the rest exported. However, seed distribution is heavily skewed toward maize, and particularly hybrid maize. For example, in the 2015-16 season, combined certified seed volumes for groundnut, pigeonpea, pearl millet, sorghum, cowpea, and OPV maize was 5,185 metric tonnes, compared to 57,658.5 metric tonnes of hybrid maize (see Table 16 below). Legume seed is distributed by three companies, mainly through FISP and large institutional buyers. EGS availability is a serious challenge, with many sourcing seed from Consultative Group (CG) centres in neighbouring countries, such as ICRISAT Malawi for groundnut and pigeonpea.

Table 16: Seed production for main food crops in Zambia (MT)

	2014-15 season	2015-16 season
Groundnut	2,361	1,610
Pigeonpea	6	40
Soybean	5,655	7,789
Cotton (OPV)	25,219	36,265
Sunflower (OPV)	421	423
Rice	1,020	1,125
Pearl Millet	99	42
Beans	495	701
Sorghum (OPV)	632	336
Cowpea	422	1,215
Maize (OPV)	1,686	1,943
Maize (Hybrid)	58,500	57,658

Source: *Seed Control and Certification Institute*

Groundnut poses probably the biggest challenge with EGS availability, which must be sourced through ICRISAT Malawi. Groundnut is a commercial crop with a big potential market. Popular varieties include MGV4, MGV5, and Chilimbane. ETG and other processors have been buying groundnut from farmers.

Pigeonpea also has serious challenges—to date, only two varieties have been released in Zambia (Lwangwa in 2001 and ZPP14 in 2015), although there are two varieties in the pipeline bred by a private company that are scheduled for release this year. ETG is looking to buy a lot of pigeonpea, but volumes produced in the country are low. Farmer knowledge of pigeonpea production is also a constraint.

Sorghum has low local consumption and certified seed has been distributed in small quantities. There is, however, potential for use in brewing, and one company is marketing some hybrid varieties.

7.4.3 Seed system enabling environment

The Zambia Agricultural Research Institute (ZARI) carries out research for 27 crops and produces breeder and basic seed. In the upcoming season's seed production, only 2 OPVs are being multiplied (MMH409 and MMH607, targeting 18 metric tonnes per variety). Private-sector seed producers feel that a company producing foundation seed could be a solution to this problem. ZARI is considering setting up a seed unit for EGS production only, because the law does not allow ZARI to get into seed marketing. ZARI faces serious funding challenges, onerous procurement processes, and lack of essential infrastructure such as irrigation facilities to allow for off-season production. It should be noted that weak intellectual property protection is a major impediment to commercialising ZARI varieties. ZARI has just started instituting a genetic access and transfer scheme, but the benefits are yet to reach farmers. Application of royalties and plant breeders' rights is also very weak.

The Seed Control and Certification System (SCCI) is the official national designated authority that oversees seed quality and follows Organisation for Economic Cooperation and Development (OECD), ISTA, and International Seed Federation (ISF) provisions. SCCI has good capacity through accreditation of private inspectors and analysts. In addition to an ISTA certified lab, SCCI has eight satellite laboratories, located in eight out of the country's ten provinces. There are three private laboratories. This lends good infrastructure for certification for crop seed other than maize.

Zambia also has an equivalent of standard seed, which is QDS but certified, although sampling is done at a smaller proportion. This enables efficient production of good quality legume seed.

The biggest challenge for seed producers is availability of EGS.

7.4.4 Recent developments

Zambia has been implementing a Farmer Input Support Programme (FISP) since 2002. The government recognises the need for crop diversification and has added legumes into FISP. However, some varieties that are included in FISP cannot be produced because the parent materials are no longer available. During the 2015-16 planting season, the country piloted the e-voucher system, which targeted 241,000 farmers in 13 districts. The e-voucher system allows for flexibility in the choice of inputs farmers obtain, since purchases are made through the use of an electronic card that enables access to any agricultural input. Demand for hitherto under-commercialised crops is increasing, and new crops such as pigeonpea are finding their way into agrodealer shops. The Ministry of Agriculture (MOA) plans to scale up the e-voucher program to 39 districts in the upcoming season, targeting 600,000 farmers, and has already registered 406 agrodealers. In addition to a focus on catalysing an expanded range of inputs, the e-voucher allows for instant payments and incorporates private-sector participation. An emerging challenge, however, stemmed from poor agrodealer inventory control capacity, where they were unable to apportion purchases to different input suppliers, hence funds are held up in a general pooled account while suppliers are owed money. A reconciliation exercise is underway, spearheaded by the Zambia National Farmers' Union, but progress is slow. The Ministry of Agriculture is partnering with Musika to train agrodealers.

One the initiatives focusing on certified seed distribution is the Agriculture Productivity Program for Southern Africa (APPSA), which focuses on promoting use of certified seed of legume crops in Zambia, including cowpea, common beans, groundnut, pigeonpea, and soy beans. APPSA is a World Bank-funded, six-year regional program covering Malawi, Mozambique, and Zambia, but only Zambia has the legume crops focus, which also includes dissemination of technologies through demos and extension services.

Past initiatives—such as the Climate Change Adaptation Project, which had a seed component—sought to encourage seed production through farmer cooperatives, passing on seed production and storage skills to smallholders. One such cooperative is still active in Kazungura District and sells certified seed.

7.5 Zimbabwe

7.5.1 Background

Zimbabwe is increasingly food insecure due largely to falling crop production volumes and yields. While there are many contributing factors to this, not least of which is the poor economic environment in the country, key contributing factors are sub-optimal access to (1) modern seed varieties for the target crops and (2) market channels to sell excess production. These two areas offer opportunity for meaningful intervention.

The crop seed sector in Zimbabwe is mature. There are 31 private-sector companies operating in Zimbabwe, of which 23 are national companies. Of the seed sold in Zimbabwe, 98% is supplied by private sector. Volumes of seed for the target crops available for sale from private-sector companies plus ARDC (the government seed parastatal) prior to the onset of the 2016 planting season are listed in Table 17. It is not known how much seed from informal seed producers is available for sale, as this data is not collected (personal communication, Seed Services Institute).

Table 17: Private-sector volumes of seed for target crops available for sale in Zimbabwe, 2016 planting season

Crop	Volume available for sale from private-sector companies (MT)	Comments
Cowpea	250	2 companies
Groundnut	175	2 companies
OPV Maize	4,202*	3 companies; representing approximately 10% of total maize seed production
Pearl millet	30	2 companies; an additional 15 MT of finger millet is produced
Pigeonpea	0	Not grown in Zimbabwe
Sorghum	1,945	6 companies; 1,735 MT is white, 210 MT red

**Note that 1,500 MT of this total was produced by one of the companies in a "one-off" situation, so is not normally available.*

Source: *Expert field interviews, with consolidated data provided during interviews*

Maize, wheat, barley, oats, potatoes and soybeans are priority food crops, and seed of these crops is required to be certified. Seed for the other target crops can be sold as standard seed.

7.5.2 Market context

It is not possible to consider potential climate smart seed interventions for seed of the target crops in Zimbabwe without understanding the underlying market context. Smallholders produce food for subsistence, but the key driver (according to all experts interviewed) of farmers' choice of crops and varieties is commercial viability. Farmers want to be able to sell or barter excess production, particularly in light of the current economic hardships in the country.

With the overall decline in agricultural production in Zimbabwe, maize production volumes are now far lower than what is needed to feed the country, yet maize remains the main staple. Maize is imported to meet the shortfall, but dire foreign currency shortages are now threatening even this source of food. (Cereal imports for 2016-17 are estimated to reach one million metric tonnes according to FAO.) As a result of this dynamic, maize offers the best, and most familiar and reliable, commercial market opportunity for smallholder farmers in Zimbabwe. This continues to drive smallholders' willingness to invest in hybrid maize seed.

7.5.3 Seed system enabling environment

Zimbabwe mandates that, among the target crops, seed of maize must be certified. The other target crops can be produced as standard seed, meeting only germination and purity (visual, not grow-out) standards. This had implications for seed production in rural areas.

The Seed Services Institute is responsible for certifying seed, and is well regarded by sector players. The Institute appears to carry out its responsibilities well, despite difficulties in funding and the overall economic operating environment.

Unlike many other countries, seed producers rate the availability of EGS as high because they are free to produce it themselves and carefully manage their own EGS supply chain. Participants further state that the certification system is good, and are generally satisfied with the policy environment.

Distribution of seed is through multiple channels, with government seed distribution occupying a significant share. Seed companies generally tap all channels for their distribution, to spread risk of default, or malfunction, of a specific channel. Table 18 shows seed distribution channels and their relative sizes.

Table 18: Seed company estimates of frequency of use of distribution channels

	N	Regionally based distributors/ depots	NGOs/ relief organisations	Direct to rural stockists	Direct to farmers and farmer groups	Gov't programmes
Maize	14	31%	15.8%	13%	16.5%	23.7%
Sorghum	11	28.3%	20.2%	18.2%	15.1%	18.2%

Source: *Mujaju and Jonga, 2014.*

Seed distribution options appear to be relatively robust for the largest companies, although some informants cited long distances travelled by farmers in marginal areas. For other companies, however, government non-payment for seed has caused significant damage, and some companies have been forced to sell their operations to avoid complete closure. Zimbabwe's largest seed company, SeedCo, has built a sizable production and processing operation in neighbouring Zambia to diversify its risk, and has invested heavily in expansion in numerous other countries throughout the continent.

While there have also been efforts to strengthen agrodealers, interviewees noted that there is significant room for improvement among rural stockists, particularly in terms of timely payment of suppliers and quality of seed storage.

7.5.4 Recent developments

ICRISAT is currently testing and hoping to release addition varieties of the target crops. In addition, based on the success of their groundnut value chain work in Malawi, ICRISAT is planning to bring additional groundnut varieties to Zimbabwe. In the course of the interviews, ICRISAT also indicated that they were aware of the potential for pigeonpea as a possible export crop, and were looking at possible varieties for Zimbabwe.

Formal private-sector interest in the target crops is present. SeedCo is primarily focused on maize, but throughout SSA it is expanding into other crops such as sorghum and soybean. SeedCo also recently bought Prime Seed, which focuses on low-value crops but appears to be primarily selling through bulk purchases and tenders. SeedCo clearly stated that it already has a large distribution system, and would be interested in piloting increased sales of some of the target crops through its system if the economics make sense and if there is market opportunity for farmers.

There appears to be a small but burgeoning rural seed production effort focused on crops such as sorghum, pearl millet, groundnut and cowpea (personal communication, Seed Services Institute, or SSI). However, this effort is highly fragmented, and the market is driven largely by NGOs. At the time of the field interviews, FAO had recently commissioned a field survey to be completed by Dr. Mujaju of SSI. A key conclusion was that there were many new and unexpected initiatives underway in the districts surveyed, with an average of almost three projects active per district. Seed of the target crops was being distributed for free in exchange for additional seed bulking, or distributed at seed fairs run by the NGOs. It was noted, however, that there did not appear to be much coordination or information-sharing among projects, and some projects were unaware of the role of SSI and the need to ensure seed quality, even for standard seed. It was not evident that specialists with meaningful seed expertise are involved with these projects, based on SSI observations.

In the fieldwork conducted for this study, all experts interviewed clearly identified commodity market opportunities as the key driver of farmer adoption of both crops other than maize and of modern varieties of these crops. The crops identified as having the greatest market opportunities were: groundnut, although the production area has declined significantly in recent years; sorghum, due to demand by breweries and export potential to South Africa and Botswana; and pigeonpea, due to the export market, although current experience with the crop is very limited.

Section 8:
Conclusion

Food security in SSA is one of the great unsolved challenges of our time. In the face of climate change and population growth, we urgently need to make significant progress toward long-term, sustainable solutions. Increased production and adoption of modern varieties of climate smart, drought-tolerant crops such as cowpea, groundnut, OPV maize, pearl millet, pigeonpea and sorghum are essential elements of a solution.

Many new varieties of the target climate smart crops have been released, but are commercialised either not at all or at low levels. All too often, farmers have never seen crops of these modern varieties produced. Even if they had, they most likely would not have access to the seed because it is not multiplied and disseminated at significant volumes. This is particularly true for the crops that are the subject of this study. The number of seed companies producing and selling hybrid maize seed has expanded. Most of these companies, however, produce only limited quantities of seed for crops other than maize.

There is increasing testimony from both public and private-sector stakeholders that farmers will buy high-quality seed of modern varieties of climate smart crops. The challenge, frequently, is supply.

Many donor and government efforts have been undertaken to solve this challenge. Formal-sector public and private seed production entities have been encouraged to produce and supply seed to NGOs, relief programs, donor projects, seed fairs, and for government-run subsidy programs. However, volumes tend to be low, and supply dwindles in the absence of project funding. In some countries QDS production has been undertaken and supported, and national and international research agencies have been funded to produce and distribute seed for various development projects. Despite all of these efforts, a sustainable and reliable supply chain for quality seed has not emerged. Instead, results have been driven by the funding and focus behind the next big idea for seed supply.

The paper concludes that the best way to improve farmers' sustained access to a continuous flow of high-quality seed of modern varieties for the target crops is to invest in developing more competitive commercial seed sectors. Supply of seed of modern varieties for the target crops can be significantly increased by focusing donor and government efforts on strengthening private-sector capacity to produce and distribute seed for these crops, and to avoid crowding out and weakening private-sector efforts. Both public and donor investments need to be more market-smart.

Areas of investment focus should include ensuring a reliable supply of high-quality EGS, providing working capital to seed companies, and developing the information required to assess progress in seed-sector development and coordinate donor and market-actor efforts. The difficulty in accessing reliable data is a major impediment to seed-sector development.

In the five focus countries of this study—Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe—seed systems are at various levels of development; Mozambique's situation is vastly different from Zimbabwe's, for example. Specific solutions will vary significantly by country, and will need to be thoughtfully and collaboratively developed. The analysis of all five countries, however, does point to the same conclusion: increased, and increasingly market-smart, investment in local private-sector development offers the best hope for driving production and adoption of the target crops.

"increased, and increasingly market-smart, investment in local private-sector development offers the best hope for driving production and adoption of the target crops.

Bibliography

ASARECA/KIT. 2014. Tanzania Seed Sector Assessment: A Participatory National Seed Sector Assessment for the Development of an Integrated Seed Sector Development (ISSD) Programme in Tanzania. Entebbe, Uganda: Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). 169 pp.

Audi P, Sakwera L, Ziwa R, Letayo E, Ojulong H, Manyasa E. 2015. The effectiveness and complementarity of field days and small seed packs (SSPs) in delivering dryland cereal technologies. Working Paper Series No. 61. ICRISAT Research Program Markets, Institutions and Policies. 32 pp.

Banda HM, Kachule R, Zidana A, Carpena PC. 2013. Malawi seed entrepreneurship assessment. ISSD Briefing Note—April 2013. Wageningen: Centre for Development Innovation Wageningen UR. 10 pp.

CGIAR. 2014. CGIAR's DIIVA Project: A consolidated database of crop varietal releases, adoption, and research capacity in Africa south of the Sahara. Database accessible at https://www.asti.cgiar.org/diiva. Accessed 9 July 2016.

Challinor AJ, Watson J, Lobell DB, Howden SM, Smith DR, Chhetri N. 2014. A meta-analysis of crop yield under climate change and adaptation. *Nature Climate Change* 4: 287-291.

Context Network. 2016. *Kenya Early Generation Seed Study*. Washington: United States Agency for International Development. 83 pp.

FAO. 2016. FAOSTAT database. Rome: Food and Agriculture Organisation.

Kim, JY. 2015. Interviewed by SJ Dubner. Transcript of the Freakonomics podcast, episode "Hacking the World Bank." Available from http://freakonomics.com/2015/02/19/hacking-the-world-bank-full-transcript/.

Mabaya E. 2012. The African Seed Access Index (TASAI): Design. 53 pp. Available from http://tasai.org/wp-content/uploads/TASAI-Design-Final1.pdf.

MALF. n.d. Statistics available from website of Tanzanian Ministry of Agriculture, Livestock and Fisheries. Available from kilimo.go.tz.

Maredia MK, Reyes BA. 2015. Are we measuring what we think we are measuring? Recent experience in using DNA fingerprinting and implications for tracking varietal adoption and assessing impacts. Paper presented at the 2015 AAEA WAEA Joint Annual Meeting, San Francisco, California, July 26-28, 2015.

McGuire S, Sperling L. 2016. Seed systems smallholder farmers use. *Food Security* 8: 179-195.

Monyo ES and Varshney RK, eds. 2016. *Seven seasons of learning and engaging smallholder farmers in the drought-prone areas of sub-Saharan Africa and South Asia through Tropical Legumes, 2007–2014.* Patancheru 502 324, Telangana, India: International Crops Research Institute for the Semi-Arid Tropics. 236 pp.

Mujaju C, Jonga M. 2014. *Zimbabwe seed sector report.* Unpublished report produced for TASAI background study. 48 pp.

Rubyogo JC, Magreta R, Kambewa D, Chirwa R, Mazuma E, Andrews M. 2016. Using subsidised seed to catalyse demand-driven bean seed systems in Malawi. *Development in Practice* 26: 15-26.

Rubyogo JC, Magreta R, Kambewa D, Chirwa R, Mazuma E, Martin A. 2016. Using subsidized seed to catalyse demand-driven dean seed systems in Malawi. Poster for the Pan-African Grain Legume & World Cowpea Conference, 27 Feb – 4 Mar 2016.

Shiferaw BA, Kebede TA, You L. 2008. Technology adoption under seed access constraints and the economic impacts of improved pigeonpea varieties in Tanzania. *Agricultural Economics* 39(3): 309-323.

Sperling L, McGuire S. 2010. Persistent myths about emergency seed aid. Food Policy 35(3): 195-201.

Spielman D, Smale M. 2016. Policy options to accelerate variety change among smallholder farmers in South Asia and Africa south of the Sahara. Unpublished report. 62 pp.

Tittonell P, Giller KE. 2013. When yield gaps are poverty traps: The paradigm of ecological intensification in African smallholder agriculture. Field Crops Research 143: 76-90.

World Bank. 2008. *World Development Report 2008: Agriculture for Development.* Washington D.C. World Bank. 52 pp.

Annex 1:
Full list of reviewed literature

ACBIO. 2015. *The expansion of the commercial seed sector in sub-Saharan Africa: Major players, key issues and trends.* Johannesburg: African Centre for Biodiversity. 79 pp.

AGRA. 2006. *Program for Africa's Seed Systems: Country report: Mozambique*. Nairobi: Alliance for a Green Revolution in Africa (AGRA). 72 pp.

AGRA. 2007. *Country report: Tanzania.* Program for Africa's Seed Systems (PASS), AGRA. Unpublished report. 71 pp.

AGRA. 2010. *Final narrative report of project "Enhancing farmers' initiatives for multiplication and dissemination of cassava virus tolerant planting materials in Zanzibar*. Unpublished report. AGRA. 17 pp.

AGRA. 2015. *Progress Report: 2007-2014*. Nairobi: Alliance for a Green Revolution in Africa (AGRA). 67 pp.

AGRA. 2016. *Malawi early generation seed study*. Unpublished first draft. 91 pp.

AGRA. 2016. *Mozambique early generation seed study*. Unpublished first draft. 137 pp.

AGRA. 2016. *Tanzania early generation seed study*. Unpublished first draft. 137 pp.

ASARECA/KIT. 2014. *Tanzania Seed Sector Assessment: A Participatory National Seed Sector Assessment for the Development of an Integrated Seed Sector Development (ISSD) Programme in Tanzania*. Entebbe, Uganda: Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). 169 pp.

Audi P, Sakwera L, Ziwa R, Letayo E, Ojulong H, Manyasa E. 2015. *The effectiveness and complementarity of field days and small seed packs (SSPs) in delivering dryland cereal technologies.* Working Paper Series No. 61. ICRISAT Research Program Markets, Institutions and Policies. 32 pp.

Banda HM, Kachule R, Zidana A, Carpena PC. 2013. *Malawi seed entrepreneurship assessment.* ISSD Briefing Note – April 2013. Wageningen: Centre for Development Innovation Wageningen UR. 10 pp.

Bandiera O, Rasul I. 2002. *Social networks and technology adoption in northern Mozambique*. London: London School of Economics and Political Science.

Bishaw Z, van Gastel AJG. 2008. ICARDA's seed-delivery approach is less favourable areas through village-based seed enterprises: Conceptual and organisation issues. *Journal of New Seeds* 9: 68-88.

CABI. 2014. *Good Seed Initiative: A strategy for CABI-led work on seed systems in Sub-Sharan Africa and South Asia, 2014-2019*. Available from www.cabi.org. 32 pp.

CARE. 2003. *Final evaluation of the VIDA I project*. Unpublished report. 60 pp.

CARE. 2010. *Pedaling power: CARE and Zambikes go the last kilometre for input supply in rural Zambia*. Market Engagement Series, August 2010. 4 pp.

Charyulu DK, Bantilan MCS, Ndjeunga J, Mausch K. 2014. *Revisiting adoption and adaptive capacity parameters for impact assessment: Synthesis paper on diffusion studies.* Hyderabad: Research Program on Markets, Institutions and Policies and ICRISAT. 26 pp.

Chinsinga B. 2012. *Seeds and subsidies: The political economy of input support programmes in Malawi*. Future Agricultures Consortium, Policy Brief 046. 7 pp.

Chiyembekeza AJ, Subrahmanyam P, Ngulube S. 2002. *Rural prosperity is nation's economic stability: End of Project Report 1999-2001*. Lilongwe: ICRISAT, in partnership with the Ministry of Agriculture and Irritation, Malawi, and USAID. 18 pp.

Christinck A, Diarra M, Horneber G. 2014. *Innovation in seed systems: Lessons from the CCRP-funded project "Sustaining farmer-managed seed initiatives in Mali, Niger, and Burkina Faso".* Commissioned by The McKnight Foundation. 74 pp.

Coomes OT, McGuire SJ, Garine E, Caillon S, McKey D, Demeulenaere E, et al. 2015. Farmer seed networks make a limited contribution to agriculture? Four common misconceptions. *Food Policy* 56: 41-50.

DAI. 2003. *Groundnut and pigeonpea multiplication project*. In: USAID/Malawi's SO1: Increased agricultural incomes on a per capita basis – 1993 to 2001. Washington: USAID. 9pp.

David S, Sperling L. 1999. Improving technology delivery mechanisms: Lessons from bean seed systems research in eastern and central Africa. *Agriculture and Human Values* 16: 381-388.

DFID. 2012. *Project completion review: Emergency supply of maize seeds to drought-affected farmers in Tanzania*. 12 pp.

Erman A, Hagos HG, Mogues T. 2016. *Access to markets for smallholder farmers in Alto Molocue and Molumbo, Mozambique*. Washington: International Food Policy Research Institute (IFPRI). 47 p.

FAO. 2010. *Evolving a plant breeding and seed system in sub-Saharan Africa in an era of donor dependence*. Rome: UN Food and Agriculture Organisation. 64 pp.

Granqvist B. 2009. *Is quality declared seed production an effective and sustainable way to address seed and food security in Africa?* Denmark: BriAgri ApS Consultancy Company. 4 pp.

Hamukwala P, Tembo G, Larson D, Erbaugh M. 2010. *Sorghum and pearl millet modern seed value chains in Zambia: Challenges and opportunities for smallholder farmers.* INTOSORMIL Scientific Publications. Paper 3. 44 pp.

ISSD Africa. 2013. *Introduction to Integrated Seed Sector Development and its guiding principles*. Wageningen: Centre for Development Innovation Wageningen UR. 2 pp.

ISSD Africa. 2016. *Access to early generation seed: Promoting commercial and sustainable supply of EGS for food crops in Sub-Saharan Africa*. ISSD Africa Technical Note. 2 pp.

ISSD Africa. 2016. Zambia National Seminar. Wageningen: Centre for Development Innovation Wageningen UR. 26 pp.

Jayne TS, Sitko NJ, Mason NM, Skole D. 2016. *Can input subsidy programs promote climate smart agriculture in Africa?* Policy Synthesis for Cooperating USAID Offices and Country Missions No. 93. USAID and Michigan State University. 4 pp.

Juma C. 2015. *Local start-ups hold the key to transforming African's seed industry.* The Conversation, September 2, 2015. Available from http://theconversation.com/local-start-ups-hold-the-key-to-transforming-africas-seed-industry-46893

Katungi E, Karanja D, Wozemba D, Mutuoki T, Rubyogo JC. 2011. A cost-benefit analysis of farmer based seed production for common bean in Kenya. *African Crop Science Journal* 19: 409-415.

Keyser JC. 2013. *Opening up the markets for seed trade in Africa.* Africa Trade Practice Working Paper Series Number 2. World Bank. 29 pp.

Kopainsky B, Derwisch S. 2009. *Model-based exploration of strategies for fostering adoption of improved seed in West Africa.* Paper presented at the 27th International Conference of the System Dynamics Society, July 26-30, 2009.

Kuhlmann K. 2013. *Enabling Environment*. Planning for Scale Brief #6. Ag Partner Xchange. 52 pp.

Kuteya An, Lukama C, Chapoto A, Malata V. *Lessons learnt from the implementation of the e-voucher pilot.* Lusaka: Indaba Agricultural Policy Research Institute. 8 pp.

Lion K. 2015. *Synthesis report of the technical review of the early generation seed study.* Seattle: Bill & Melinda Gates Foundation. 13 pp.

Lion KD, de Boef WS, Huisenga M, Atwood D. 2015. *Convening report: Multiple pathways for promoting the commercial and sustainable production and delivery of early generation seed for food crops in Sub-Saharan Africa*. Seattle: Bill & Melinda Gates Foundation and Washington: USAID. 32 pp.

Longley C, Jones R, Ahmed MH, Audi P. 2001. *Supporting local seed systems in southern Somalia: A developmental approach to agricultural rehabilitation in emergency situations*. ODI Agricultural Research & Extension Network. Network Paper No. 115. 20 pp.

Maideni F, Mataya C. 2006. *Country report for Malawi.* Alliance for a Green Revolution for Africa (AGRA): Program for Africa's Seed Systems (PASS). 40 pp.

Marrule H. 2014. *Brief review of Mozambique seed market*. Prepared by DAI and Nathan Associates for USAID/Mozambique. 9 pp.

Mather D, Waized B, Ndyetabula D, Temu A, Minde I, Nyange D. 2016. *The effects of NAIVS on private sector fertilizer and seed supply chains in Tanzania.* GISAIA/Tanzania Working Paper #3. 50 pp.

Mazvimavi K, Pedzisa T, Murendo C, Minde IJ, Ndlovu PV. 2012. Cost effectiveness of seed fairs relative to direct relief distribution in Zimbabwe. *Development in Practice* 22: 978-990.

McGuire S, Sperling L. 2016. Seed systems smallholder farmers use. *Food Security* 8: 179-195.

McGuire S, Sperling L. Making seed systems more resilient to stress. *Global Environmental Change* 23: 644-653.

Monyo ES and Varshney RK, eds. 2016. *Seven seasons of learning and engaging smallholder farmers in the drought-prone areas of sub-Saharan Africa and South Asia through Tropical Legumes, 2007–2014.* Patancheru 502 324, Telangana, India: International Crops Research Institute for the Semi-Arid Tropics. ISBN 978-92-9066-568-7. 236 pp.

Mucioki M, Hickey GM, Muhammad L, Johns T. 2016. Supporting farmer participation in formal seed systems: lessons from Tharaka, Kenya. *Development in Practice* 26: 137-148.

N.A. 2013. *Agricultural technology innovation and adaption in Tanzania: A background paper.* Draft 23 August 2013. Unpublished. 9 pp.

Nakaponda B. 2012. *Zambia seed sector assessment. ISSD Briefing Note – September 2012*. Wageningen: Centre for Development Innovation Wageningen UR. 5 pp.

NML, SAGCOT. 2015. *A legal guide to strengthen Tanzania's seed and input markets. Draft Document*. New Markets Lab and the Southern Agricultural Growth Corridor of Tanzania Centre Ltd. 146 pp.

Pereira IFC, Heemskerk W. 2012. *Mozambique seed sector assessment. ISSD Briefing Note – September 2012.* Wageningen: Centre for Development Innovation Wageningen UR. 5 pp.

Rajendran S, Afari-Sefa V, Karanja DK, Musebe R, Romney D, Makaranga MA, et al. 2016. Farmer-led seed enterprise initiatives to access certified seed for traditional African vegetables and its effect on incomes in Tanzania. *International Food and Agribusiness Management Review* 19: 1-24.

Ratchford CB, Meyers LR, Ndunguru BJ, Zak MS. 1984. *Tanzania seed multiplication aid project impact evaluation report no. 55.* USAID. 47 pp.

Ribeiro R, Juma A. 2011. *Analysis of seed production, commercialisationand use in Mozambique.* Maputo: Swiss Cooperation Office Mozambique. 41 pp.

Rohrbach DD, Mashingaidze AB, Mudhara M. 2005. *Distribution of relief seed and fertilizer in Zimbabwe: lessons from the 2003/04 season.* Bulawayo, Zimbabwe: ICRISAT; and Rome, Italy: FAO. 36 pp.

Rubyogo JC, Magreta R, Kambewa D, Chirwa R, Mazuma E, Martin A. 2016. *Using subsidized seed to catalyse demand-driven bean seed systems in Malawi.* Poster for the Pan-African Grain Legume & World Cowpea Conference, 27 Feb – 4 Mar 2016.

Rubyogo JC, Sperling L, Assefa T. 2007. A new approach for facilitating farmers' access to bean seed. *LEISA Magazine* 23: 27-29.

Rubyogo JC, Sperling L, Muthoni R, Buruchara R. Bean seed delivery for small farmers in sub-Saharan Africa: The power of partnerships. *Society and Natural Resources* 23: 285-302.

Rubyogo JC, Sperling L, Nasirumbi L, Kasambala S. 2007. *Developing seed systems with and for the marginalized: case of common beans (Phaseolus vulgaris* L.*) in East, Central, and Southern Africa.* Lilongwe: CIAT.

Setimela PS, Monyo E, Banziger M, eds. 2004. *Successful community-based seed production strategies*. Mexico, D.F.: CIMMYT. 30 pp.

Shiferaw BA, Kebede TA, You L. 2008. Technology adoption under seed access constraints and the economic impacts of improved pigeonpea varieties in Tanzania. *Agricultural Economics* 39: 309-323.

Smith RA, Findeis J. 2013. Exploring audience segmentation: Investigating adopter categories to diffuse an innovation to prevent famine in rural Mozambique. *Journal of Health Communication* 18: 6-19.

SNV, et al. n.d. *Concept note: ISSD Zimbabwe (draft).* SNV, Community Technology Development Trust, KIT, Wageningen UR, ISSD Africa. Unpublished document. 21 pp.

Sperling L, Cooper HD, Remington T. 2008. Moving towards more effective seed aid. *Journal of Development Studies* 44: 586-612.

Sperling L, Longley C. 2002. Editorial: Beyond seeds and tools: Effective support to farmers in emergencies. *Disasters* 26: 283-287.

Sperling L, McGuire S. 2010. Persistent myths about emergency seed aid. *Food Policy* 35: 195-201.

Sperling L, McGuire S. 2012. Fatal gaps in seed security strategy. *Food Security* 4: 569-579.

Tsusaka TW, Msere HW, Homann-KeeTui S, Orr A, Ndolo P. 2015. *Sorghum in semi-arid subsistence agriculture: The case of central Mozambique.* Lilongwe: ICRISAT. 58 pp.

Walker T, Alene A, Ndjeunga J, Labarta R, Yigezu Y, Diagne A, et al. 2014. *Measuring the Effectiveness of Crop Improvement Research in Sub-Saharan Africa from the Perspectives of Varietal Output, Adoption, and Change: 20 Crops, 30 Countries, and 1150 Cultivars in Farmers' Fields.* Report of the Standing Panel on Impact Assessment (SPIA), CGIAR Independent Science and Partnership Council (ISPC) Secretariat: Rome, Italy. 83 pp.

Walker TS, Alwang J, eds. 2015. *Crop improvement, adoption and impact of improved varieties in food crops in Sub-Sharan Africa*. Oxfordshire and Boston: CGIAR and CABI. 450 pp.

Winter-Nelson A, Mazvimavi K. 2014. *Economic Impact Evaluation of the ICRISAT Jewels*. Patancheru: International Crops Research Institute for the Semi-Arid Tropics. 40 pp.

Zhou Y, Kuhlmann K. 2015. *Seed policy harmonisation in SADC and COMESA: The case of Zimbabwe*. Working Paper. Syngenta Foundation for Sustainable Agriculture and Seeds2B Africa. 31 pp.

Zidana A, et al. 2012. *Malawi seed sector assessment. ISSD Briefing Note – September 2012.* Wageningen: Centre for Development Innovation Wageningen UR. 5 pp.

Annex 2:

Modern varieties released by target countries, 2000–15

Malawi:

Crop/species varieties	Year of release	Commercialising company
Maize: open-pollinated varieties		
ZM 309	2009	
ZM 523	2009	Funwe
Chitedze 2	2009	
Chitedze 4	2009	
Chitedze 5	2008	
AFRIC 1	2004	Afgri Seed/SA
ZM 623	2003	Funwe
ZM 611	2003	
ZM 421	2001	
ZM 521	2001	
ZM 621	2000	
ZM 721	2007	
Sorghum (*Sorghum bicolor)*		
Gwiramtima	2003	
Makolokoto	2003	
Sinakhomo	2003	
Kayera	2003	
ACC 967	2003	
Cowpea (*Vigna unguiculata*)		
IT99K-494-6	2010	Bunda/NBP
IT82E-16	2003	Funwe, Peacock, Multi Seed Company, Mgommera
Sudan 1	2003	Multi Seed Company
Nkanaufiti	Data not available	
Pearl millet (*Pennisutum glaucum*)		
Thobwa	2004	
Pigeonpea (*Cajanus cajan*)		
ICEAP 01485/3	2014	Funwe
Mwaiwathualima (ICEAP00557)	2009	Peacock, Funwe, Mgommera
Chitedze Pigeonpea 1 (ICEAP 01514/15)	2010	
Chitedze Pigeonpea 2 (ICEAP 01485/14)		

Crop/species varieties	Year of release	Commercialising company
ICPL 87105	2003	
ICPL 93026	2003	
Kachangu (ICEAP 00040)	2003	
Sauma (ICPL 9145)	Data not available	
ICPL 87015	2003	
Groundnut (*Arachis hypogaea)*		
ICGV 08501	2014	
ICGV 08503	2014	
ICGV 01731	2014	
ICGV 01724	2014	
ICGV 99551	2014	
ICGV 99556	2014	
ICGV 01514	2014	
Chalimbana 2005 (C851/7)	2005	
Chitala (ICGV SM 99568)	2005	Peacock
Baka (ICG 12991)	2001	
Nsinjiro (ICGV-SM 90704)	2001	
Kakoma (JL 24)	2001	Peacock

Source: *DARS*

Mozambique

Crop/species varieties	Year of release	Commercialising company
Open-pollinated varieties		
Gogoma	2013	
Dimba	2011	
ZM523	2011	Oruwera, Klein Karoo
Gema	2011	
Changalane	2003	
Djanza	2003	
Chinaca	2003	
Tsangano	2003	
Sussuma	2003	
Angania	2003	
Mocuba	2000	
Milange	2000	
Sorghum (*Sorghum bicolor)*		
Matica 1	2011	
Tocole	2011	Oruwera
Matica 2	2011	Mozambique Renewable Energy
Mapupulo	2011	Mozambique Renewable Energy

Crop/species varieties	Year of release	Commercialising company
Mussequesse	2011	
Mucuvea	2011	Oruwera, Mozambique Renewable Energy
Otela	2011	Oruwera, Mozambique Renewable Energy
Sima	2011	
Millet (*Pennisutum glaucum*)		
Changara	2000	
Kuphanjala 1	2000	
Kuphanjala 2	2000	
Cowpea (*Vigna unguiculata*)		
IT 82 E-16	2011	Oruwera
IT 97K-1069-6	2011	
ITOOK-1263	2011	Oruwera
Pigeonpea (*Cajanus cajan*)		
ICEAPOO020	2011	
ICEAPOO040	2011	Oruwera
ICEAP00554	2011	Oruwera
ICEAP00557	2011	Oruwera
Groundnut (*Arachis hypogaea)*		
JL 24	2013	Oruwera
ICGV-SM 99541	2011	
ICGV-SM 99568	2011	
ICGV-SM 01513	2011	
ICGV-SM 01514	2011	
CG7	2011	Oruwera
ICG 12991 (Nematil)	2002	
ICGV-SM 90704 (Mamane)	2002	

Source: *Mozambique EGS study, August 2016*

Tanzania

Crop/species variety	Year of release	Commercialising company
Cowpea		
Raha I	2015	
Raha 2	2015	
Vuli AR 1	2014	
Vuli AR 2	2014	
Vuli-2	2003	
Groundnut		
Naliendele-09	2009	
Mnanje-09	2009	
Masasi-09	2009	

Crop/species variety	Year of release	Commercialising company
Nachingwea-09	2009	
Mangaka-09	2009	
Maize		
114.K6Q	2013	Aminata
TZM 523	2012	SATEC
TZM 523	2011	SATEC
TAN 222	2009	Tanseed International Limited
Bora	2008	ARI-Ilonga
VUMILIA K1	2007	ARI-Selian
TAN 250	2006	Tanseed International Limited
TAN 254	2006	Tanseed International Limited
Longe 4	2003	FICA Seed Limited
Lishe-K1	2001	ARI-Selian
Situka-M1	2001	ARI-Selian, Beula Seeds, Aminata Seeds
Situka 2	2001	ARI-Selian
Pigeonpea		
Kiboko	2015	
Karatu 1	2015	
Ilonga 14 - M1	2015	
Ilonga 14 – M2	2015	
Tumia (ICEAP 00068)	2003	
Mali (ICEAP 00040)	2002	
Sorghum		
PAC 537	2014	Advanta Seed Company
PAC 501	2014	Advanta Seed Company
NACOSH 1	2013	Namburi Agricultural Company
NACOSH 2	2013	Namburi Agricultural Company
NACO Mtama 1	2012	Namburi Agricultural Company
Sila	2005	SEEDCO
Wahi	2002	ARI Ilonga
Hakika	2002	ARI Ilonga

Source: *EGS, Tanzania (2016) Varieties released from 1966 to 2014/15*

Zambia

A. CEREALS

1. MAIZE (*Zea mays L.*)

Variety	Year of release	Commercialising company (title holder/agent)
ZMS OP 23 (OPV)	2012	Zambia Seed Company Ltd
MMV 405 (OPV)	2011	Zambia Agricultural Research Institute (ZARI)
MMV 409 (OPV)	2011	Zambia Agricultural Research Institute (ZARI), Kamano

MMV 415 (OPV)	2011	Zambia Agricultural Research Institute (ZARI)
MMV 420 (OPV)	2011	Zambia Agricultural Research Institute (ZARI)
MMV 530 (OPV)	2011	Zambia Agricultural Research Institute (ZARI)
Nelsons Choice (OPV)	2010	Capstone Seeds South Africa (Pty) Ltd
ZM 423 (OPV)	2008	Kamano Seed Company Ltd
ZM 721 (OPV)	2008	Kamano Seed Company Ltd
ZM 625 (OPV)	2008	Kamano Seed Company Ltd
MRI EP (op)	2005	Maize Research Institute
MRI MP (op)	2005	Maize Research Institute
AFRIC 1 (op)	2004	Klein Karoo Seed, KKS (holder up to 19th Dec 2011 was AFGRI Cooperation)
ZM 421 (op)	2004	Zambia Agricultural Research Institute (ZARI)
ZM 521 (op)	2004	Zambia Agricultural Research Institute (ZARI)
ZM 621 (op)	2004	Zambia Agricultural Research Institute (ZARI)
Obatanpa (op) (QPM)	2004	GTZ
POP 10 (op)	2002	S.C.R.B – MAFF
POP 25 (op)	2002	S.C.R.B – MAFF

(OPV) = Open Pollinated Variety of Maize, (y) = Yellow Maize, (QPM or P) = Quality Protein Maize

2. SORGHUM *(Sorghum bicolor L.)*

Variety	Year of release	Commercialising company (title holder/agent)
Mr Buster	2015	Advanta
ZSV 16	2015	Zamseed
ZSV 17	2015	Zamseed
Rakodzi	2015	Klein Karoo Seeds
Shirikure	2015	Klein Karoo Seeds
Vumba	2015	Klein Karoo Seeds
ZSV 36R	2013	Zambia Agricultural Research Institute (ZARI)
Sugar Graze (F)	2012	Advanta
SC Shaku	2007	SeedCo International (Z) Ltd
WP 13	2005	Zambia Agricultural Research Institute (ZARI)
MMSH 1365	2005	Zambia Agricultural Research Institute (ZARI)
MMSH 625	2005	Zambia Agricultural Research Institute (ZARI)

R = Red sorghum, F = Forage sorghum, OP = Open pollinated

3. PEARL MILLET *(Pennisetum typhoides)*

Variety	Year of release	Commercialising company (title holder/agent)
Nutrifeed (F)	2012	Advanta
Dola	2007	Zambia Agricultural Research Institute (ZARI)
Mulatiwa	2005	Zambia Agricultural Research Institute (ZARI)
Liseli	2005	Zambia Agricultural Research Institute (ZARI)

F = Forage

4. FINGER MILLET *(Eleusine voracana)*

Variety	Year of release	Commercialising company (title holder/agent)
Sumina	2009	Zambia Agricultural Research Institute (ZARI)
Chipa	2009	Zambia Agricultural Research Institute (ZARI)
Chibuli	2001	S.C.R.B – MAFF

B. LEGUMES

1. COWPEA *(Vigna unguiculata)*

Variety	Year of release	Commercialising company (title holder/agent)
Namuseba	2011	Zambia Agricultural Research Institute (MACO)

2. PIGEONPEA *(Cajanus cajan)*

Variety	Year of release	Commercialising company (title holder/agent)
ZPP 14	2015	Zambia Seed Company Ltd
Luangwa	2001	Legumes Team (MAFF), Kamano

3. GROUNDNUT *(Arachis hypogea)*

Variety	Year of release	Commercialising company (title holder/agent)
CG 243	2015	New Rotations Farming
MGV 6	2015	Zambia Agricultural Research Institute (ZARI)
MGV 7	2015	Zambia Agricultural Research Institute (ZARI)
Wazitatu	2015	Zambia Agricultural Research Institute (ZARI)
Wamusanga	2015	Zambia Agricultural Research Institute (ZARI)
Lupande	2015	Zambia Agricultural Research Institute (ZARI)
Shinje	2015	Klein Karoo Seeds
ZamG 14	2014	Zambia Seed Company Ltd
SC Orion	2008	Seed Co International Ltd
MGV 5	2008	Zambia Agricultural Research Institute (ZARI)
SC Mwenje	2006	Seed Co International Ltd
Muyuni	2003	Maize Research Institute
SC Nyanda	2003	Seed Co International Ltd
Chishango	2002	Zambia Agricultural Research Institute (ZARI)

Zimbabwe

Crop/ variety	Year of release	Commercialising company (title holder/agent)
Maize (*Zea mays* L.) - **White Maize-Open-Pollinated**		
ZM 401	2009	Crop Breeding Institute, Zimbabwe Super Seeds
ZM 309	2009	Crop Breeding Institute, Zimbabwe Super Seeds

Crop/ variety	Year of release	Commercialising company (title holder/agent)
ZM423	2006	Agpy (Pvt) Limited
ZM623	2004	Seed Co Limited
ZM523	2004	Seed Co Limited
Kalahari early pearl	2003	Seed Co Limited
Matuba	2003	Seed Co Limited
Obatanpa	2003	Seed Co Limited
ZM421	2002	Crop Breeding Institute
ZM521	2002	Crop Breeding Institute, Zimbabwe Super Seeds
Cowpea (*Vigna unguiculata L. Walp.*)		
IT18	2004	Seed Co Limited
CBC2	2003	Crop Breeding Institute, Zimbabwe Super Seeds
CBC3	2003	Crop Breeding Institute, Zimbabwe Super Seeds
Groundnut (*Arachis hypogaea L.*)		
Shinje	2013	Progene Seeds
Ilanda	2006	Crop Breeding Institute
Tern	2005	Crop Breeding Institute
SC Orion	2004	Seed Co Limited
Nyanda	2000	Seed Co Limited
Hybrid Sorghum *(Sorghum bicolor (L.) Moench)*		
Rakodzi	2013	Progene Seeds
SC Smile	2010	Seed Co Limited
PAN888	2000	Pannar Seed (Pvt) Ltd
NS5511	2000	Seed Co Limited
Open pollinated sorghum (*Sorghum bicolor L.*)		
Shirikure	2013	Progene Seeds
Vumba	2013	Progene Seeds
Sila	2004	Seed Co Limited
OKASHANA 1	2010	Matopos Sorghum and Millets Crop Improvement Programme

No finger millet after 2000

Pearl Millet

Annex 3:
DIIVA adoption estimates for selected varieties of target crops in focus countries

Malawi

Crop/species varieties	Year of release	Commercialising company	DIIVA adoption estimate
Cowpea			
IT82E-16		Funwe, Peacock, Multi Seed Company, Mgommera	3%
Sudan 1		Multi Seed Company	7%
Pigeonpea			
Kachangu (ICEAP 00040)			20%
Mwaiwathualima (ICEAP00557)	2011	Peacock, Funwe, Mgommera	5%
Sauma (ICPL 9145)			25%
Groundnut			
Baka (ICG 12991)	2001		0.5%
CG7 (ICGV-SM 83708)	1990	Funwe, Peacock, ASSMAG, Global Seeds	30%
Chalimbana 2005 (C851/7)	2005		0.1%
Chitala (ICGV SM 99568)	2005	Peacock	0.2%
Kakoma (JL 24)		Peacock	7%
Nsinjiro (ICGV-SM 90704)	2000		20%

Mozambique

Crop/species varieties	Year of release	Commercialising company	DIIVA adoption estimate
Cowpea			
IT 82 E-16	2011	N/A	IT 16, .5%
Varieties listed in the adoption sheet in DIIVA, but not on the release list provided by government: IT 18 (8.1%), INIA 36 (1.6%), Timbawene (.7%), and IT 16 (.5%)			

Tanzania

Crop/species variety	Year of release	Commercialising company	DIIVA adoption estimate
Cowpea			
Vuli-2	2003	N/A	10.6%
Vuli-1	1987	N/A	3.1%
Tumaini	1982	N/A	8.8%

Crop/species variety	Year of release	Commercialising company	DIIVA adoption estimate
Fahari	1982	N/A	8.8%
Groundnut			
Naliendele-09	2009	ARI Naliendele	0.5%
Mnanje-09	2009	ARI Naliendele	0.1%
Nachingwea-09	2009	ARI Naliendele	0.1%
Sawia	1998	ARI Naliendele	3.7%
Pendo	1998	ARI Naliendele	18.4%
Maize			
Longe 4	2003	FICA Seed Limited	1.49%
Lishe-K1	2001	ARI-Selian	0.25%
Situka-M1	2001	ARI-Selian, Beula Seeds, Aminata Seeds	Situka 1 = 3.6%
TMV1	1987	Tropical Seeds	3.92%
Staha	1983	ARI Ilonga	3.41%
Kilima	1983	ARI Ilonga	1.77%
TMV-2	1987	ARI Uyole	.27%
Katumani	Late 1950s	N/A	.1%
Kito	1983	ARI Ilonga	.03%
Pigeonpea			
Tumia (ICEAP 00068)	2003	N/A	0.3%
Mali (ICEAP 00040)	2002	N/A	30.6%
Kiboko (ICEAP 00053)	2015	N/A	12.8
Komboa (ICPL 87091)	1999	N/A	1.6%
ILONGA 14-M1 (ICEAP 00557	2015	ARI Ilonga	2.2%
ILONGA 14-M2 (ICEAP 00554)	2015	ARI Ilonga	.8%
Sorghum			
Wahi	2002	ARI Ilonga	7.1%
Hakika	2002	ARI Ilonga	6.2%
Macia	1999	Namburi Agricultural Company, Beula Seeds	20.8%
Tegemeo	1986	ARI Ilonga	8.1%

Zambia

Variety	Year of release	Commercialising company (title holder/agent)	DIIVA adoption estimate
Cowpea			
Bubebe	1995	Zamseed	11%
Katete	2004	Zamseed	3.2%
Lutembwe	1993	Zamseed	2.9%
Groundnut			
MGV4	1990	Kamano, Eastern Province Farmers Cooperative, may be others	23%

Variety	Year of release	Commercialising company (title holder/agent)	DIIVA adoption estimate
MGV 5	2008	Zambia Agricultural Research Institute (ZARI)	6%
Chishango	2002	Zambia Agricultural Research Institute (ZARI)	10%
Luena	1988	Zamseed	2%
Makulu Red	1963	Zamseed	2%
Chipego	1995	Zamseed	2%
Natal Common	1954	Zamseed	2%

Zimbabwe

Crop/variety	Year of release	Commercialising company (title holder/agent)	DIIVA adoption estimate
Cowpea			
IT18	2004	Seed Co Limited	45%

Sources: Variety release lists provided by target countries (see sources in Annex 2), and CG Center DIIVA data (https://www.asti.cgiar.org/diiva)

Pearl Millet

Annex 4:
Registered private seed companies

Registered Private Seed Companies in Malawi

Company/institution	Address	Crop seed Y/N	Designated crops
1. Peacock Seeds	Lilongwe	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut, Hybrid maize
2. Monsanto	Lilongwe	Y	Hybrid maize
3. NASFAM	Lilongwe	Y	Soybean and Groundnut
4. Seed Co	Lilongwe	Y	Beans, Soybean, Groundnut, Hybrid maize
5. Seed Tech	Blantyre	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut, Hybrid maize
6. Funwe	Lilongwe	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut, Hybrid maize
7. Panthochi Farm	Mangochi	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut, Hybrid maize
8. Demeter	Lilongwe	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut, Hybrid maize
9. Mgommera	Lilongwe	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut, Hybrid and OPV maize
10. CPM Agrienterprise	Lilongwe	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut, Hybrid maize
11. ASSMAG	Lilongwe	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut, OPV maize
12. WASA	Lilongwe	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut
13. MSI	Lilongwe	Y	Beans, Cowpea, Soybean, Groundnut, OPV maize
14. Premium	Blantyre	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut, Hybrid and OPV maize
15. Pindulani	Mangochi	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut, OPV maize
16. C&M	Lilongwe	Y	Hybrid maize
17. AISL	Lilongwe	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut
18. Global Seed	Lilongwe	Y	Beans, Cowpea, Pigeonpea, Groundnut, Hybrid maize
19. Multiseeds	Lilongwe	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut, Hybrid maize
20. Virelishama Seed	Kasungu	Y	Beans, Cowpea, Soybean, Pigeonpea, Groundnut, Hybrid maize
21. Syngenta	Lilongwe	Y	Hybrid maize
22. Pannar	Lilongwe	Y	Hybrid maize

Source: *Seed Trade Association of Malawi*

Registered Private Seed Companies in Tanzania

	COMPANY	Address	Year Reg	Active Y/N	Crop Seed Y/N	Designated crops	Comments
1.	Monsanto (T) Ltd	Arusha	2010	Y	Y	Maize and horticulture	
2.	Krishna Seed Company Limited	Arusha	2010	Y	Y	OPV maize, Pigeonpea and horticulture	
3.	East Africa Seed (T) Ltd	Arusha	2010	Y	Y	Maize and Horticulture	
4.	Kibo Seed Company (T) Ltd	Arusha	2010	?	?	?	
5.	Suba Agro Company	Arusha	2010	Y	Y	Maize and legumes and horticulture	Supported by AGRA (PASS)
6.	Alpha Seed Company Ltd	Arusha	2010	N			
7.	Pannar Seed Ltd	Arusha	2010	Y		Maize and horticulture	
8.	Rotian Seed Co Ltd	Arusha	2010	N			
9.	Multiflowers Ltd	Arusha	2010	Y		Flowers	
10.	Pop Vriend (T) Ltd	Arusha	2010	Y		Horticulture	
11.	Tanseed International Ltd.	Njombe	2010	Y	Y	Maize and rice	Supported by AGRA (PASS)
12.	Enza Zaden Africa Limited	Arusha	2010	?	?	?	
13.	IFFA Seed Company	Arusha	2010	Y	Y	Maize and Horticulture	Supported by AGRA (PASS)
14.	Highland Seed Company Ltd	Mbeya	2010	Y	Y	Maize	Supported by AGRA (PASS)
15.	Northern Seed Company Ltd	Moshi	2010	Y	Y	OPV maize	Supported by AGRA (PASS)
16.	Meru Agro-Tours and Consultants Co.	Arusha	2010	Y	Y	Maize and legumes	Supported by AGRA (PASS & SSTP)
17.	Aminata Seed company	Tanga	2011	Y	Y	Maize and legumes and Cassava	Supported by AGRA (PASS & SSTP)
18.	Tropical Seeds	Mbeya	2009	Y	Y	OPV maize	Supported by AGRA (PASS)
19.	RIJK Zwaan Afrisem Ltd	Arusha	2009	N			
20.	RIJK Zwaan Q-Sem Ltd	Arusha	2009	Y	Y	Yellow maize	Imported yellow maize seed
21.	Kipato Seed Limited	Njombe	2009	Y	Y	Maize and legumes	Supported by AGRA (IGGSAS)
22.	Agriseed Technologies Ltd	Morogoro	2010	Y	Y	Maize and legumes	Supported by AGRA (PASS)
23.	Bytrade Tanzania Ltd	Dar es Salaam	2010	Y	Y	Hybrid maize and horticulture	Is main agent of Pioneer
24.	Dirma Holdings	Arusha	2010	N			
25.	Bajuta International (T) Ltd	Arusha	2010	Y			Seed and Agro inputs trader
26.	Namburi Agricultural Company Limited	Arusha	2010	Y	y	Maize and Sorghum	Supported by AGRA (PASS)

	COMPANY	Address	Year Reg	Active Y/N	Crop Seed Y/N	Designated crops	Comments
27.	Seed Co Tanzania Ltd	Arusha	2010	Y	Y	Maize	
28.	Agricultural Seed Agency	Morogoro	2010	Y	Y	Maize, rice, oil seed and legumes	
29.	Kisimbaguri Estates Ltd	Songea	2010	N			
30.	Mtanga Farms Ltd	Dar es Salaam	2010	Y		Seed potato	Supported by AGRA (SSTP)
31.	Kilimo Markets Ltd	Arusha	2011	Y		Legumes	
32.	Msanju Agriculture Enterprise Co. Ltd	Mbeya	2012	?	?	?	
33.	Khebhandza Marketing Co. Ltd	Mbeya	2012	?	?	?	
34.	Lowland Seed Co. Ltd	Morogoro	2012	?	?	?	
35.	Kibo Trading Co. Ltd	Moshi	2012	?	?	?	
36.	Panda International Co. Ltd	Shinyanga	2012	?	?	?	
37.	Meru Seed Co. Ltd	Njombe	2011	?	?	?	
38.	Beula Seed Company and Consultancy Limited	Arusha	2011	Y	Y	Maize, legumes and Irish potato	Supported by AGRA (PASS & IGGSAS)
39.	Itente Company Limited	Bukoba	2010	N			Supported by AGRA (PASS)
40.	Sunflower Development Co. Ltd	Dar es Salaam		?	?	?	
41.	Circle H. Ranch Ltd			N			
42.	Selous Farming Ltd			N			
43.	Rockem Tanzania Ltd			N			
44.	STRAD Fumigation Company Ltd			N			
45.	Enza Zaden Africa Ltd			N			
46.	Mount Meru Seed Company			N			
47.	FAMCO Seed Ltd			Y		Horticulture	
48.	BRAC Tanzania			Y		Horticulture	
49.	Morogoro Agribusiness Centre Ltd			N			
50.	Kagera Seed Farm Ltd			N			
51.	Mamico (T) Ltd			N			
52.	Farm Products Ltd			N			
53.	FMG Agriculture Ltd			N			

	COMPANY	Address	Year Reg	Active Y/N	Crop Seed Y/N	Designated crops	Comments
54.	Mukpar Tanzania Ltd			Y			Seed and agro inputs traders. Now trade as Positive International Limited
55.	Mbegu Technologies Ltd			N			
56.	Zanobia Seeds Limited			Y	Y	OPV maize	
57.	AfriAsia Seed Company			Y	Y	Pigeonpea and horticulture	Supported by AGRA (SSTP)
58.	Mocrops Tanzania Ltd			N			
59.	Mayo Co Ltd			N			
60.	Kamal Seeds & Research Ltd			N			
61.	Tanzania Crop Care Ltd			Y			Seed and Agro inputs trader
62.	Sagera Estates Ltd			N			
63.	Seed Resources of Tanzania Ltd			N			

Source: *Ministry of Agriculture, Livestock and Fisheries*

Registered Seed Companies in Mozambique

	Company	Address	Year registered	Designated crops
1	Agrifocus	Maputo	2012	Vegetables
2	Tecap	Maputo	2007	Vegetables, Legumes
3	Soluções Rurais	Maputo	2012	Vegetables, Roots &Tubers
4	Campo Terra	Maputo	2009	Vegetables, Cereals
5	BIOCHEM – Biológicos, Medicamentos E Quimicos, Lda	Maputo	2014	Vegetables, Cereals, R&T, Legumes, Oil Crops, Pastures
6	Mozasem, Lda	Maputo	2012	Vegetables
7	Timber Land, Lda	Maputo	2011	Vegetables, Roots &Tubers
8	Consultoria, Representaçao E Comércio, Lda	Maputo	2010	Vegetables, Cereals
9	Agro Global, Lda	Maputo	2010	Vegetables, Cereals, Oil Crops
10	Horticolas De Mocambique	Maputo	2009	Vegetables, Cereals, R&T
11	JCF Procampo, Lda	Maputo	2006	Vegetables, Cereals, Legumes
12	Ka Chilenge Investimento (Kci)	Maputo	2014	Vegetables, Cereals, Legumes
13	Lozane Farms	Maputo	2010	Vegetables, Cereals, Legumes

	Company	Address	Year registered	Designated crops
14	Mindzo Comercial	Maputo	2012	Vegetables, Cereals, Legumes
15	Sete Agraria E Consultoria Lda	Maputo	2014	Vegetables, Cereals
16	Matuel Comercial	Zambezia	2008	Vegetables, Cereals, Legumes, Oil Crops
17	Agro Comercial, Olinda Fondo	Zambezia	2010	Cereals
18	Nzara Yapera	Manica	2009	Vegetables, Cereals, Oil Crops
19	Jnb - Empreendimentos	Nampula	2008	Cereals, Legumes
20	SEMOC – Sementes de Mocambique, SARL	Manica	2008	Cereals, Legumes, Oil Crops, R&T
21	Ikuru, SARL	Nampula	2007	Legumes, Oil Crops
22	Dengo Comercial (May not be active)	Manica	-	Cereals, Legumes
23	Semente Perfeita (May not be active)	Manica	-	Vegetables, Cereals
24	Manica Mbeu	Manica	-	Vegetables, Cereals, Legumes
25	IAV	Sofala	-	Vegetables, Cereals, Legumes
26	Mocotex	Zambezia	-	Oil Crops
27	Prime Seed	Manica	-	Vegetables, Cereals
28	Phoenix Seed	Manica	-	Cereals, Legumes
29	Montesco, Sa	Manica	2014	R&T
30	Sementes de Nampula, Lda	Nampula		
31	Pannar Seed, Lda	Maputo		Vegetables, Cereals, Legumes
32	Morais Comercial (May not be active)	Nampula		
33	Oruwera Lda	Nampula		Cereals, Legumes
34	Multi Flor de Tete	Tete	2013	Cereals, Legumes, R&T
35	LUSOSEM			Vegetables, Cereals, Legumes
36	Syngenta			Vegetables, Cereals, Legumes
37	Phoenix	Manica		Cereals, Legumes
38	Zembe			Cereals, Legumes
39	Klein Karoo			Vegetables, Cereals, Legumes
40	Emilia Comercial			Cereals, Legumes
41	Kapstone			Cereals
42	Timbeu			Cereals

Registered private seed companies in Zambia*

	Company	Address	Year registered	Designated crops
1.	Zambia Seed Company Ltd	Lusaka	Late 1980s	Hybrid maize, OPV maize, Sorghum, Pearl Millet, Cowpea, Pigeonpea, Groundnut
2.	Pioneer Oversees Corporation	Lusaka	1992	Hybrid maize
3.	Cargill Hybrid (Z) Ltd			No longer in operation
4.	Carnia Seeds (Z) Ltd			No longer in operation
5.	Pannar Seeds (Z) Ltd	Lusaka		Hybrid maize, Sunflower, Beans and Vegetables
6.	Seed Co International Ltd	Lusaka	1995	Hybrid maize, Soybean, Wheat, Barley, Groundnut, Beans
7.	Monsanto	Lusaka		Hybrid maize
8.	Klein Karoo Seeds (was AFGRI Cooperation)		2011	Hybrid maize, OPV maize, Sorghum, Groundnut, Vegetables and Pastures
9.	Progeny Seed		2009	Hybrid maize, Cowpea, Groundnut and Sorghum
10.	Kamano Seed Company Ltd	Lusaka	2004	Cowpea, Pigeonpea, Groundnut, Sorghum, OPV maize, Beans
11.	MRI Syngenta		1997	Hybrid maize and Soy bean
12.	Advanta		2010	Hybrid maize, Pearl millet, Tobacco
13.	Capstone			Hybrid maize, OPV maize
14.	Crop Serve			Vegetables
15.	Starke Ayres			Vegetables
16.	Hygrotech			Vegetables
17.	Radseed			Vegetables
18.	Afriseed	Lusaka	2007	Beans, Soybean, Cowpea, Groundnut, Sorghum, Vegetables
19.	Pamllo	Lusaka	2009	Beans, Cowpea, Soy bean and Groundnut
20.	Unit Seed	Chipata	2011	Beans, Cowpea, Soy bean and Groundnut
21.	Zasaka			Legumes

**List compiled from interviews with seed companies and official release variety register from SCCI*

Registered seed companies – Zimbabwe

Note: The 16 companies in bold produce, or are likely to produce, seed for focus crops

	Company	Address	Year registered	Designated crops
1.	Agri-Seeds (Agricultural Seeds & Services) Now part of Klein Karoo	P O Box 6766 Harare Tel: 701795/701846	1983	Field Beans, groundnut, millets, bambara nuts, sorghum, maize, paprika, sunflower, sunhemp, cowpea, vegetables.
2.	ARDA (parastatal)	P O Box CY1420 Causeway Harare Tel: 705841/700095	2002	Wheat, groundnut, millets, sorghum, maize, cowpea, soybeans
3.	Kutsaga Seed Association	Tobacco Research Board, P O Box 1909, Harare	2002	Tobacco, Katambora Rhodes grass

	Company	Address	Year registered	Designated crops
4.	National Tested Seeds	P O Box 2705 Harare Tel: 310284-7	1979	Maize, wheat, sorghum, field, beans, velvet beans, soybeans, groundnut, cowpea, vegetables
5.	Pannar Seeds	P Box 99 Ruwa Tel: 073-2631-4 Fax: 073-2652	1984	Maize, sunflower, wheat, vegetables (Focuses primarily on hybrid maize)
6.	Pioneer Seeds Company	P O Box 100 Juru 100 The Chase West Emerald Hill P Bag A6118 Avondale Harare	1988	Maize (hybrid)
7.	Seed-Co	P O Box WGT64 Westgate Harare	1940	Sugar beans, groundnut, millets, sorghum, maize, sunflower, cowpea, wheat, barley, soybeans, oats
8.	Quton Seed Company (Zimbabwe Cotton Seed Association)	9 Blealfast Emerald Hill Harare	1994	Cotton
9.	Zimbabwe Seed Potato Co-op (Zimbabwe Potato Seed Association)	P O Box AY28 Amby, Harare Tel: 0912909477 Manzira 0448	1950	Potatoes
10.	Zimbabwe Tobacco Seed Association	P O Box A1253 Avondale Harare Tel: 305195	1950	Tobacco
11.	Zimbabwe Micro-propagation Association	C/o Tobacco Research Board P O Box 1909 Harare	2001	Potatoes
12.	600 Seeds	P O Box CY1270 Causeway Harare	2002	Katambora Rhodes grasses, soybeans
13.	Prime Seeds (Pvt) Ltd. (acquired by SeedCo)	Box BW1798 Borrowdale Harare Tel: 48050/2 485572/3 447114/5-9 Fax: 480501/2	1997	Maize, sorghum, millets, beans
14.	Klein Karoo (Pristine Seeds (Pvt) Ltd)	6 Wellington Ave Belvedere Harare P O Box BW1546 Borrowdale 280 Sherpperton Road Marondera Tel/Fax 750582	2005	Groundnut, millets, sugar beans, sorghum, maize, cowpea

Company	Address	Year registered	Designated crops
15. Progene Seeds (Pvt) Ltd	1A Kent Road Chisipite P O Box BW1500 Borrowdale 280 Sherpperton Road Marondera Tel: 443828/443931/4	2004	Beans, groundnut, millets, bambara nuts, sorghum, maize, sunflower, cowpea, potatoes, wheat
16. Reapers Seed Company (May not be currently active)	Reapers Seed Company P O Box 58 Marlborough Harare	2005	Field beans, groundnut, millets, bambara nuts, sorghum, maize, sunflower, cowpea
17. Chemco Seed Crops Association (AGPY)	P O Box 66024 Kopje Harare Tel: 754666-9 Fax: 7578042	1997	Soybeans, wheat, groundnut, maize, sunflower, cowpea
18. Platinum Agriculture (Pvt) Ltd	Platinum Agriculture (Pvt) Ltd Mt Pleasant Business Park Block D Delken Complex Harare	2005	Potatoes
19. Monterey Estates P/L	T/a Monterey Estate Clive Wakefield, P O Box 160, Bindura	1986	Cowpea, groundnut, soybeans, sorghum, maize
20. FSI Agricom Holdings (Pvt) Ltd	Box WGT989 Westgate, Harare Tel. 0772220885 011408633	2005	Sugar beans, groundnut, millets, bambara nuts, sorghum, maize, sunflower, cowpea
21. Dar Al Salam	Al Jazira Trading (Pvt) Ltd 135 Nkwame Nkrumah Avenue, Harare P O Box 2162, Harare	2007	Katambora Rhodes Grass
22. Lomag Exports	ZIMSEEDS (PVT) LTD 1 Shamwari Road Stapleford Harare	2007	Katambora Rhodes Grass
23. ZIMGYPT International P/L	Box CY1823, Causeway, Harare	2007	Katambora Rhodes Grass
24. Rockriders (Pvt) Ltd	15 Dolphin Square, Borrowdale, Harare	2007	Katambora Rhodes Grass
25. MAYDALE	17 Colbell Drive, Greendale, Harare	2007	Katambora Rhodes Grass
26. Forestry Commission	No 1 Orange Drive, Highlands, Harare	1949	Trees
27. Zaka Super Seeds	Zaka Super Seeds c/o Agritex P O Box 34Z Zaka	2012	Maize, Sorghum, Cowpea, sugar beans, rice
28. Pittsworth Seeds	Pittsworth Seeds (Private) Limited P O Box BW707 Borrowdale Harare	2012	Katambora

	Company	Address	Year registered	Designated crops
29.	Alliance Ginneries	P O Box 361 Norton 88 Endeavour Rd, Norton	2012	Cotton
30.	Zimbabwe Technological solution	P O Box 6640, Harare 574 Alpes Rd, technology Drive Hatcliffe Harare	2012	Maize
31.	Tocek Investments (former Monsanto)	P O Box EH 47 Emerald Hill	1998	Maize (most likely only hybrid maize)
32.	Agri-Crop International (Pvt) Ltd, Green Croft , Harare	14 Elly Avenue	2008	Potatoes
33.	Highlands Seed Company (Savannah)	Plot 183, Munhondo Road, Ruwa, Zimbabwe	2011	Maize, wheat, soybeans, sorghum, sugar beans and other dried beans, groundnut, cowpea and millets
34.	Cargill Cotton	Cargill Zimbabwe (Pvt) Ltd, P O Box BW320, Borrowdale, Harare	2012	Cotton
35.	Matapiri Seed Sales	Matapiri Seed Sales 16 Cambridge Ave. Newlands Harare	2012	Potatoes
36.	ACFD/Sandbrite	ACFD-Sandbrite Seed Association, 79 Harare Drive, P. O. Box MP1140, Mt. Pleasant, Harare	2007	Maize, soybeans, sorghum
37.	Seeds for Development	44 Quorn Avenue, Mount Pleasant, Harare	2006	Maize, Sorghum and Cowpea
38.	Zimbabwe Pastures Seed growers Association	Farmers Co-op/ Horticulture Dept P. O. Box 510, Harare	1955	Pasture/Grass seeds
39.	Syngenta	Syngenta Agro Services Suite Za Sam Levy's Village, Borrowdale, Harare		Maize (not sure if any OPV maize seed is produced)

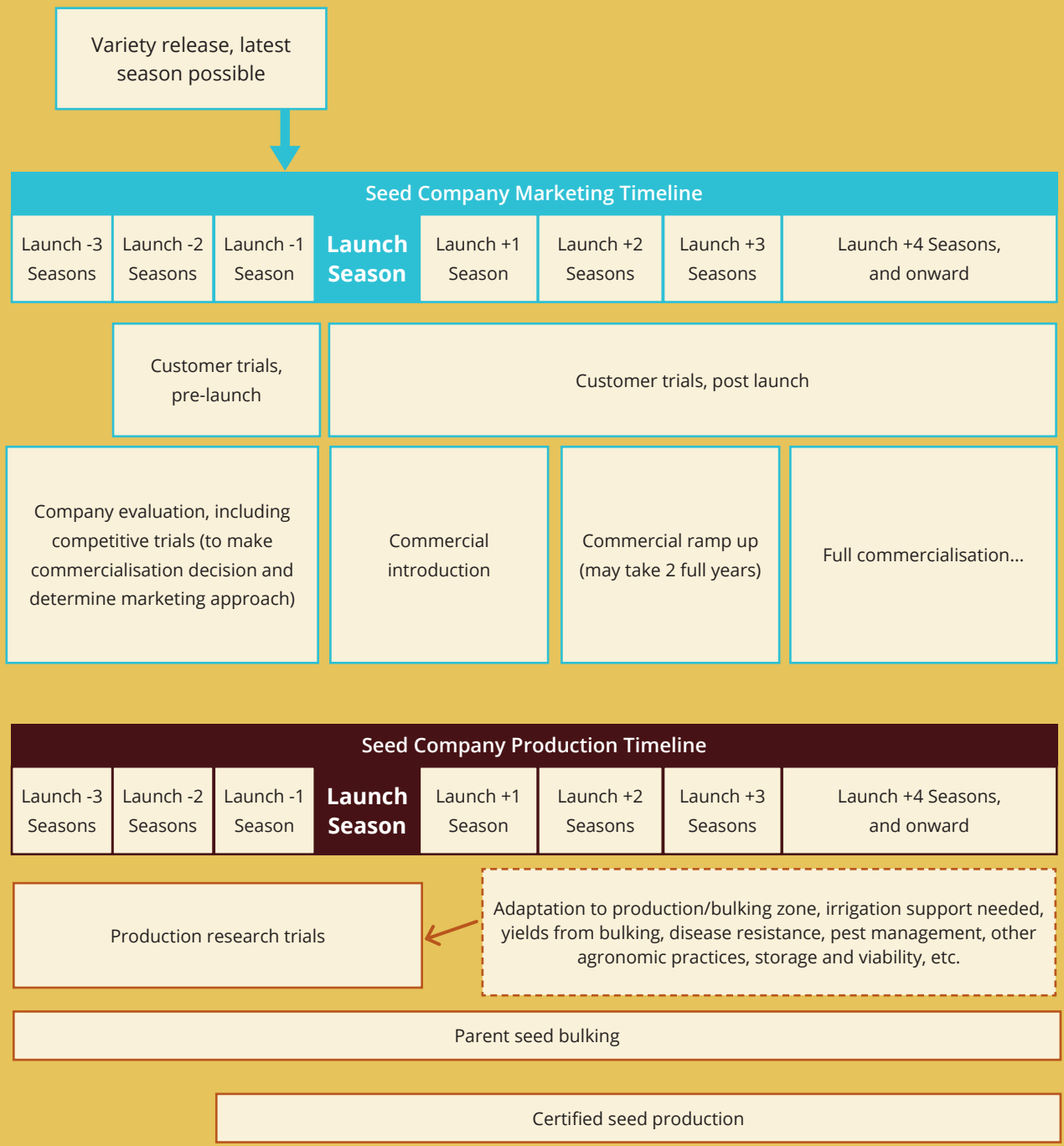
Source: *Seed Services Institute*

Groundnut

Annex 5:
Indicative private-sector commercialisation timeline

Thorough but aggressive company timelines for product commercialisation

Note: Timeline assumes 2 seasons a year

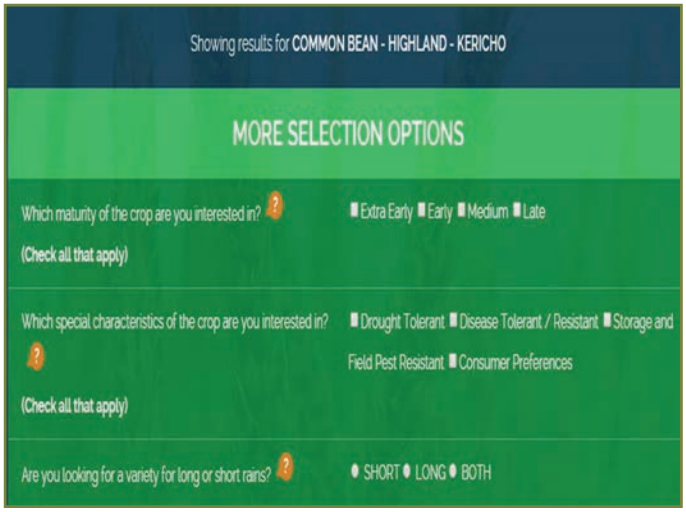


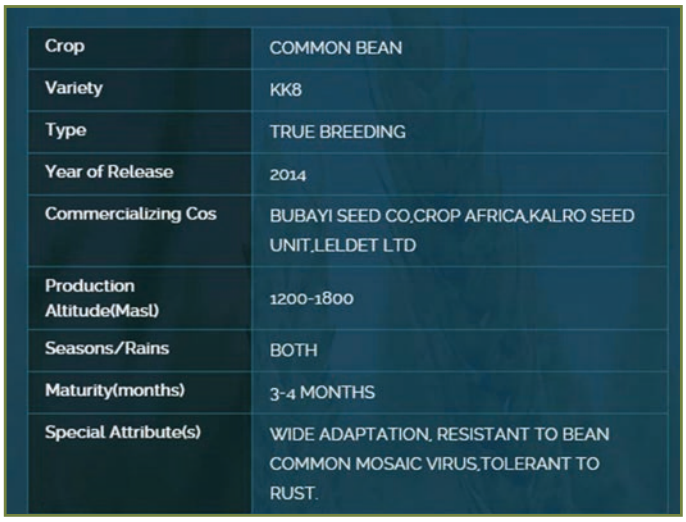
Annex 6:

Example of seed referral information given by MbeguChoice

All varieties recommended by scientists and seed companies for the given criteria are presented, chronologically, from newest to oldest.

www.mbeguchoice.com





Crop	COMMON BEAN
Variety	KK8
Type	TRUE BREEDING
Year of Release	2014
Commercializing Cos	BUBAYI SEED CO,CROP AFRICA,KALRO SEED UNIT,LELDET LTD
Production Altitude(Masl)	1200-1800
Seasons/Rains	BOTH
Maturity(months)	3-4 MONTHS
Special Attribute(s)	WIDE ADAPTATION, RESISTANT TO BEAN COMMON MOSAIC VIRUS,TOLERANT TO RUST.


Sorghum

Scan the code to read more on Vuna's work on seed systems in East and Southern Africa.

Contact Us:

T: +27 12 342 3819
E: contact@vuna-africa.com
W: www.vuna-africa.com

Search for **Vuna Africa**