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Decentralized Seed Services in Africa:

An Assessment of Tanzania and Uganda

Michael Waithaka, Mainza Mugoya, Edward Mabaya and Krisztina Tihanyi

Abstract

The overall goal of decentralizing seed services is to increase the availability and accessibility of quality seed to farmers. The governments of Uganda and Tanzania have endeavoured to enhance access to improved seed for smallholder farmers. These efforts have achieved results and encountered challenges. The successes include an increase in the number of key players in the seed sector in general.

In Uganda, the number of community seed banks (CSBs) has increased from one to five over the last five years (Adokorach et al., 2020). The number of Local Seed Businesses (LSBs)has increased from 27 in 2012 to 256 in 2020. In addition to the increase in actors involved in improved seed production, the interaction between them has also improved. The LSBs are developing strong links with the Zonal Agricultural Research and Development Institute (ZARDI), and the CSBs are working closely with the Plant Genetic Resources Centre.

In Tanzania, the government has demonstrated willingness to support the production of Quality Declared Seed (QDS) through the enactment of the QDS Regulations in July 2020. The new regulations clarify hitherto grey areas and introduce fees for inspection, germination, and moisture tests, among others. In addition to introducing the regulations, the sector has also demonstrated steady performance over the years. QDS production has increased five-fold between 2015 and 2019. QDS farmers work closely with the Tanzania Agricultural Research Institute (TARI), the Agricultural Seed Agency (ASA) and district agricultural officers to ensure that farmers produce quality seeds.

Despite these notable improvements, various challenges affect the performance of the decentralized seed system. The two specific services that have yet to be fully decentralized are the management of plant genetic resources in Tanzania and seed testing in both countries.

Even though other seed services have been decentralized, further challenges persist. For example, some of the system's key players, namely the CSBs, LSBs, and QDS farmers, are not yet financially sustainable. These entities are still dependent on external project support. Without it they may not cover some of their operational costs. It is important to note that the decentralized system's challenges may be, because the system and some of the players are still in their infancy. The regulatory framework for QDS is yet to be finalized and implemented in Uganda. In addition, most of the CSBs and LSBs are less than seven years old. The first few years of their operations were mainly dedicated to setting up their governance and operational structures. An evaluation of their performance over the next few years would provide a completer and more comprehensive picture of their performance and the viability of various decentralized services.

One notable difference between the QDS system in Uganda and Tanzania is the presence of a coordinating entity. In Uganda, Integrated Seed Sector Development (ISSD) Uganda has actively played the role of a coordinating agency to advance the production of QDS in the country. In Tanzania, such an agency does not exist. As such, many activities in Tanzania are less coordinated.

Keywords: seed systems, seed services, Tanzania, Uganda, Africa

JEL codes: 013, 055, Q16 , Q18 , L16

Acronyms

AGRA	Alliance for a Green Revolution in Africa
AMCOS	Agricultural Marketing and Cooperative Society
ASA	Agricultural Seed Agency
CBO	Community-based organization
CCAFS	Climate Change, Agriculture and Food Security
CGIAR	Consultative Group for International Agricultural Research
CSB	Community Seed Bank
DAE	District Agricultural Extension Officer
DAO	District Agricultural Officer
GOU	Government of Uganda
HCSB	Hoima Community Seed Bank
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDP	Islands of Peace
ISSD	Integrated Seed Sector Development
LSBs	Local Seed Businesses
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MoA	Ministry of Agriculture
NARIs	National Agricultural Research Institutes
NARO	National Agricultural Research Organization
NARS	National Agricultural Research System
NGO	Non-Governmental Organization
NPGRC	National Plant Genetic Resources Centre
NSCS	National Seed Certification Service
OPV	Open Pollinated Variety
QDS	Quality Declared Seed
RECODA	Research Community and Organizational Development Associates
SCP	Structure, Conduct Performance
TARI	Tanzania Agricultural Research Institute
TASAI	The African Seed Access Index
TOSCI	Tanzania Official Seed Certification Institute
TPRI	Tropical Pesticides Research Institute
URT	United Republic of Tanzania
USD	United States Dollar
ZARDI	Zonal Agricultural Research and Development Institute

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Table of Contents

List of Tables, Figures and Boxes

1 Introduction and Background

1.1 Basic overview of seed systems in Sub-Saharan Africa

In most sub-Saharan African countries, there are three seed systems: a system for certified seed, also referred to as the formal seed sector, a system for farmer-saved seed, which is often referred to as the informal sector (Sperling and Cooper, 2003; Francis and Waithaka, 2014, and McGuire and Sperling, 2016)[1] and a semi-formal system, sometimes referred to as an integrated seed system (Sperling et al., 2013). Although these systems are distinct, they are interconnected.

The formal system focuses on the breeding and evaluation of improved varieties, and the production and sale of certified seed. Its structure comprises several institutions, including government, the private sector, and development institutions. These institutions and actors are required to be formally registered with relevant government authorities (Sperling and Cooper, 2003; ASARECA/KIT, 2014). The seed produced within this system is expected to be of the highest quality in terms of varietal purity and physical and sanitary quality. The sale of certified seed from this system is regulated through recognized channels such as companies' distribution systems or registered agro-dealers. Seed from this system costs more than seed produced within other systems.

The **informal system** broadly refers to the system in which farmers produce, obtain, maintain, and distribute seed resources from one growing season to the next (FAO, 1998). Activities in this system tend to be integrated with farmers' food crop production practices. This system allows seed to be accessed directly from farmers' own harvests through exchange and barter among friends, neighbors, and relatives, and through local grain markets (Sperling and Cooper, 2003). In contrast to the formal system, standards in the informal seed system are not monitored or controlled by government policies and regulations; rather, they are guided by indigenous knowledge, customs, and local social structures. This system is therefore expected to produce seed of variable varietal purity and physical and sanitary quality.

While the formal system has been growing steadily in many countries, especially for seed crops such as maize, many smallholder farmers continue to rely on the informal system as their primary and often only source of seed. According to McGuire and Sperling (2016), smallholder farmers[2] access 90% of the seed for the crops they sow (including legumes, vegetatively propagated crops and cereals except for maize) through the informal system. In eastern and central Africa, an estimated 60-80% of smallholder farmers access seed through the informal system (Francis and Waithaka, 2014). Although similar numbers are given for Kenya, Tanzania, and Uganda (Vernooy, 2016), the extent to which farmers use seed sourced through the informal system varies by crop and location in a country. The heavy reliance on the informal system is due to several factors, including limited knowledge about the benefits of certified seed, low availability (or unavailability) of certain preferred varieties or crops, a lack of financial means to purchase more expensive certified seed, and a lack of or limited access to agro-dealers who sell certified seed.

The semi-formal system has emerged as a possible solution that bridges the gap between the formal and the informal systems. Within this system, farmers and community-based organizations (CBOs) multiply seed of improved varieties with minimal quality checks from regulatory agents. They are only allowed to sell the quality declared seed to farmers within the zone where the seed is produced.

[1] Most studies identify formal, informal and semi-formal seed systems. However, these can be split into further sub-categories depending conditions prevailing in a country. For example, ASARECA/KIT (2014) identifies nine seed systems in Tanzania: farmer-saved, farmer-to-farmer, community based, open markets, local seed business, relief, public, private seed company and a closed system for high value cash crops. ISSD Ethiopia identifies five systems: farmer-saved, local seed business, public seed enterprises, private seed producers and private seed companies (Tesfaye et al., 2012).

[2] The study covered the Democratic Republic of Congo (DRC), Haiti, Kenya, Malawi, South Sudan and Zimbabwe.

The production process for Quality Declared Seed (QDS) is outlined in the 2006 FAO Plant Production and Protection Paper 185 ("Quality Declared Seed System"). The idea for QDS grew out of the recognition that smallholder farmers were and remain vastly underserved in many developing countries when it comes to high-quality seed and improved varieties. At the same time, building a fully-functioning formal system, with all the elements that it entails, was – and is – beyond the means of most governments in developing countries.

Against this background, the purpose of QDS is to offer an alternative, which can be used for those crops, areas and farming systems in which highly developed seed quality control activities are difficult to implement or make relatively little impact. It may more easily accommodate varieties of crops, which, for different reasons, do not easily fit within a conventional seed quality control scheme. Being implemented primarily by seed producers, it also facilitates local seed production initiatives, which have advantages for many of the staple grain crops. [In short,] QDS is an attempt to reconcile the continuing need to improve seed supply to farmers with the desire to reflect and accommodate the diversity of farming systems, particularly in the more difficult areas where highly organized seed systems do not function well (FAO, 2006: 6).

The production of improved varieties starts with a breeding process that culminates in production of breeder seed by breeders. This seed is then multiplied to produce pre-basic seed[3]. Pre-basic seed is multiplied to produce basic seed, which is also called foundation seed. Basic seed is used to produce certified seed. Quality declared seed is also produced from basic seed but adheres to lower quality standards. Farmers use certified and QDS to produce their crops.

1.2 How do formal, informal, and semi-formal seed systems compare?

The main differences between the three seed systems when viewed though a value chain lens are presented in Table 1. The value chain components are research and development, seed production, quality assurance and expected quality, seed packaging and labeling, seed distribution and seed pricing.

- *Research and development*: The production of breeder seed and the multiplication of basic seed in Africa often falls within the mandates of National Agricultural Research Institutes (NARIs). The main focus is on production of breeder seed by breeders while production of basic seed is a peripheral activity that is handled by other technical staff or seed units if any exists. In recent developments, some privates seed companies are engaging in production of basic seed for other seed companies, examples are in Ghana, Kenya, Malawi, Mali and Nigeria[4]. Formal and semi-formal systems are required by law to only use improved seed varieties from the NARIs and/or approved institutions[5]. In the informal system, farmers rely on each other to select and maintain superior varieties.
- *Production of seed*: In formal and semi-formal systems, seed producers must be registered by the national authority in most countries[6]. In these two systems, seed production is undertaken by

[3] The steps of pre-basic and basic seed production are commonly used in Africa but are not universal for all countries and crops.

[4] The Legacy Crop Improvement Centre (LCIC) in Ghana produces basic seed for maize, cowpea, and rice. In Malawi, Multi-Seed Company (MUSECO) produces basic seed for bean, soya beans, and groundnut. In Mali, Doun Ka Fa produces cowpea and millet basic seed. QualiBasic Seed Company (QBS), Kenya has seed production facilities in Zambia and South Africa, focuses on hybrid maize. In Nigeria, Premier seeds and Value seeds are involved in production of basic seed for maize hybrids.

[5] Private companies that specialize in the production of basic seed are common in southern African and have also been allowed in Ghana and Kenya.

[6] For detailed analysis of the legal frameworks of seed production in Africa, please see https://www.kit.nl/wp-content/uploads/2018/11/Working-Paper-Series-2017-%E2%80%93-9-The-support-for-farmers-led-seed-systems-in-African-seed-laws.pdf

registered seed companies, individual seed producers, or seed producer groups, depending on a country's regulations. In the informal system, farmers select what they consider to be superior seed as they produce their staple grains or other food crops.

- *Quality assurance systems*: Quality assurance constitutes a crucial step in the production and sale of quality seed. The system for certified seed follows a rigorous assessment of varietal purity and of the activities that contribute to the production and sale of the seed. High standards are upheld for seed inspection in the field and in the laboratory. The semi-formal system follows a less rigorous regime[7], while there are no formal quality assurance measures for farmer-saved seed.
- *Seed packaging:* Though variations exist by country, certified seed and QDS are required to be sold in packages which are clearly labelled with the characteristics of the variety. Farmer-saved seed is not packaged.
- *Seed distribution:* Since certified seed is produced centrally and sold nationally, the seed is distributed through multiple channels including agro-dealer networks. By contrast, QDS is sold locally.
- *Seed pricing*: Due to the costs associated with the production and marketing of certified seed, this seed usually costs more than QDS and farmer-saved seed. The cost is even higher for hybrid varieties.
- *Expected varietal purity and seed quality*: Assuming the activities and requirements in each system are strictly followed, certified seed should be of a higher quality and varietal purity than QDS and farmer-saved seed. However, QDS should be of a higher quality and varietal purity than farmer-saved seed.

While the three systems differ in important ways, at certain points of the seed value chain they connect, thus allowing the semi-formal and informal systems to share some of the attributes that form a part of the formal system.

However, an important point of differentiation is the level of centralization of the seed systems. Borrowing from a general understanding of organizational forms[8], Figure 1 below illustrates three possible ways to organize a system. The first option (a centralized system) is the most apt to describe the formal seed sector, which is characterized by central control – in other words, the activities of government and the private sector alike follow this model, with decisions made and activities controlled by the center. In contrast, the informal seed system is best understood as a distributed system, in which the individual actors each have the same level of control over the system and make decisions independently. The semi-formal system fits somewhere in the middle and is thus illustrated by the 'decentralized' model, which shows several localized systems

[7] For instance, field inspections under QDS are carried out on 10% of the seed plots.

[8] Different forms of system organization https://mutualwelfare.org/centralized-decentralized-and-distributed-from-the-pyramid-to-the-circle/

Table 1: Salient characteristics of the three seed systems

Components / attributes	Formal system	Semi-formal system	Informal system
Research and Development	Production of breeder seed and multiplication of basic seed is carried out by NARIs	Production of breeder seed and multiplication of basic seed is carried out by NARIs	There is no reliance on NARIs for basic seed. Farmers select and maintain varieties that they deem important to them
Seed production	Only registered seed companies or producers can produce certified seed	Only registered local seed businesses can produce QDS	There are no legal requirements
Quality Assurance (QA)	QA process is rigorous and includes requirements for formal laboratory and field inspection	QA is less rigorous than in the formal system	There is no formal QA process
Seed packaging	Certified seed can only be sold when packaged	QDS should be packaged, though this varies by country	No packaging requirements
Seed pricing	Highest price	Priced in between certified and farmer-saved seed	Lowest prices
Seed distribution	Centralized distribution utilizing agro-dealer networks	Localized distribution (QDS is not allowed to be sold by agro-dealers in Uganda). The conditions for QDS sale in Tanzania are not clear	Farmers exchange with and sell to others in the same locality
Expected varietal purity and quality of seed	Highest varietal purity and quality which should be consistent across purchases	The quality of QDS lies between that of certified and farmer-saved seed. However, QDS should meet declared characteristics for yield, etc.	Lowest quality and reducing over time; may be inconsistent across 'purchases'
Organizational form	Centralized	Decentralized	Distributed

Source: Authors' compilation

1.3 A focus on decentralized seed services

Regardless of the level of centralization, all three systems rely on a variety of services to produce seed and deliver it to farmers. These services include the management of plant genetic resources, plant breeding, seed production and multiplication, seed inspection, analysis and certification, seed processing, and seed marketing and distribution. These services are more centralized in the formal system and become more decentralized as one moves towards the semi-formal and informal seed systems. This report dwells primarily on ***seed services***, through which seed travels as it makes its way to the end user – the farmer.

Specifically, the current report focuses on decentralized seed services. These are seed services that can best be understood as belonging to the semi-formal system, even though some overlap with the formal system. Decentralized models of seed production and distribution address diverse needs of end-users and aim to ultimately reduce transaction costs associated with access to improved seed (Christinck et al., 2018). The resulting system is one that is more locally based, which aims to better recognize and serve farmers' needs in a specific area; it is a system in which decisions are made and services are performed by locally-based organizations and actors, often producing seed that is more affordable to farmers compared to seed produced through centralized systems.

1.4 Objectives of the study

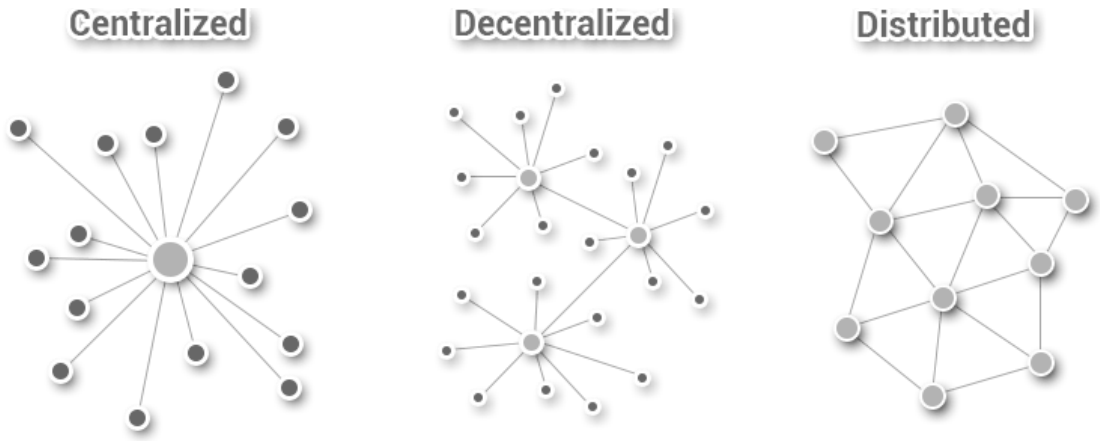
The objective of the present study is to assess the extent, nature, achievements, innovations, and shortcomings of decentralized seed services in Tanzania and Uganda. The study examines decentralized practices because these offer a way to extend farmers' access to various seed services, among them the production of QDS. Specifically, the study examines:

i. How decentralized seed-sector activities and services impact the performance of seed systems, and

ii. How such services may be improved to better serve smallholder farmers.

To achieve these objectives, this paper analyzes the structure and conduct of actors in decentralized seed services. The policy environment that influences the performance of the services is evaluated in the section on the assessment of decentralized seed services.

Figure 1: Different forms of system organization



Source: Baran, 1964.

2 Methodology

2.1 Implicit focus on system on the semi-formal seed system

Of the three seed systems, the semi-formal system can be most closely described as being decentralized. There are two reasons for this:

Reason 1: Most of the public seed services and actions in this system are undertaken through decentralized government structures. This contrasts with the system for certified seed, where most public seed services are administered by a centralized government institution. For example:

- In most cases, basic seed is sourced from decentralized NARIs spread across regions or zones in a country.
- Seed inspections are conducted by district agricultural officers, as opposed to seed inspectors from the national seed inspection authority.

However, it is important to recognize that decentralized seed services do not only benefit the semi-formal system. Often, decentralization can benefit all three systems, for example:

- In many places, agricultural extension services have been decentralized to the district level, and serve all actors in the agriculture sector, including seed companies that produce and market certified seed, local seed businesses and farmers who produce QDS, and even farmers involved in the production of their own farmer-saved seed.
- NARIs provide basic seed for all registered seed producers, whether these are seed companies (which produce certified seed) or local seed businesses (LSBs) (which produce QDS).
- Community seed banks benefit the informal seed system by conserving varieties of farmer-saved seed. Conversely, the informal seed system benefits decentralized seed services, because farmer-saved seed is one of the sources of seed for community seed banks.

Reason 2: The key operations under the semi-formal system are decentralized. The key operations of seed production and marketing are limited within local areas.

An illustration of how the three systems interact is provided in the section on the assessment of decentralized seed services.

2.2 Country selection – Tanzania and Uganda

Having recognized the potential benefits of the decentralization of seed services, several African countries have set up QDS programs. Nine countries mention QDS in at least one of their seed policy instruments. These are Ethiopia, Ghana, Malawi, Mozambique, Rwanda, South Sudan, Tanzania, Uganda, and Zambia (Herpers et al., 2017). In Rwanda, South Sudan, and Ghana, the policy instruments are either still in draft form or their implementation is still in its infancy. QDS standards were endorsed by the Ethiopian government in 2015 for potato and in 2016 for sweet potato (Walsh and Sperling, 2019). Malawi recognized QDS in its 1996 seed law, but the 2013 draft law does not contain any provisions for the initiation of QDS production (Herpers et al., 2017). Although the seed law that recognizes QDS is in place in Mozambique, the regulations have not been developed (Herpers et al., 2017). In Tanzania, QDS was formalized in 2003 (URT, 2003) and is used for many crops, including indigenous vegetable crops, pulses, and cereals (ASARECA/KIT, 2014; Vernooy, 2016). In Uganda, QDS was recognized as a seed class in 2018 and is used across many crops, including pulses, cereals, and vegetatively propagated crops (GOU, 2018; Vernooy, 2016). Zambia has a well-developed private sector-driven formal seed sector. However, this sector is dominated by maize, with very little focus on

other crops. The production of QDS in Zambia was designed specifically for lower-margin crops such as groundnut and common bean. Producers of QDS are cooperatives, farmer groups, associations, and selected seed companies. In Zambia, QDS was recognized as a seed class in 1995 (GOZ, 1995). In all these countries, the production of QDS is seen as a way of improving access to quality improved seed due to less stringent quality testing, its low cost, and the more decentralized system of seed quality control (FAO and ICRISAT, 2015).

This report assesses the performance of decentralized seed services in Tanzania and Uganda. Out of the nine countries, Tanzania and Uganda stand out as examples of countries where QDS is used widely across many crops. These countries offer diverse lessons for extending smallholder farmers' access to improved seed varieties.

2.2.1 Uganda

QDS was formally introduced as a seed class in Uganda in the National Seed Policy of 2018. However, prior to the introduction of this policy, QDS had been accepted by the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) and was being produced and inspected in collaboration with other organizations. The MAAIF works closely with the ISSD program in Uganda to promote the production of QDS. QDS production and marketing is limited to the area where the seed is grown. This is done to reduce competition with certified seed, which is of higher quality. As such, some of the seed services have been decentralized to respond to the structure of the system through which QDS is produced. Furthermore, ISSD Uganda plays a key role in the country's production of QDS by coordinating most activities, working with most of the actors, and documenting the performance and experiences of various QDS operations.

2.2.2 Tanzania

Although the Tanzania Seed Act does not recognize QDS as a seed class, the law allows for the production and sale of QDS. Its introduction was promoted through projects throughout the country. QDS production and marketing are decentralized and confined to wards within districts. Seed inspection is mandated to authorized district extension officials, under the supervision of the Tanzania Official Seed Certification Institute (TOSCI).

Where applicable, comparable examples from other African countries that offer important lessons on the decentralization of seed services will be discussed. The section on the management of plant genetic resources will discuss lessons from seed banks in Ethiopia, Zimbabwe, and Mali. The section on seed inspection will explore the authorization of private seed inspection in Kenya.

2.3 Case study approach

To obtain a better understanding of the operational details related to decentralized seed services, a case study approach was adopted. Care was taken to ensure that the areas chosen for the study would represent areas with close linkages between the key actors in the decentralized seed services chain, i.e., actors in plant genetic resource management, the production of basic and breeder seed, seed inspection, processing and marketing. Six specific cases that touch on all the applicable decentralized seed services in the two countries were selected and examined.

In Uganda, case studies were selected to cover the major parts of the country, including western, central, eastern, and northern Uganda. Visits were made to the ISSD program in Kampala and to Entebbe, which houses the headquarters for the National Agricultural Research Organization (NARO) and the National Plant Genetics Resource Centre (NPGRC), Uganda. The two case studies under the plant genetic resource management were the Nakaseke community seed bank and Hoima community

seed bank. There are five community seed banks in Uganda. Hoima and Nakaseke are relatively active, have a broad portfolio of crops (some community seed banks focus on only one crop), have administrative and governance structures, and have developed relations with agricultural research institutions and QDS producers. The two cases of decentralized agricultural research institutions were the Ikulwe-Bugi and Ngetta Zonal Agricultural Research and Development Institutes (ZARDIs). There are nine ZARDIs in Uganda. These two were selected because of their working relationship with and close proximity to LSBs. The two decentralized seed production cases were Namunasa Stream Rice Farmers Cooperative Society Ltd LSB and Aye Medo Ngeca LSB. There are 256 LSBs in Uganda. However, not all are active. These two businesses were selected because they are located close to, source their breeder seed from, the ZARDIs, and have a relatively good administrative and governance structure.

In Tanzania, the study coincided with the reporting of the first COVID-19 cases in the country. This led to travel restrictions across the country. Babati and Karatu districts were chosen as case studies since these districts are among the country's major bread producers. All the major crops grown in Tanzania – maize (*Zea mays*), wheat (*Triticum*), sorghum (*Sorghum*), rice (*Oryza sativa*), common bean (*Phaseolus vulgaris*), pigeon pea (*Cajuns cajun*), sesame (*Sesamum indicum*), and sunflower (*Helianthus*) – are grown in the districts selected as case studies. The districts are also home to many local, regional, and international seed companies, the National Plant Genetics Resources Centre, Tanzania, regional offices for government agencies such as the Agricultural Seed Agency (ASA), TOSCI, and many non-governmental organizations (NGOs). The Tanzania Agricultural Research Institute (TARI) at Selian has a long history of working in the two districts, in collaboration with district extension staff. The district extension staff were instrumental in selecting farmer groups. Visits were made to the TOSCI headquarters in Morogoro and the ASA and TARI headquarters in Dodoma.

The examination revealed the details of the structure, conduct, and performance of the decentralized seed services in both countries. The linkages between these services are explained in the section on the assessment of decentralized seed services.

2.4 Data collection

Information was collected through structured interviews and a review of secondary data.

- Structured interviews were conducted among a total of 36 people in Uganda and 56 people in Tanzania. Key informant interviews were conducted with representatives of institutions that play a key role in the provision or use of a decentralized service along the seed value chain. The institutions include national gene banks, community seed banks, QDS inspectors, plant breeders at a sub-national level, producers of basic seed, QDS producers, agricultural extension officers, and NGOs active in supporting this seed system. The structured interviews were guided by questions listed in Appendix 1.
- To kick off the interviews, the researchers contacted the local government authority offices, i.e., District Executive Officer/Extension Officer, by phone to introduce the study, purposes, and how it would be conducted. This was followed by an official letter to the same offices explaining the intention of the study. The letter also sought collaboration with the extension office to identify representative farmers working in respective areas and finally select farmers who would participate in the interviews representing wards, villages, and sub-villages.
- The researchers interviewed 60 farmers (40 from Tanzania and 20 from Uganda[9]) through group discussions. In Tanzania, the farmers were in five groups spread across the study region. Each group had two to 25. In total, there were ten women farmers in the five groups. In

[9] The 20 farmers in Uganda are all users of the two CSBs.

Uganda, the interviews were organized into two groups, with ten farmers each. The farmers belonged to two farmer groups – Kalagala farmers' group in Nakaseke district and Kyabigambire Farmers' group in Hoima district. Through their respective groups, the farmers source seed from the two community seed banks – Nakaseke CSB and Hoima genebank. In the group and individual interviews, all farmers involved had a chance to give their opinions and even leave the interview. Fortunately, none opted out. The local language that was understood by everyone was used in the interview. At the end of each interview, the summary of the findings was discussed with each group. The intention was to ensure that the summary was a true reflection of the discussions and endorse the conclusions. The researchers took notes of the meetings and translated them from the local languages to English. The list of guiding questions is presented in Appendix 2.

- Secondary information was obtained from multiple sources, including research studies and reports on seed systems and various government policy instruments, including seed policies, seed laws, seed regulations, local government laws, and QDS regulations.

3 Seed systems and policy environment

3.1 Overview of seed systems in Uganda

Like most other African countries, the seed industry in Uganda consists of three systems: the informal, semi-formal and the formal system.

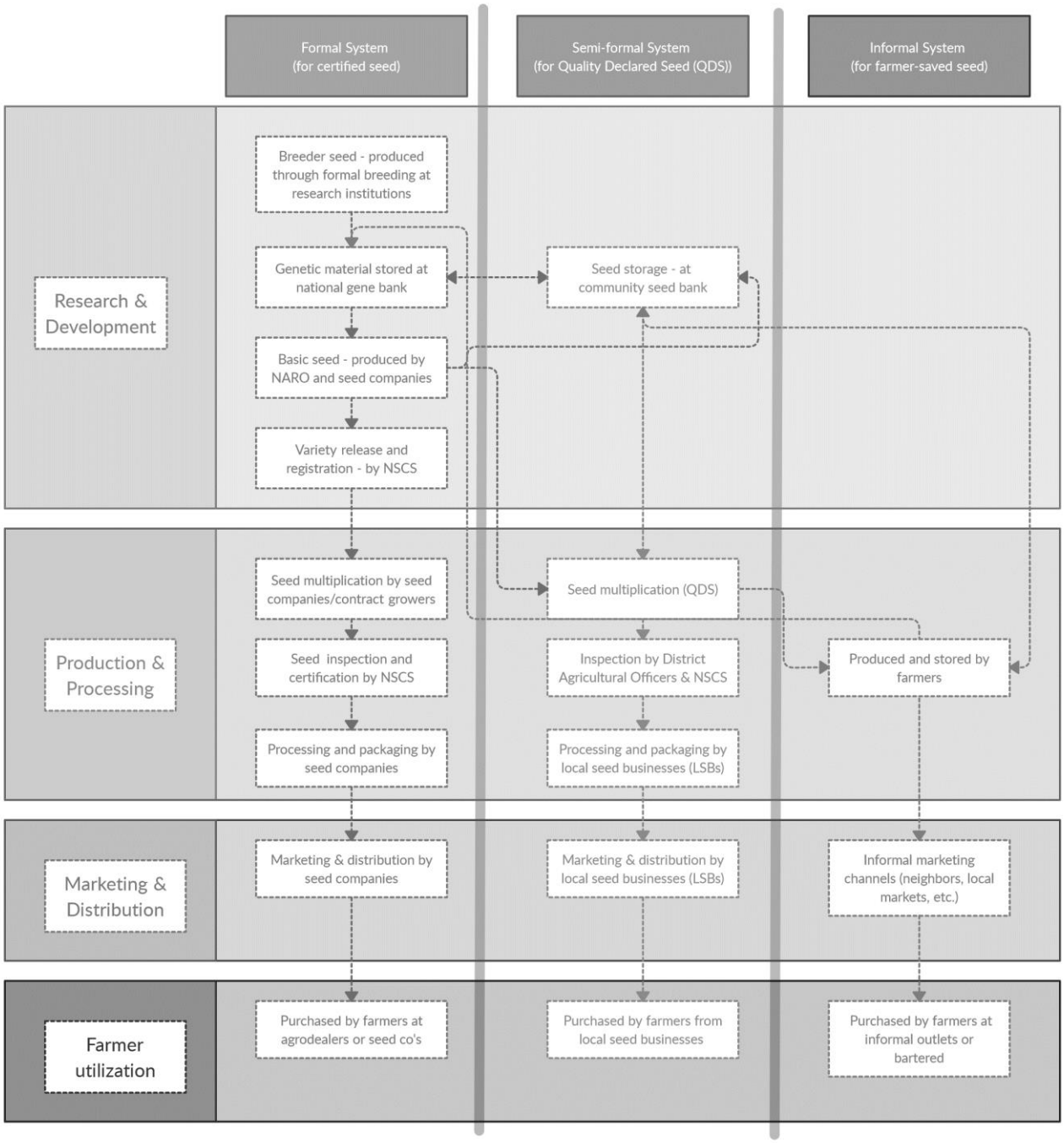
The informal system in Uganda is developed in response to limited access to improved varieties, low availability of varieties, inability to purchase seed, and limited access to agro-dealers. Most smallholder farmers in Uganda still rely at least in part on informal seed systems, particularly for crops other than maize. In the informal system, farmers generally acquire seed from the local community, including markets and the farmers' social networks. Standards in the informal seed sector are not monitored or controlled by government policies and regulations; rather, they are guided by indigenous knowledge and standards and local social structures.

The formal system focuses on breeding and evaluating improved varieties and producing and selling seed of these varieties certified by the National Seed Certification Service (NSCS). The NSCS is the government entity under the MAAIF responsible for regulating Uganda's seed industry. As shown in Table 1, Uganda's formal seed sector comprises many institutions, including government (e.g. MAAIF, DCIC, NSCS, NARO, and local government extension services), the private sector (MNCs and local seed companies), agro-dealers, and development agencies (NGOs and CBOs). The country's most important seed association, the Uganda Seed Trade Association (USTA), plays an important role in sharing information and advancing members' interests.

The semi-formal system combines the key aspects of regulation and quality control, though not at the same level as the formal system. QDS production by necessity occurs in a semi-formal system. The MAAIF works closely with the ISSD program in Uganda to promote the production of QDS. QDS sale and marketing is limited to the area where the seed is grown.

Figure 2 illustrates the value chain for the three seed systems in Uganda. The three systems are inter-connected at different stages of the chain. The informal system is simple and comprises only two value chains, i.e., the production of seed and sale to neighbors or in open-air markets. The informal system is connected to formal and semi-formal systems through its contribution to collecting and storing plant genetic resources at the national or community levels. It also benefits from collections stored in community seed banks (CSBs). The other link between the informal and semi-formal systems is that many farmers who produce QDS also engage in the production of farmer saved seed. In the semi-formal system, after production, QDS is subjected to inspection, and processing, and packaging. The formal system adds two more value chains to those operating in the semi-formal system: variety release and registration and seed multiplication. The common links between the formal and semi-formal systems are the production of basic seed by NARO and the national gene bank and CSBs in the collection and storage of plant germplasm.

Figure 2: Value chains under the three seed systems in Uganda



Source: Authors' creation

3.2 Policy, legal and regulatory environment in Uganda

The extent to which a country's seed sector is decentralized depends on legal and governance arrangements defined in the country's various policy instruments. One of the democratic principles in Uganda's constitution is the devolution and decentralization of government functions at appropriate levels (GoU, 1995). Guided by this principle, decentralization is incorporated into different sectoral policies and programs where applicable. The policy instruments that allow for the decentralization of various types of seed services include the Local Government Act and extension strategy. Seed sector-specific policy instruments are the National Seed Policy, and draft seed law and seed regulations. The National Agricultural Research Organization Act guides the production of basic seed. Table 2 summarizes the five policy instruments that allow for the decentralization of various seed services, including seed production, seed inspection, and agricultural extension.

Table 2: Summary of the policy environment for decentralized seed services in Uganda

Seed service	Policy instrument	Overview of relevant provisions
Seed production	National Seed Policy 2018	Policy area 3.3.2 allows for the decentralization of the registration of seed producers at the zonal and district levels.
	Draft Seeds and Plant (Quality Declared Seed) Regulations 2019	Though not yet implemented, the regulations provide guidelines for QDS producers and the production process.
Production of basic seed	National Agricultural Research Organization (NARO) Act 2015	The act establishes ZARDIs that provide agricultural research services, such as producing basic seed at the zonal and district levels.
Marketing of seed	Draft Seeds and Plant (Quality Declared Seed) Regulations 2019	Though not yet implemented, the regulations define the geographical scope for marketing QDS. According to the regulations, QDS can only be sold in the district in which it was produced. This is specified in the certificate that is issued after the seed passes the relevant tests.
Agricultural extension, including seed inspection	National Agricultural Extension Strategy 2016/17 to 2020/21	Section 5 outlines the implementation arrangements of the strategy. Various services, including agricultural extension, quality assurance, planning, and monitoring, are decentralized to the districts.
	Local Government Act of 1997	Agricultural extension is one of the services that is decentralized to the district/ municipal levels.

Source: Authors' compilation

The relevant legal instruments guiding QDS production are the National Seed Policy of 2018 and the Draft Seeds and Plant (Quality Declared Seed) Regulations of 2019.

National Seed Policy, 2018 (GOU, 2018): This policy introduced QDS as a seed class. The marketing of QDS is limited to the area in which the seed is produced. As such, most of the support services, such as the registration of seed producers, access to basic seed and seed inspection, are decentralized to the districts where QDS production is undertaken.

Draft Seeds and Plant (Quality Declared Seed) Regulations 2019 (GOU, 2019): The MAAIF has drafted the QDS Regulations that are awaiting approval by the Solicitor General. Once consent is obtained, the MAAIF will start to enforce them. The regulations outline the requirements for the application and registration of QDS growers and provide guidelines for the production, processing, inspection, and sale of QDS.

The production of basic seed is guided by the **National Agricultural Research Organization Act of 2005** (GOU, 2005)**.** The law establishes nine Zonal Agricultural Research and Development Institutes (ZARDIs). The ZARDIs decentralize research services to various agro-ecological zones. They are

governed by a management committee that provides management and operational oversight in the running of the ZARDI. The management committee is composed of representatives from the districts in which the ZARDIs are located. The marketing of seed is guided by the draft Seeds and Plant (Quality Declared Seed) Regulations of 2019.

Agricultural extension and seed inspection are guided by the **National Agricultural Extension Strategy (2016/17 to 2020/21)** (GOU, 2016) and the Local Governments' Act, 1997. One of the National Agricultural Extension Strategy tenets is the decentralization of agricultural extension services across the agricultural value chain. Under the strategy, the MAAIF provides policy direction and technical guidelines on agricultural extension. However, most specific activities are mandated to the district agricultural officers (DAOs). These activities include the development of district plans, the training of sub-county and village-level extension officers, quality assurance, which includes aspects of seed inspection services, and the linking of the national agricultural research system to farmers.

Local Governments Act, 1997 (GOU, 1997): This law entered into effect on 24 March 1997 and concerns the decentralization and devolution of functions, powers and services to all levels of local government to ensure good governance and democratic participation in, and control over, decision-making by the people. Among the services that are decentralized to the district level are agricultural extension services.

3.3 Overview of the seed systems in Tanzania

The informal sector is relied upon by most smallholder farmers in Tanzania to source their seed, especially for grain, legumes, millet, cassava, and sweet potato. Standards in the informal seed sector are not monitored or controlled by government policies and regulations. Rather, they are guided by indigenous knowledge and standards and local social structures. The locally grounded nature of transactions, coupled with the lack of a clear distinction between seed and grain, means that there is scant performance data available on the informal seed sector. However, it is estimated that this sector provides 95% of all seed used in Tanzania (ASARECA/KIT, 2014).

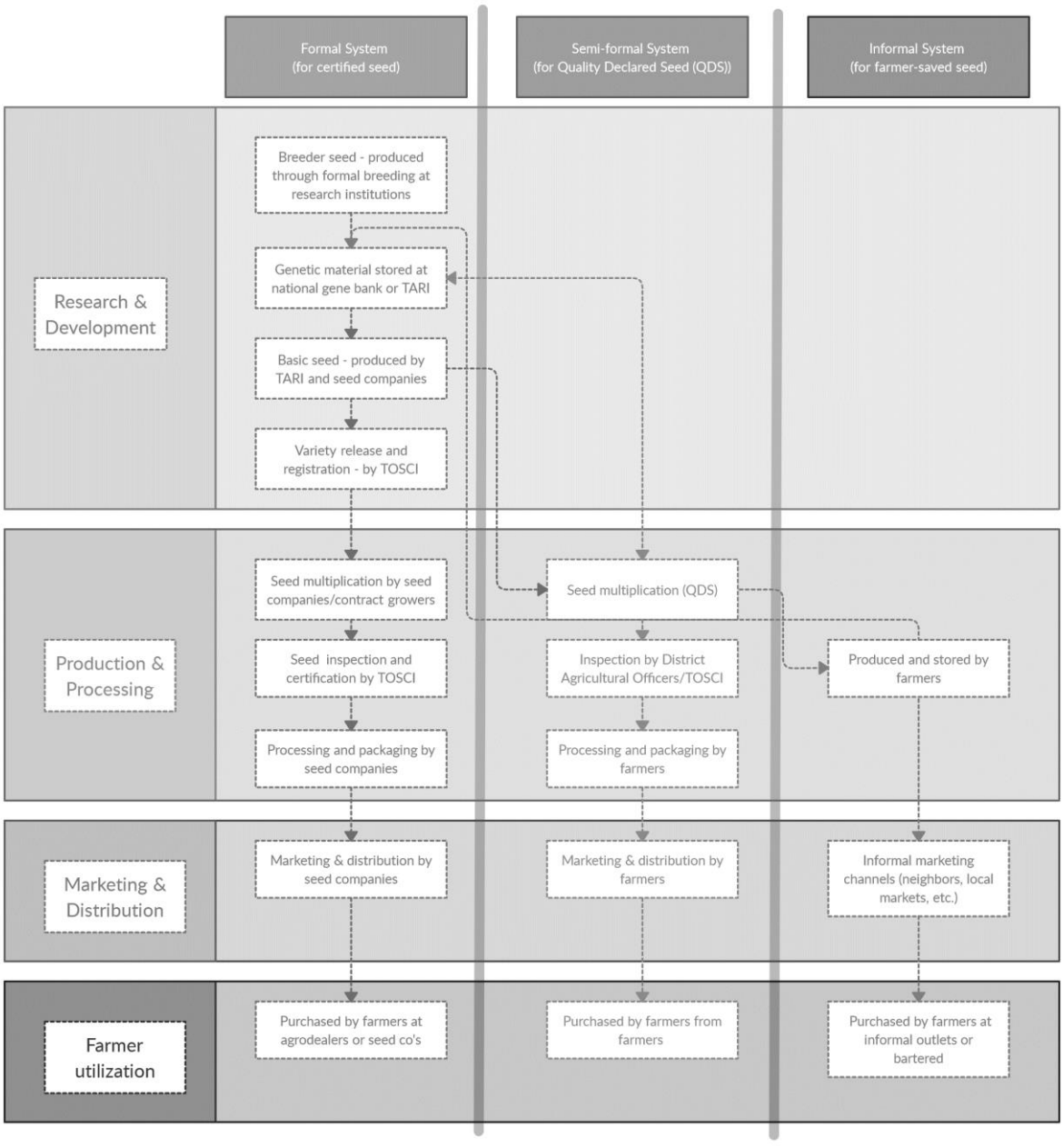
The formal sector focuses on breeding and evaluating improved varieties. The production and sale of seed of these varieties are certified by the government regulator, TOSCI, under the Ministry of Agriculture (MoA). The formal seed sector comprises government institutions such as agricultural research institutes and the ASA, private seed companies and agro-dealers, and development agencies. The Tanzania Seed Trade Association (TASTA) is the umbrella association that brings together the seed companies in the country and plays a key role in representing their interests at the policy level (Mabaya et al., 2019).

The QDS system was introduced through the National Seeds Act of 2003 (URT, 2007). The main distinction from the certified seed system is that only a proportion of fields are inspected each season. The local agricultural officer conducts the inspection. This reduces travel distances and thus the costs of the inspections. The main requirements are that QDS can only be multiplied from formally registered open-pollinated varieties (OPVs), and marketing is restricted to the ward in which it is produced (ASARECA/KIT, 2014; ESAAF, 2013).

Figure 3 illustrates the value chain for the three seed systems in Tanzania. The three systems are inter-connected at different stages of the chain. The informal system is simple and comprises only two value chains, i.e., the production of seed and sale to neighbors or in open-air markets. This system is linked with the semi-formal system because many farmers who produce QDS also engage in the production of farmer-saved seed. It also benefits from collections stored in the national gene bank. In the semi-formal system, after production, two value chains are introduced: inspection and processing and packaging. The formal system adds two more value chains to those in the semi-formal system, i.e., variety release and registration and seed multiplication. The formal and semi-formal systems are

connected through the production of basic seed by TARI and the national gene bank's involvement in the collection and storage of plant germplasm.

Figure 3: Value chains under the three seed systems in Tanzania



Source: Authors' creation

3.4 Policy, legal and regulatory environment in Tanzania

The seed sector's structure and conduct in Tanzania are guided by the legal and governance arrangements set out in the national policies and acts. The highest law guiding the seed sector is the National Agriculture Policy (Table 3). The conservation of genetic materials and the development of varieties are guided by the Tropical Pesticides Research Institute Act and the Tanzania Agricultural Research Institute Act. The Executive Agencies Act guides the production of basic seed. With respect to QDS, the guiding laws are the Seed Act and the Local Government Act.

The National Agriculture Policy of 2013 (URT, 2013) is the overarching instrument guiding the seed sector. It facilitates the participation of local and international entities in seed breeding and production and promotes the involvement of private sector players in the multiplication of pre-basic and basic seed. It supports farmers in purchasing improved inputs so as to encourage their use.

Seed Act No. 18, 2003 (URT, 2007) recognizes and encourages the production of QDS. It empowers the Minister of Agriculture to set rules and procedures for its certification and control. Section 10 of the act established TOSCI and its functions under the Ministry of Agriculture. TOSCI[10] is responsible for the certification and promotion of quality agricultural seed produced or imported into the country for sale.

The Seeds (control of Quality Declared Seeds) Regulations, 2020 (URT, 2020) define QDS dealers, producers, and growers. A QDS dealer is any small-scale farmer or group of small-scale farmers producing or processing seed for their own use or for sale to neighboring farmers within the district where QDS is produced. A QDS producer or grower is any small-scale farmer or group of small-scale farmers producing QDS. The regulations delineate that production will be restricted to the village and district. They also specify eligible land size, inspection standards, and fees for inspection, germination tests, soil health testing, and training of persons involved in QDS production.

Tanzania Agricultural Research Institute Act No. 10 of 2016 (URT, 2016) established TARI to strengthen Tanzania's agricultural research system. TARI[11] is a semi-autonomous body under the Ministry of Agriculture and is responsible for all public agricultural research activities conducted in the country.

The **Executive Agencies Act** (URT, 2002) established ASA, which was launched in June 2006 as a semi-autonomous body under the MAAIFC. The aim of establishing ASA was to ensure that high quality agricultural seed would be available to farmers at affordable prices. While ASA focuses on producing basic seed, it also produces certified seed for crops that do not attract private sector players. Examples are the common bean, sunflower, pigeon pea, and rice. The basic seed is sold to national private sector seed companies and QDS producers.

The **Tropical Pesticides Research Institute Act of 1977** (URT, 1977) established the Tropical Pesticides Research Institute (TPRI). The National Plant Genetic Resources Centre (NPGRC) of Tanzania is one of the four divisions under the Technical Services Department of the TPRI.[12] The TPRI was established in 1991 in the second schedule of this act under programs of the institute.

The **Local Government Act No. 6 of 1999** (URT, 1999) authorizes local governments to implement agricultural production and extension services. They do so in close collaboration with the Ministry of Agriculture and the regional administration in charge of local governance.

The **Southern African Development Community (SADC) Harmonized Seed Regulatory System,** to which Tanzania is a signatory, recognizes QDS as a seed class (SADC, 2008). QDS producers are

[10] www.tosci.go.tz

[11] https://www.tari.go.tz/

[12] https://www.tpri.go.tz/national-plant-genetic-resources-centre

required to be registered with the national seed agency. The national seed agency – TOSCI in Tanzania - is supposed to inspect 10% of the seed crops (SADC, 2008).

Table 3: Seed services acts in Tanzania

	Policy instrument	Overview of relevant provisions
Seed production	National Agriculture Policy 2013	This policy allows the participation of private sector players in the multiplication of pre-basic and basic seed.
	Seed Act No. 18, 2003	This act recognizes and encourages QDS production.
	SADC harmonized seed regulations 2008	These regulations restrict the source of basic seed to varieties listed in the SADC catalog. They call for the registration of QDS producers by the national seed agency, TOSCI.
	Seeds (control of Quality Declared Seeds) Regulations 2020	The regulations define QDS dealers, producers, and growers. Sale is restricted to the village and district where it is produced. The regulations also define eligible land size, inspection standards, and fees for inspection, germination tests, soil health testing, and training of persons.
Production of basic seed	National Agriculture Policy 2013	This policy allows the participation of private sector players in the multiplication of pre-basic and basic seed.
	TARI Act No. 10, 2016	This act established the Tanzania Agricultural Research Institute to provide agricultural research services.
	Executive Agencies Act 2002	This act established the Agricultural Seeds Agency to produce of basic seed at the local and district levels.
Agricultural extension and seed inspection	Local Government Act No. 6, 1999	The act delineates the implementation of agricultural production and extension services.
	Seed Act No. 18, 2003	This Act established the Tanzania Official Seed Certification Institute (TOSCI).
	National Agriculture Policy 2013	The National Agriculture Policy provides for the strengthening of agricultural extension services.

Source: Authors' compilation

4 Assessment of decentralized seed services

This section provides a detailed assessment of the decentralized seed services in Tanzania and Uganda. It is divided into six sub-sections; the structure is based on the path of seed as it moves along the value chain. The sections discuss the structure, conduct, and performance of the seed services that have been decentralized in the two countries. The services include plant genetic resource management, the production of breeder and basic seed, the production of QDS, seed inspection, and seed distribution and marketing.

4.1 Decentralized management of plant genetic resources

The fundamental objective of plant genetic resources conservation is to maintain broad-based genetic diversity within each plant species with a known or potential value to ensure availability for exploitation by present and future generations (Paroda and Arora, 1991). One of the most common ways to preserve genetic material is through gene banks, which store various planting materials. In most countries in Africa, national gene banks are maintained by the NARIs. Seed banks are a type of gene bank specializing in the storage and preservation of seed in a controlled environment to maintain seed viability for long periods. Other types of gene banks include tissue gene banks and field gene banks, where the genetic resources are conserved in the open field (also called *ex situ* conservation).

At present, Africa has 42 national gene banks in 23 countries, which hold close to 300,000 accessions (Table 4). Gene banks are supported by NARIs. East Africa has the most gene banks and accessions in – 24 gene banks in 8 countries. The countries with the most accessions are Ethiopia (over 80,000) and Kenya (over 50,000).

Table 4: Status of Plant Genetic Resources in Africa, by region

	Number of accessions	Number of gene banks	Number of countries
Eastern Africa	158,626	24	8
Northern Africa	109,187	5	5
Southern Africa	15,632	5	5
Western Africa	7,892	8	5
TOTAL	291,337	42	23

Source: Authors' compilation, January 2020

In addition to the NARIs, some of the Consultative Group for International Agricultural Research (CGIAR) institutes also maintain gene banks for the crops that they focus on. According to the organizations' respective websites, Africa Rice (for rice) maintains gene banks in Cote d'Ivoire, Benin, and Nigeria. The International Center for Agriculture Research in the Dry Areas (ICARDA) (for barley, chickpea, lentil, and wheat) maintains a gene bank in Morocco. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) maintains gene banks in Kenya, Niger, and Zimbabwe. The International Institute for Tropical Agriculture (IITA) (for groundnut, cowpea, maize, soya bean, African yam bean, banana, cassava, and yam) maintains gene banks in Benin and Nigeria. The resources in these facilities are available for breeding, research, and educational purposes.

The management of these resources can also be decentralized at the community level through community-based seed banks (CSBs). CSBs were started in the 1980s with the main purpose of conserving local varieties being used by farmers (Vernooy et al., 2015). Their creation has often been driven by shocks such as famines after prolonged droughts and pest infestations, leading to the loss of local seed supplies. Over the years, the objectives and scope of CSBs have expanded to include providing access to varieties for farmers, serving as a platform for community development, and

contributing to seed sovereignty. These additional functions have arisen due to the farmers' demand, who are the owners of the CSBs. Since farmers pay to access these varieties, this enables the CSB to generate revenue, which can be used to pursue their other objectives.

CSBs were created in Zimbabwe in 1998, following a drought that ravaged the region in 1991/92. Their creation was spearheaded by the Community Technology Development Trust[13] (CTDC) in collaboration with the government and other stakeholders. From the initial three districts, CSBs had spread to 10 districts by 2017 (Kasasa and Mushita, 2018).

In Ethiopia, CSBs were revived by the Seeds of Survival program[14] in collaboration with the Institute for Biodiversity Conservation of Ethiopia in 1989, following the devastating drought and famine of 1984 (Vernooy et al., 2015). Researchers from the Institute for Biodiversity Conservation multiplied many varieties of sorghum, wheat, and locally adapted maize on farms in most areas affected by drought. These varieties were then reintegrated into local seed systems and distributed to many others. CSBs were introduced to ensure that the reintroduced varieties were maintained locally. Over the years, CSBs have expanded the range of crops they work with beyond cereals and pulses to include Irish potato (*Solanum tuberosum*). Strategies used to sustain CSBs in Ethiopia include beekeeping, fruit production, membership fees, and the rental of meeting/office rooms as training facilities.

In Mali, CSBs were set up after devastating droughts, floods, and locust invasions that wiped out food and seed reserves (Vernooy et al., 2015). They now serve the dual role of conservation of and repositories for seed. They are supported by NARIs such as the *Unité des Ressources Génétiques* at the *Institute d'Economie Rurale*, and by NGOs and international research and development institutions which focus on capacity-building and offer support for facilities and equipment. Initially, the CSBs were organized and managed based only on local knowledge. This improved when the NARIs intervened with technical assistance. They benefit from and continue to strengthen group members seeking solutions to common problems. Notable achievements include the conservation of neglected and underutilized varieties and their success in providing farmers with a wider range of crop varieties, including those newly developed by research institutes.

The experiences of CSBs in pioneer countries like Ethiopia and Mali have inspired Bioversity's move to establish and support CSBs in China, Rwanda, and Uganda (Vernooy et al., 2015). The following section highlights the structure, conduct and performance of the decentralized management of plant genetic resources in Uganda, using two CSBs as case studies.

4.1.1 Management of plant genetic resources in Uganda

The first CSB was established in Uganda in 2010. By the end of 2019, there were five CSBs in Uganda, all established with support from Bioversity International and NARO (Adokorach et al., 2020). The main purpose of the decentralized community-based management of seed banks in Uganda is to bring varietal conservation services closer to the farmers, who are the main users of seed.

The seed at the CSBs is obtained from multiple sources, including farmers, the national gene bank, and seed fairs. Before constructing these seed banks, farmers were mainly conserving their varieties at the household level and from season to season. The advantage of seed banks is that, provided that they are well-constructed and well-maintained, varieties can be conserved for up to 10 years, reducing the need to collect seed every season.

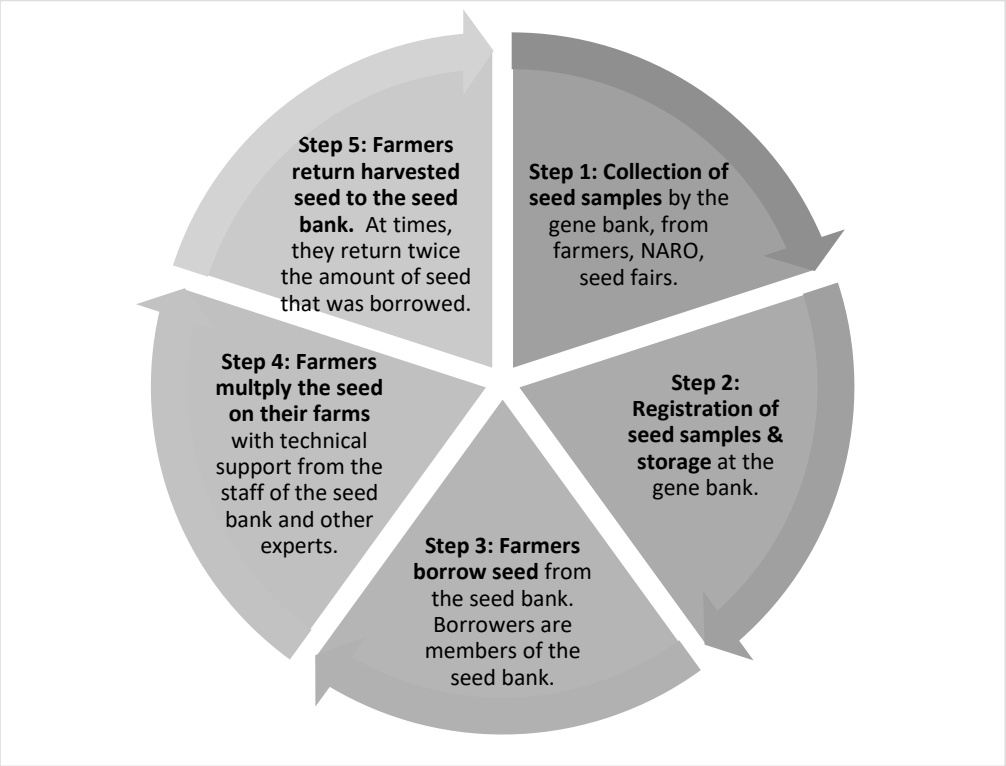
Community-based seed conservation follows five generic steps[15], illustrated in Figure 4.

[13] http://www.ctdt.co.zw/

[14] https://weseedchange.org/see-the-impact/global-impact/

[15] Adapted from Vernooy et al. (2020).

Figure 4: Five steps of the seed conservation process in Uganda



Source: Authors' creation

Step 1. Collection of seed samples

The CSB collects samples of seed from three main sources:

i. Farmers in the community who collect local varieties of crops of importance to the community, which are usually native to the area.

ii. Research institutions like NARO or Bioversity International. In this case, the farmers first receive seed multiplication training, participatory breeding, the licensing of seed as farmers' varieties, and trading seed under open-source labels.

iii. Seed fairs: these attract hundreds of farmers and provide an opportunity to showcase the different local seed varieties being grown by farmers. Seed fairs also provide an excellent opportunity for farmers from different parts of the country to exchange seed and share experiences.

Step 2. Registration and storage of samples at the seed bank

The collected seed varieties are registered at the seed bank in the diversity book/register and given a CSB number. Each entry contains the name of the variety (if known), general characteristics, method of cultivation, perceived nutritional value, and cultural and religious uses. The varieties supplied by NARO have already been tested in seed laboratories, and the information on their characteristics is available.

Step 3. Borrowing of seed from the seed bank

This entails the following steps:

i. Farmers receive training on agronomic practices before they are permitted to borrow seed from the seed bank.

ii. Farmers borrow seed as individuals or in groups. Farmers collect clean seed that has been approved by the quality assurance manager and distribution manager. Farmers sign for the collection and receive a receipt. Groups like the Nakaseke farmers' group in Nakaseke and the Kyabigambire farmers' group in Hoima source seed from their respective CSBs. Individual farmers who borrow seed provide their personal information, i.e., name and location, names of varieties, the amount borrowed, and amount to be returned.

Step 4. Multiplication of the seed

The farmer plants the seed following the agronomic practices described by the seed bank. The staff and leadership of the CSB conduct routine follow-up visits to ensure farmers follow appropriate production and post-harvest practices.

Step 5. Returning seed to the seed bank

After harvest, the farmer returns the agreed amount of seed to the seed bank. The seed is checked for cleanness and moisture content. If additional drying is needed, the seed is sun-dried. The seed that meets the required quality standards is packed in Purdue Improved Crop Storage (PICS) bags or other containers and then kept in the CSB's storeroom.

4.1.2 Requirements for a functional CSB

According to the managers, CSBs function on principles of participation, collective decision-making, and shared responsibility for resources, risks, and benefits. These principles strengthen their capacity for collective action and build human resource capacity across the CSBs' management and membership. To effectively manage a CSB while following these principles, the following logistical and human resource requirements must be met:

Logistical requirements include:

- A storage room for conserved seed, with adequate ventilation, lighting, and shelf space to ensure that there is no damage to the seed.
- A storage room for seed for sale, which should also have adequate ventilation, lighting, and shelf space.
- An equipment room for assorted materials like moisture meters, weighing scales, storage bags and threshers.
- Office space, for record management. This should have a computer and basic office furniture for data entry and record-keeping.

The basic human resource requirements for a functioning CSB include:

- A manager, who oversees the overall day-to-day running of the seed bank.
- A technical/quality assurance manager in charge of quality assurance, whose main role is to ensure that the seed is maintained properly at the seed bank to preserve its quality. This officer would also lead the farmer training program.
- A storage/distribution manager, in charge of managing the CSB's seed inventory. The storage/distribution manager is a member of the management committee and works closely with the quality assurance manager to approve the seed that is given to farmers. In addition, the manager ensures that the farmers who borrow seed return the agreed quantities of seed to the warehouse after their harvest.
- A secretary, in charge of record-keeping. This officer receives the applications for seed from farmers and maintains all the records for the CSB.

- An accountant, in charge of the financial management of the CSB's operations. This officer's tasks include receiving payments from farmers, issuing receipts and preparing financial reports. The accountant also serves as the loans officer who handles and processes loan applications.
- Field assistants, working under the supervision of the quality assurance manager, train farmers and monitor quality control of seed production.

Ideally, the community seed bank's overall management should be guided by a management committee composed of the seed bank's membership and a few other seed experts from the NPGRC, NARO, or Bioversity. The management committee should determine the overall strategic direction of the CSB, oversee the performance of the CSB's staff, and support the staff in the implementation of some of the field activities. Beyond supporting access to improved varieties, the NPGRC, NARO, and Bioversity also offer invaluable technical guidance and training on the management of CSBs. The support to the CSBs' management should aim to have them stand on their own as sustainable entities. Thus, there should be exit strategies to move toward a situation in which communities manage their CSB independently.

Table 5. Status of the logistical and human resources at two Ugandan seed banks

	Specific requirements	Nakaseke Community Seed Bank	Hoima Community Seed Bank
Logistical requirements	Seed storage (conserved seed)		
	Seed storage (commercial seed)	Uses conserved seed storage room	Uses conserved seed storage room
	Equipment storage room	Uses seed storage room	Uses seed storage room
	Office space	Not available	Not available
	Computer	Not available	Not available
	Office desk	Not available	Not available
	Electricity	Not available	Not available
Human resource requirements	Manager	Volunteer (board member)	
	Technical/Quality Assurance Manager	NARO/Bioversity support	NARO/Bioversity support
	Distribution Manager	Volunteers (board members)	Volunteers (board members)
	Field assistants	NARO/Bioversity support	Volunteers (board members)
	Secretary (record-keeper)	Volunteers (board members)	Volunteers (board members)
	Accountant/Loans officer	Volunteers (board members)	Volunteers (board members)

Color code: logistics/ human resources partly available, logistics/ human resources available.

Source: Authors' compilation, January 2020

The performance of the decentralized management of plant genetic resources in Uganda is discussed through two case studies, the Hoima Community Seed Bank (Table 5) and the Nakaseke Community Seed Bank (Box 1). The two seed banks lack some logistical and human resource requirements to operate optimally as a seed bank (Table 5). The Nakaseke Community Seed Bank does not have any paid employees. Instead, the leadership of the seed bank performs some of the day-to-day functions, such as member recruitment and farmer training. NARO and Bioversity International provide financial

support for the salary of one person who serves as the technical/quality assurance manager, sometimes referred to as the site coordinator. NARO and Bioversity International also support four field assistants. The Hoima Community Seed Bank only employs a manager. The two seed banks each have one storage room, which serves as the storeroom for both conserved and commercial seed, as well as the equipment store. Neither seed bank has office space.

Box 1: Profile of Nakaseke Community Seed Bank

The Nakaseke Community Seed Bank is in the Nakaseke district in central Uganda. The CSB is an association of seven farmer groups, all of which are also its founders. The CSB does not yet have any legal status. However, it is in the process of registering as a CBO, under the Non-Governmental Organizations Act of 2016. As a CBO, the seed bank will be registered at the district level and will only be permitted to operate at the level of a sub-county or below. The CSB built a storeroom in 2014 with support from the NARO/Bioversity International project, the local community and the Buganda Kingdom government. The kingdom is a religious institution whose jurisdiction includes the district in which the CSB is located. The kingdom provided the community land on which the storeroom is built. The first set of seed was brought by local farmers and obtained from seed fairs.

The objectives of the CSB are conserving crop diversity in the community, increasing crop diversity by accessing new varieties, supplying clean and affordable seed to the community, and training farmers on good agronomic practices and seed management. In addition, the CSB intends to serve as a place where farmers can meet and share farming knowledge and experience. The CSB is led by a management committee of 22 people, the majority of whom are women, and who are democratically elected by the members. The committee is composed of a chairperson who is a woman, a vice-chairperson, secretary, treasurer, quality assurance manager and assistant, distribution manager and assistant, 14 village representatives/mobilizers (two for each of the seven villages, one male and one female), and group chairpersons for the seven villages. All farmers in each village are eligible to be in a village group. NARO and Bioversity International support the staff salaries for the site coordinator and four staff members. The field staff are normally facilitated with allowances to carry out field work. They help in training farmers on other agronomic practices, participate in field research on varieties, organize and train farmer groups, establish demonstration and seed multiplication gardens, organize exposure visits to other CSBs, organize seed exhibitions, and provide storage bags and moisture meters.

The CSB focuses on the following crops: cassava (24 varieties), ground yams (8 varieties), assorted vegetables (3 varieties), groundnut (24 varieties) and bean (38 varieties). At the time this study was conducted, the volume of seed in the seedbank was 350-400 kg of bean seed, 250 kg of groundnut seed, and 15 kg of assorted vegetable seed. At the time of the survey, cassava and ground yams, being perennial crops, were still growing in the gardens. The CSB was in its second week of seed distribution for the other crops, as it was the start of the planting season. Seed is given out in two categories - individual farmers and farmer groups. On average, each individual farmer receives 5 kg of seed, while a group receives between 50 and 100 kg of seed for distribution to its members. Everyone who receives the seed is expected to return twice the amount. Most of the farmers (about 95%) return the seed they receive.

In spite of its current performance, the CSB is still not able to generate enough financial resources to fund its operations. As a result, the CSB is still dependent on NARO and Bioversity International for financial support. Without this support, the CSB would not be able to cover the cost of staff salaries. The lack of financial resources also hinders activities such as travel to the different farm sites to monitor seed production in the fields and to recruit members. The staff would prefer to use motorized transport, which is more efficient, but currently can only move around by bicycle or on foot.

To address the financial challenge, the CSB has planned to undertake the following immediate actions: to register the CSB as a cooperative society. As a cooperative, the CSB would be legally permitted to enter into business contracts. In addition, the CSB intends to expand its crop portfolio by sourcing new local varieties from seed companies and other farmers across the country. Thirdly, the CSB plans to expand its membership by increasing the frequency and coverage of its farmer training programs.

Source: Authors' compilation

4.1.3 Role of government in supporting community seed banks

Three government institutions – the PGRC, NARO, and the NSCS have supported the community seed banks in various ways. Of the three, the PGRC is the most active support institution. The following outlines the functions of the three institutions:

The *Plant Genetic Resource Centre (PGRC),* under NARO, oversees the management of plant genetic resources, including the national gene bank. The PGRC supports the CSBs in the following ways:

- Storage of seed samples from the community seed bank in the national gene bank. The national gene bank serves as a back-up storeroom for the seed at the CSB.
- Training the managers of the CSBs on the protocols and procedures for managing a seed bank. In addition, the PGRC regularly monitors the performance of the CSBs.
- Linking the CSBs to other partner organizations like Bioversity International which provide financial and technical support. Bioversity International supported the construction of the storerooms of some of the CSBs.
- Building the capacity of the management and leadership of the CSBs through exposure and learning visits to other CSBs.
- Conducting on-site research on pests and diseases in the community where the CSB is located.

The *National Seed Certification Service (NSCS)*, the government agency in charge of seed certification and quality control, provides the following support:

- Training on seed quality management at the farm level.
- If the CSB produces QDS, the NSCS samples the seed and conducts laboratory tests before issuing a QDS certificate.

The *National Agricultural Research Organization (NARO)* was created as the lead institution for agricultural research in Uganda. NARO institutes are the main suppliers of basic seed in the country. In supporting CSBs, NARO's roles include:

- Supply of basic seed from one of the ZARDIs. NARO is one of the sources of seed for the CSBs.
- The supply of basic seed from NARO is usually accompanied by training on seed production and management.
- In collaboration with Bioversity International, NARO has supported the operational management of some CSBs by covering the costs of some of the staff who run the day-to-day affairs of the CSBs.

4.1.4 Lessons from Community Seed Banks in Uganda

CSBs are relatively new in Uganda. Since the establishment of the first CSB in 2010, they have had a number of significant successes while still facing several challenges:

Contribution to the broader goal of plant genetic resource conservation: The establishment of CSBs has strengthened efforts to identify and conserve plant genetic resources at the village and community levels. This is the main purpose of CSBs. This is also important because: (i) the CSBs promote the commercialization of these underutilized crops by supplying them to farmers; (ii) the CSBs conserve local varieties that possess unique characteristics but are in danger of becoming extinct; and (iii) the CSBs identify varieties that can be bred with other existing commercial varieties to improve their traits.

Increase in the number of plant varieties available to farmers: For most crops, the CSBs conserve and offer more varieties to farmers than are provided through the variety release and registration process

of the formal seed system. Nakaseke, Hoima, and Kiziba (another CSB in Uganda) all conserve and provide more varieties of bean, cassava, groundnut, and millet than have been formally released through the government variety release process (coordinated by the NSCS) between the 1960s and 2015 (Table 6). The Kiziba CSB conserves 70 bean varieties (Adokorach, Vernooy, & Kakeeto, 2020), which is more than twice the number released by the NSCS (31 varieties). Nakaseke conserves 13 millet varieties, compared to 7 millet varieties released by the NSCS.

Table 6: Comparison between varieties conserved by CSBs and varieties released by the NSCS

	Number of varieties being conserved			Number of varieties released by the NSCS
	Nakaseke CSB	Hoima CSB	Kiziba CSB	
Bean	38	42	70	31
Cassava	24	-	-	22
Groundnut	24	-	-	21
Finger millet	13	-	-	7

Source: Authors' compilation

Improvements in the quality of seed available to farmers: Through collaborations with the PRGC and NARO, the managers of the CSBs have made notable progress in improving the quality of seed that is available to farmers. The common advantages of quality seeds are higher yields, resistance to drought, resistance to pests, and disease, among other attributes. These national government agencies work with the CSBs to clean the seed and then test the seed in government laboratories. This process ensures that farmers can access quality seed. Testimonies from the farmers offer evidence of the improved quality of seed that is being accessed through the CSBs. The group of 10 farmers from the Kalagala farmer group who were interviewed reported an increase in their yield when using seed sourced from the Nakaseke CSB. For example, when a farmer planted 5 kg of bean seed sourced from a neighboring farm, the average yield was 50 kg. However, the average yield doubled to 100 kg when the farmers sourced seed from the Nakaseke CSB.

Strong collaboration with the NPGRC and other government institutions: Owing to the important role they play in agricultural development, the CSBs have developed a strong collaboration with the NPGRC, through which it accesses long-term storage facilities for some of its varieties and training on plant genetic resource conservation. In addition, NARO serves as an important source of varieties for conservation in the CSBs. These collaborations are key to the overall strengthening and professionalizing of the CSBs.

Despite these positive aspects, the CSBs still face several notable challenges:

The CSBs are not yet financially sustainable: Despite their performance, the two seed banks are not yet financially sustainable. They are both partly dependent on external project funding for some of their key activities. As a result of this dependence, they cannot cover most of their logistical and human resource costs.

Low number of farmer beneficiaries: Much as their main purpose is variety conservation, the CSBs also aim to supply farmers with the varieties that they maintain. However, the number of farmers accessing varieties from these CSBs is still very low. The Hoima CSB is intended to serve five districts - Hoima, Buliisa, Kiryandongo, Kibaale, and Masindi. The total rural household population in these districts is 253,524 (UBOS, 2018). However, the seed bank currently serves 0.1% of these households.

4.1.5 Management of plant genetic resources in Tanzania

The management of plant genetic resources is the responsibility of the NPGRC, based in Arusha, Tanzania. The NPGRC's mandate is to conserve plant genetic materials as valuable food security resources for present and future generations. Its core functions are to explore and collect plant germplasm of cultivated and wild species and conserve and document plant genetic resources. It promotes the utilization of plant genetic resources through multiplication and regeneration and exchanges information on plant germplasm with researchers, breeders, and farmers.

The NPGRC works closely with the SADC Plant Genetic Resource Centre (SPGRC)[16] . This is an autonomous regional organization established in 1989 for the SADC member states and is based in Lusaka, Zambia. The SPGRC collaborates with plant genetics centers in member states to preserve the genetic diversity and viability of Southern African plant stocks. The SPGRC maintains a base collection for the SADC member states at the Chalimbana Research Station in Zambia. Among the activities of the SPGRC is the promotion of the establishment of field gene banks and *in situ*/on-farm conservation in the member states. The SPGRC provides technical backstopping to the member states' national plant genetic resources centers on germplasm collection, multiplication, regeneration, characterization and documentation, and staff training.[17]

The seed conservation process follows four generic steps, illustrated in Figure 5:

Step 1. Collection of seed samples

The NPGRC collects samples of seed from the following sources:

i. Farmers who collect local varieties of native crop species of importance to the community.

ii. Research institutions like TARI. In this case, the farmers first receive seed multiplication training, participatory breeding, and licensing of seed as farmers' varieties.

Step 2. Registration, characterization and storage of samples at the seed bank

The collected varieties are registered at the national seed bank. Each entry records the collection area, the name of the variety, general characteristics, cultivation method, perceived nutritional value, and cultural and religious uses. The varieties are tested in seed laboratories and fields and are characterized.

Step 3. Accessing seed from the seed bank

This entails the following steps:

i. Farmers receive training on agronomic practices before they are permitted to access seed from the seed bank.

ii. Individual farmers access seed upon request or after having supplied samples of the seed of their crops to NPGRC. Individual farmers who access seed are expected to provide their personal information, location and the names of the varieties, and the quantities accessed. Farmers do not pay for the seed.

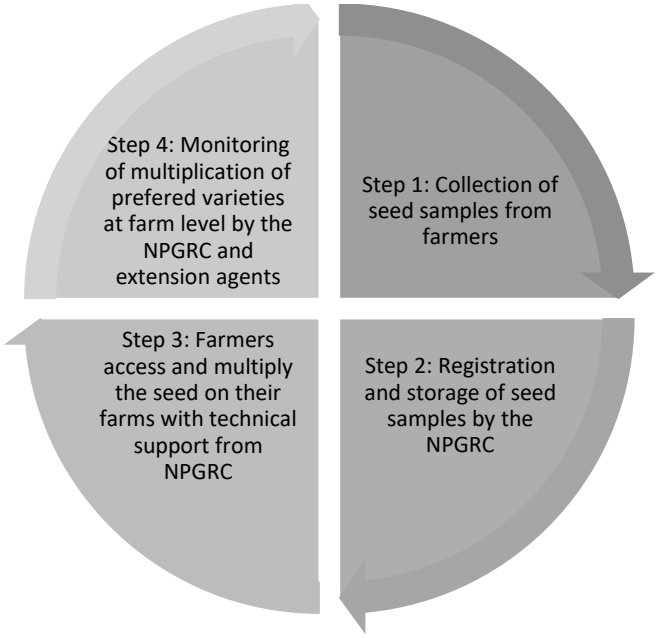
[16] https://www.sadc.int/sadc-secretariat/services-centres/spgrc/

[17] https://www.spgrc.org.zm/tanzania-mainmenu-34

Step 4. Multiplication of the seed

Extension staff and the leadership of the NPGRC conduct routine follow-up visits to make sure that farmers follow the recommended production and post-harvest practices.

Figure 5: Four steps of the seed conservation process in Tanzania



Source: Authors' creation

4.1.6 Role of government in supporting community seed banks

The NPGRC works in collaboration with TARI, NGO's, the SPGRC, and international institutions dealing with plant genetic resources such as Bioversity International. **The gene bank at the NPGRC** in Arusha has conserved more than 4,000 accessions from 120 different plant species, varying from crop species and their wild relatives to forages, shrubs, and big trees of economic importance (Box 2). The gene bank has also distributed more than 500 accessions of germplasm to researchers, breeders, and farmers (William, 2020).

The NPGRC faces three constraints. First, it has a shortage of professional staff. It has only three graduates: the curator, a seed technologist, and a documentalist. The curator is the Officer-in-Charge and leads work in *ex-situ* and on-farm conservation. The documentalist leads work in germplasm collection and *ex-situ* conservation. The seed technologist leads characterization and evaluation. This staff compliment is inadequate, given the large mandate and coverage of the center. Secondly, the center has insufficient storage facilities. It uses deep freezers to store seed. The freezers get filled quickly, and this limits the volumes of seed that can be conserved. A solution would be to convert the whole storeroom into a cold room. This can be partitioned into shelves running across the room, thereby increasing the volume of seed that can be stored. Thirdly, limited financial capacity has slowed the initiation of community seed banks and community capacity-building in the management of community seed banks.

Box 3: Achievements of the National Plant Genetic Resources Centre in Tanzania

The NPGRC has collected more than 4,000 crop accessions from different parts of the country and has characterized and multiplied over 3,200 crop accessions. Six NPGRC and non-NPGRC staff have been trained to master's level or PhD level, and 38 staff have received short course training internationally or nationally.

The NPGRC has sent 3003 crop accessions to the SPGRC for long-term storage and has distributed 443 crop accessions to different users, particularly breeders, research institutes and farmers.

The NPGRC has built two screen houses, one greenhouse, and a tissue culture lab. It has three vehicles, a tractor, and a motorbike, two driers, ten freezers and assorted equipment. It has built a water reservoir for irrigation at its farm in Madiira with support from the Danish International Development Agency (DANIDA).

In collaboration with the Ministry of Agriculture and Food Security (MAFS), the NPGRC has compiled relevant data and information, which finally enabled Parliament to ratify the International Treaty on Plant Genetic Resources for Food and Agriculture.

Source: Granqvist, 2009.

The NPGRC's future plans include the development of a strategic and business plan. It intends to create awareness among stakeholders of the importance of conserving plant genetic materials, including those of released crop varieties. It also plans to conserve landraces of vegetatively propagated crops, spices, and other horticultural crops. Furthermore, guided by its new strategic and business plans, the NPGRC intends to step up fundraising to expand its activities and procure essential equipment.

The NPGRC and TARI do not have an agreement on germplasm exchange or storage. As a result, the NPGRC does not receive improved varieties from TARI. This is the case even though the NPGRC is willing to store varieties from TARI in the gene bank without fees or prohibition on repatriation. This is important for TARI-Selian in Arusha since it does not have adequate seed storage facilities. This has resulted in the loss of breeder and pre-basic seed of earlier released varieties through spoilage. This is a major drawback to the sustainability of seed systems and varieties.

TARI and the NPGRC should revive their collaboration to allow centers in different parts of the country to cooperate in genetic resource management. For example, during the pigeon pea germplasm collection in 2001, ICRISAT collaborated successfully with the NPGRC and three TARI institutions - Ilonga, Naliendele, and Selian (Silim et al., 2005). This way, both external or internal resources were sourced, and responsibilities were shared. Over the years, this collaboration dwindled as the CGIAR centers started to focus on short-term impact-focused projects. In contrast, collecting and conserving genetic resources takes time to produce impacts that are not feasible within project durations. CGIAR centers and TARI require conserved materials to produce improved crop varieties. Therefore, there is room for the research institutions and the NPGRC to look for opportunities that would allow them to work together. For instance, TARI institutions with breeding programs that do not have cold rooms for germplasm storage can use those of the NPGRC. On the other hand, the NPGRC can make use of TARI's collection of landraces.

Farmers who rely on improved certified seed have relatively good access since seed companies have well-developed distribution networks. However, farmers who still use their local landraces do not have access to improved seed of underutilized crops such as legumes, millet, and sorghum. They then resort to conserving their local germplasm from generation to generation.

Most farmers usually follow a two-pronged approach to their agricultural production. They cultivate local crop varieties for home consumption and improved varieties such as hybrid maize for sale. They prefer local varieties for food because they store for longer periods, taste better, and cook fast than

improved varieties. To make sure that such local varieties are not lost, and for the benefit of farmers, the NPGRC conserves the varieties and makes them available to farmers at no cost when they need them.

4.1.7 Performance of centralized management of plant genetic resources in Tanzania

The NPGRC visits farming communities to collect landrace varieties, which it characterizes and stores at the national gene bank. NPGRC staff identify locations where collections are to be made in consultation with agricultural extension officers. During the collection missions, germplasm passport data, including descriptors, information on cultural practices and uses are recorded. The NPGRC assures farmers that they can access the seed whenever they need it.

Currently, there are no seed banks at the community level. This is surprising since, until 2009, community-based seed multiplication existed for sesame, groundnut (*Arachis hypogaea*), sorghum, cowpeas (*Vigna unguiculata*), pigeon pea, maize, green gram (*Vigna radiata*), rice, and cassava (*Manihot esculenta*), and involved an estimated 30,000 farmers (Ngwediagi et al., 2009). Over the years, community-based seed banks died out as donor support dwindled. However, it is expected that the NPGRC will create community-based seed banks when it implements its upcoming strategic plan. Before this is done, farmers will continue to collect local genetic materials on their own initiative and may need to be trained in how to characterize their collections and conserve them.

4.1.8 Conservation of genetic materials at the community level

Farmers involved in the collection of genetic materials in collaboration with the NPGRC were visited in two villages in Bashnet and Bohay in Babati district, Manyara region. Bohay village is on the way to the neighboring Kondoa district and Bashnet is near Mbulu district.

In the two villages, farmers have been selecting, preserving, and conserving local varieties from season to season. The common varieties include maize, millet, sorghum, bean, and a variety of vegetables. They use indigenous knowledge which has been passed down through generations. During the harvest, farmers select seed they consider to be true to type based on, among others, size, shape, and color. Farmers dry the seed, treat it with local preservatives, and store it. Healthy seeds are selected and stored in sacks. Alternatively, the unthreshed sheaves are hung under rooftops in kitchens or sheds for threshing in the next planting season. The farmers preserve their local landrace varieties as individuals. The two villages visited did not have any CSBs, and this is the norm across Tanzania.

Through the collaborative collection of local germplasm with communities, the NPGRC has collected genetic materials of local varieties that are cultivated by farmers. The crops collected include a mottle of red, black, yellow, and white maize, common bean, pigeon pea, sorghum (*Sorghum bicolor*), finger millet (*Eleusine coracana*), tomato (*Solanum Lycopersicon*), sweet potato (*Ipomea batatas*), pumpkin (*Cucurbita*), cowpea, and Roselle (*Hibiscus sabdariffa*). From farmers' perspectives, the advantages of their landrace varieties are their ability to cope with adverse weather conditions such as drought and resistance to pests and diseases. Some sorghum varieties can thrive in low-fertility soils, thereby reducing the need to purchase fertilizer. For maize, the flour from local varieties is preferred to that from hybrids because it lasts longer since lower quantities are required for a meal. Local maize is preferred for roasting because it is sweet and because it is good for cooking the local "makande" - a mixture of maize, beans, and coconut milk. Local maize is resistant to pests because of its hard seed coat, which does not allow easy penetration. It can therefore be stored for long periods without being damaged by storage pests. The grains can withstand dehulling without being broken. However, the market prefers the bigger white maize grains from improved varieties for commercial flour production. The common red bean is resistant to pests, is tolerant to drought, and does not cause

flatulence. The local sweet potato variety is not watery. In general, grains of landrace varieties are small and are preferred for home consumption.

In the discussions held in both Bashnet and Bohay, all farmers who spoke appreciated the NPGRC's initiative of decentralizing the collection and conservation of local germplasm to the community level. The farmers indicated that if the NPGRC supports CSBs, they will have access to suitable storage facilities for their seeds.

Farmers currently store their germplasm as individuals, and they perceive their local germplasm as having benefits to individuals and not communities. They are concerned that CSBs will involve additional costs and may result in individuals losing rights to their materials. These farmers prefer to maintain local germplasm privately. This implies a decentralized system of germplasm conservation at the family level. However, more farmers recognize that for CSBs to succeed, farmers will need to be organized and trained in the characterization and identification of their genetic material and conservation. The NPGRC favors a revival of CSBs since they are easier to manage than hundreds of individual farmers' banks.

NGOs are also involved in the conservation of genetic resources. For example, Islands of Peace (IDP)[18], a Belgian NGO founded in 1962, targets vulnerable rural communities with programs that tackle food insecurity. It collaborates with the Research Community and Organizational Development Associates (RECODA)[19], a local NGO founded in Tanzania in 2000. The two are among a few NGOs that are involved in research and development. In Karatu district, IDP, Kilimo Endelevu, and Karatu District Council[20] also collaborate with government-sponsored Community Economic Projects earmarked for the improvement of the livelihood and resilience of small-scale farmers. With respect to genetic resources, IDP and RECODA collected local plant genetic materials from farmers and grow them for characterization. At the time of this study, they were waiting to harvest materials to characterize the germplasm and compare the information provided by local communities during collection.

4.2 Decentralization of the production of breeder and basic seed

In most African countries, NARIs are the main producers of breeder and basic seed. This section discusses how these institutes decentralize the production of breeder and basic seed in Tanzania and Uganda.

4.2.1 Production of breeder and basic seeds in Uganda

In Uganda, basic and breeder seed production has been decentralized to the sub-national level, through zonal research institutions, for certain crops. NARO was established by an Act of Parliament in 2005 to provide for the development of agricultural research systems in the country. The law also establishes nine ZARDIs, which manage agricultural research services within various agro-ecological zones. The ZARDIs produce breeder and basic seed in collaboration with NARO institutes.

To obtain a better understanding of how the ZARDIs operate, this study profiles two such institutes – the Ikulwe-Bugi ZARDI in Bulambuli district in eastern Uganda, and the Ngetta ZARDI in Lira district in northern Uganda. These two were selected because of their working relationship with and close proximity to QDS producers.

[18] https://www.ilesdepaix.org

[19] https://recoda.or.tz/

[20] In mainland Tanzania, there are three types of urban authority: city, municipal and town councils. In rural areas there are two levels of authority: the district councils with the township authorities, and the village council. District councils promote development initiatives in their areas (URT, 1999).

Ikulwe-Bugi ZARDI: The Ikulwe-Bugi ZARDI has three research stations: the Buginyanya station, which is the ZARDI headquarters located in Bulambuli district, the Bulegen station in Kapchorwa district, and the Ikulwe station in Mayuge district in eastern Uganda. The ZARDI was formed in 2008 to produce basic seed on behalf of NARO. The ZARDI started with the production of coffee seedlings and then added cassava, sweet potato, and Irish potato to its crop portfolio. In 2012/13, the ZARDI started wheat production with support from NARO. In addition to the above, the ZARDI produces pasture seed for Napier grass (*Pennisetum purpureum*) and Brachiaria (*Brachiaria*), bean seed, soya bean (*Glycine max*) seed, banana (*Musa*) cuttings, and fruit tree seedlings. In 2019, the ZARDI produced and sold 1,100 kg of soya bean seed, 150 bags of pasture seed, and 600 bags of sweet potato vines.

Ngetta ZARDI: The ZARDI is located 7 km from the town of Lira and serves the Lango and Acholi sub-regions in northern Uganda. It has been in operation since 2007/2008, but has only been producing seed since 2017. In 2019, the ZARDI produced and sold 1,626 kg of three varieties of soya bean seed, 1,689 kg of three varieties of groundnut seed, 1,510 kg of one variety of bean seed, 6,649 kg of three varieties of rice seed, 300 kg of one variety of sesame seed and 4,160 bags of two varieties of cassava cuttings.

In the last fiscal year (2018/19), by the end of the first quarter, the percentage of funds spent by the Buginyanya and Ngetta ZARDIs (16% and 19%) was higher than the percentage of expenditure by NARO overall (14%) (GoU, Vote Budget Framework Paper FY 2019/20, 2019).

How ZARDIs supply basic seed to buyers: The process through which ZARDIs supply basic seed to seed producers follows two main steps.

Step 1: Purchase/procurement of basic seed: The purchasing arrangements vary according to the scale of the purchase. Advance booking is required for buyers who want to buy in bulk. Some of these large-volume buyers include LSBs, local governments, government parastatals like the Uganda Coffee Development Authority (UCDA), private companies and organizations including Swisscontact, the International Fertilizer Development Center (IFDC), the Lutheran World Federation (LWF), and Caritas.

Step 2: Collection of basic seed: The payments are made directly into the ZARDI's account, after which a receipt is issued. Institutional buyers such as NGOs, government agencies, and private companies are informed when to collect the seed. ISSD Uganda purchases seed on behalf of several LSBs. In this case, they submit a list of the quantities required by each LSB. The ZARDI then packages the seed accordingly before it is collected by ISSD Uganda, which then distributes the seed to the respective LSBs.

Main challenges faced by the ZARDIs

The decentralization of services from NARO to the ZARDIs is intended to improve the availability of basic seed at the district and zonal levels. The two ZARDIs are key sources of QDS basic seed for LSBs and other players. However, logistical, financial, and human resource challenges within the ZARDIs have led to inconsistencies in the quantity and quality of seed. The specific challenges they face include:

Inadequate facilities for processing and storing basic seed: The ZARDIs lack adequate facilities, including cold storage rooms or warehouses which can store seed for long periods. They also lack seed processing equipment for the drying, grading, cleaning, and treatment of harvested seed. The storerooms need to be refurbished as the current facilities have a negative effect on the quality of seed being sold to seed producers. Improvements in storage capacity would enable the ZARDIs to manage the fluctuations in demand for basic seed.

Inadequate security: This has led to an increase in the cases of crop theft. There is a need to improve security by fencing the land, hiring security personnel, and securing the storage rooms.

Insufficient funding to hire permanent staff: The ZARDIs currently use contract laborers to work on the farms. These laborers are from the community and own/manage their own farms and are consequently not fully focused on the ZARDI farms. There is a need to hire permanent laborers to work on the farms, who can focus fully on their work for the ZARDIs.

Inadequate supply of breeder seed: The ZARDIs do not always receive the volume of breeder seed that they request from NARO, leading to low production of basic seed. The low supply from NARO is due to production-related challenges. For example, the Ngetta ZARDI aimed to produce 1,000 kg of the groundnut variety Serenut 14R but only received enough breeder seed to produce 566 kg of basic seed. The same applied to the groundnut variety Serenut 5R – the production target was 2,000 kg, but the Ngetta ZARDI only received enough breeder seed to produce 492 kg of basic seed. These challenges need to be addressed to improve the performance of the QDS system.

Ways of overcoming the challenges

1. Strengthen the CSBs' governance and management: The CSBs play an important role in providing quality seed to farmers in their respective communities. However, they face numerous challenges. To address these challenges, the management and leadership of the CSBs need to strengthen the CSBs in the following areas:

- Human resource capacity, by hiring and retaining key staff including a manager, technical/quality assurance manager, storage/distribution manager, accountant, secretary, and field officers, who would undertake a range of tasks which are currently carried out by volunteers or external project staff.
- Logistical capacity, by ensuring that each CSB has sufficient space for storing conserved seed, storing commercial seed, storing equipment and office functions.
- Technical capacity to document the characteristics of the varieties that are maintained. This effort needs to conform to the documentation guidelines followed by the national gene bank.

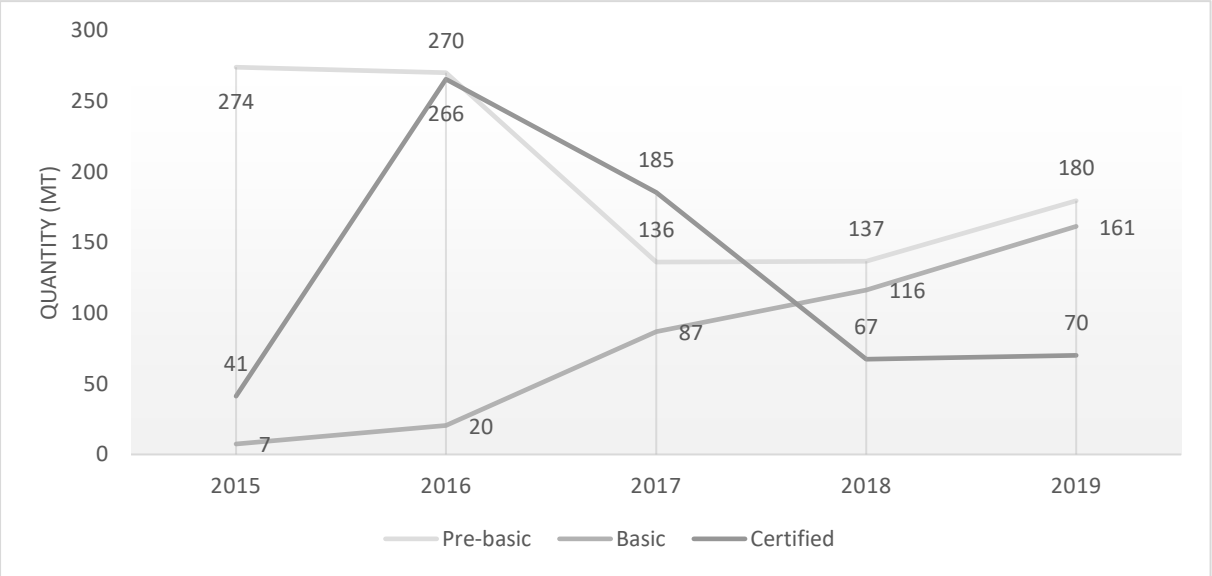
2. Improve the CSBs' financial capacity by:

- Establishing a financial arm of the CSB. This may take the form of a VSLA or a savings and credit cooperative society (SACCO), which can serve as a vehicle for increasing the members' savings and improving the members' access to credit.
- Registering the CSBs as cooperative societies. The leadership of the two CSBs is already registering their respective CSBs as cooperative societies. As cooperatives, the CSBs would be legal entities that can professionally conduct business by entering into supplier and buyer contracts. In addition, the CSBs would be expected to maintain a book of audited accounts.
- Expanding the CSBs' membership base: To improve their financial base, the CSBs need to increase their membership by reaching out to more farmers in the districts that they serve. A high number of members would lead to an increase in membership contributions and a higher volume of business.
- Engagement with other income-generating ventures, such as the production of others crops or an enterprise like beekeeping and hiring out of office spaces as training or social facilities, as in the case of Ethiopian CSBs.
- Advocating for government funding: to an extent, the CSBs provide a public good, as they identify and conserve genetic resources that are evidence of a country's diversity. The PGRC performs the same tasks, but at the national level, and receives funding from the government. Therefore, there is justification for the CSBs to advocate for funding from the national government. This funding could be used to cover some of the infrastructural costs, such as constructing a storage unit.

4.2.2 Production of breeder and basic seeds in Tanzania

TARI is mandated to produce breeder and pre-basic seed in Tanzania. Similar to Uganda, TARI has decentralized its functions to 8 centers and 10 sub-centers located in different agro-ecological zones across the country.[21] Most TARI centers have crop improvement mandates. Except in the case of maize, for which the centers conduct research on hybrid and open-pollinated varieties (OPVs), the TARI centers focus only on OPVs for other cereal and legume crops. The vegetatively propagated crops that TARI deals in are banana, sweet potato, Irish potato, and cassava. Breeder seed of the varieties released is multiplied into pre-basic seed which is sold to the ASA for multiplication into basic seed. TARI also multiplies basic seed for national seed companies that produce certified seed and for farmers that produce QDS. The total amounts of different classes of early-generation seed produced by TARI over a five-year period are given in **Fehler! Verweisquelle konnte nicht gefunden werden.**

Figure 6. Different types of seed produced by TARI



Source: TARI Selian

This figure shows high initial production in the first two years, followed by declining, then slowly increasing pre-basic seed production over the years, while the production of basic seed has grown steadily. The decline in pre-basic seed production results from self-correction to meet market demands for basic and certified seed production.

This section provides an illustration of the performance of one the TARI centers – TARI Selian. This center has been selected because it has the research mandate for the districts where interviews were conducted. It also produces basic seed for the crops grown in the districts. TARI Selian in Arusha is mandated to conduct and coordinate research in medium-altitude maize, wheat, barley, and common bean. It also conducts research on pigeon pea in collaboration with TARI Ilonga in Morogoro. TARI Selian has released 11 maize varieties, eight wheat varieties, two barley varieties, and 15 varieties of the common bean (TOSCI, 2020). The production of seed by TARI Selian in 2019 is shown in Table 7. It focuses on maize, wheat, and bean varieties. It only produced pre-basic seed for maize and some wheat varieties. It only produced one wheat variety of basic seed.

[21] https://www.tari.go.tz/#team

Table 7: Seed production (kg) by TARI Selian in 2019

	Variety	Breeder seed	Pre-basic seed	Basic seed
Maize	Selian H115	5	10	
	Kilima ST-SR	20	300	
	Situka M1	30	400	
Wheat	Chiriku	200	1,000	1,200
	Lumbesa	200	500	
	Riziki C1	200	400	
	Mbayuwayu	150		
	Sifa	150		
Bean	Jesca	5,900		
	Selilan 13	1,200		
	Calima Uyole	500		
	Uyole 18	100		

Source: TARI Selian

The main buyers of early generation seed from TARI Selian are ASA, seed companies, farmers, and groups of farmers. They obtain information on released varieties from TARI institutions, the national variety catalog, or TOSCI. Clients who purchase seed from TARI Selian prefer the common bean and OPV maize, and in some cases, hybrid maize. ASA and seed companies are expected to order early-generation seed from TARI at least one season in advance and indicate the quantities required by variety. Since farmers and groups of farmers do not use large quantities of seed, they always obtain the quantities that they order. However, seed companies never submit their request on time and the supply of seed is therefore based on the quantities available for the specified season. This can be improved if seed companies send their seed requirements to TARI Selian in advance.

Main challenges faced by TARI

TARI's main challenge in seed production is its non-functional irrigation facilities, which limit its potential to increase seed quantities through off-season production. Its irrigation facilities need to be rehabilitated and expanded to enhance seed production out of season. Further, TARI does not have cold rooms for seed storage and relies on freezers. This leads to the inadequate maintenance of breeder seed and a low supply of breeder seed to match clients' demand. TARI needs to build a cold room that can accommodate larger quantities of seed or collaborate with the NPGRC, which has relatively more storage space. In cold storage rooms, seed is arranged on shelves, allowing for the storage of larger volumes than is possible in freezers.

In addition, both ASA and TARI are currently allowed by law to produce basic and certified seed. However, ASA also depends on TARI to supply it with pre-basic seed. These overlapping roles between the two institutions are likely to cause unhealthy competition since both ASA and TARI sell certified seed. TARI could prevent ASA from getting pre-basic seed and hence jeopardize their certified seed business.

For their part, farmers and groups of farmers complained that the long distances clients must travel to get early-generation seed constitute a significant burden. QDS producers in Babati travel over 160 km one way to get to Arusha. This distance could be reduced if TARI or ASA were to set up distribution points close to certified seed or QDS production areas.

Seed companies are not involved in the production of QDS. The only exceptions are the government-owned ASA and Crop-Bioscience, a private company that supplies basic seed to QDS producers.

Agricultural Seed Agency (ASA) [22]

ASA is a semi-autonomous body under the Ministry of Agriculture that is responsible for seed multiplication and the distribution of quality-improved seed to farmers. Its focus crops are maize, rice, sunflower, sesame, common bean, wheat, and barley. ASA's main source of pre-basic seed are TARI centers. ASA places seed orders with TARI one season in advance, based on demand from seed producers. Table 8 and Table 9 show the quantities of seed bought, produced, and sold, respectively, by ASA at Ngaramtoni seed farm in Arusha during the 2019/20 cropping season. In 2020, ASA did not get any pre-basic seed for beans from TARI and only received 15% of its order for one maize variety. The varieties demanded by ASA are a reflection of what farmers like. The popular maize variety is Situka, which is drought tolerant. The most popular varieties of beans are JESCA, which is high in zinc and iron, Lyamungo 90 and 85, which are large red mottled, Selian 13, which is yellow, and Uyole 18, which has a sweet taste. For wheat, the popular varieties are Juhudi and Sifa.

Table 8: Quantities of seed bought by ASA Ngaramtoni farm from TARI in 2020

	Variety	Breeder seed ordered from TARI (kg)	Breeder seed bought from TARI (kg)
Maize	Situka	1,000	150
Bean	JESCA	500	0
	Lyamungo 85	300	0
	Selian 13	500	0
	Uyole 18	500	0

Source: ASA

In 2019, ASA Ngaramtoni farm in Arusha produced basic seed for maize and wheat and certified seed for maize, bean, and wheat (Table 9).

Table 9: Quantities of seed produced (tons) by ASA Ngaramtoni farm in Arusha in 2019

	Variety	Basic seed (MT)	Certified seed (MT)
Maize	Situka	5.8	109
Bean	JESCA	0	1.5
	Lyamungo 90	0	21.5
Wheat	Juhudi	5	0
	Sifa	13	53

Source: ASA

A total of 109 tons of certified seed of the maize variety Situka was produced at the farm, while 59 tons were produced by contract farmers (Table 10).

Table 10: Quantities of seed sold by ASA Ngaramtoni farm, Arusha in 2019

CROP	Variety	Breeders seed (MT)	Basic seed (MT)	Certified seed (MT)
Maize	Situka		2	109
Bean	JESCA			0.5
	Lyamungo 90			21.5
Wheat	Sifa			20

Source: ASA

ASA has few distribution outlets, thereby limiting its seed sales. For example, in the northern corridor covering Kilimanjaro, Arusha, Manyara, and neighboring districts, ASA operates through its Arusha

[22] https://www.asa.go.tz/

office. There is a need for seed distributors in all northern Tanzania districts to relieve reliance on the Arusha office and increase ASA's business.

ASA is unable to produce enough seed during off-season periods to meet market demand. This is due to a broken irrigation system and insufficient equipment. To overcome these challenges, ASA intends to use contract farmers who have irrigation facilities.

4.2.3 Crop Bioscience Solutions Ltd

Crop Bioscience Solutions Ltd is a Tanzanian company that engages in the multiplication of clones of vegetatively propagated crops and common beans. It focuses on common beans, Irish potato, and bananas. It multiplies basic seed for common beans on its farm in Babati on contract for TARI-Selian. It sells basic seed to other companies and farmers who produce QDS. In 2019, Crop Bioscience bought 900 kg of basic bean seed from TARI and ASA, the breakdown of which is as follows: from TARI 450 MT of JESCA and 150 MT of Lyamungo 90, and 300 MT of Uyole njano from ASA. Crop Bioscience produces pre-basic seed for Irish potato in greenhouses in Arusha to ensure clean seed. It also produces basic and certified Irish potato seed on its farm in Babati which is sold directly to farmers. Clean banana planting material is produced through tissue culture at a laboratory in Arusha and is sold to farmers throughout Tanzania.

Crop Bioscience also works with four individual farmers from Mbulu district who produce QDS using irrigation facilities. The 2020 season plan is to work with five farmers who will produce seed on Crop Bioscience premises. Crop Bioscience will offer these farmers training on good practices and mechanization, as well as storage services.

Crop Bioscience also provides seed and mechanization services to farmers who purchase seed from them. It has also established demonstration plots showing improved varieties and good agronomic practices for farmers. Its aim is to increase the adoption and sale of improved seed. According to Crop Bioscience, local banks' high interest rates limit the potential for the expansion of their production and processing capacity. This is based on their perception that there is a large market for QDS waiting to be tapped.

4.3 Decentralization of QDS production

Seed production methods constitute one of the factors differentiating certified seed from QDS. Certified seed production is centralized through seed companies, which usually work with a network of contract seed multipliers. QDS seed production is decentralized to the specific locations where the seed will be sold. One of the main reasons for the decentralization of seed production under the QDS arrangement is to increase the availability of quality seed to farmers. The formal system has not been able to produce a utilization rate of quality seed high enough to improve agricultural performance. Maize is probably the only crop for which the utilization rate of certified seed is at least 80%, and this rate is recorded in only a handful of counties like Kenya (TASAI, 2019) and Zimbabwe (TASAI, 2017). For most other crops, the utilization rate of certified seed ranges from 1% to 30%. These very low rates are one of the main drivers behind the production of QDS. It is expected that the production and sale of QDS will increase farmers' utilization of improved quality seed.

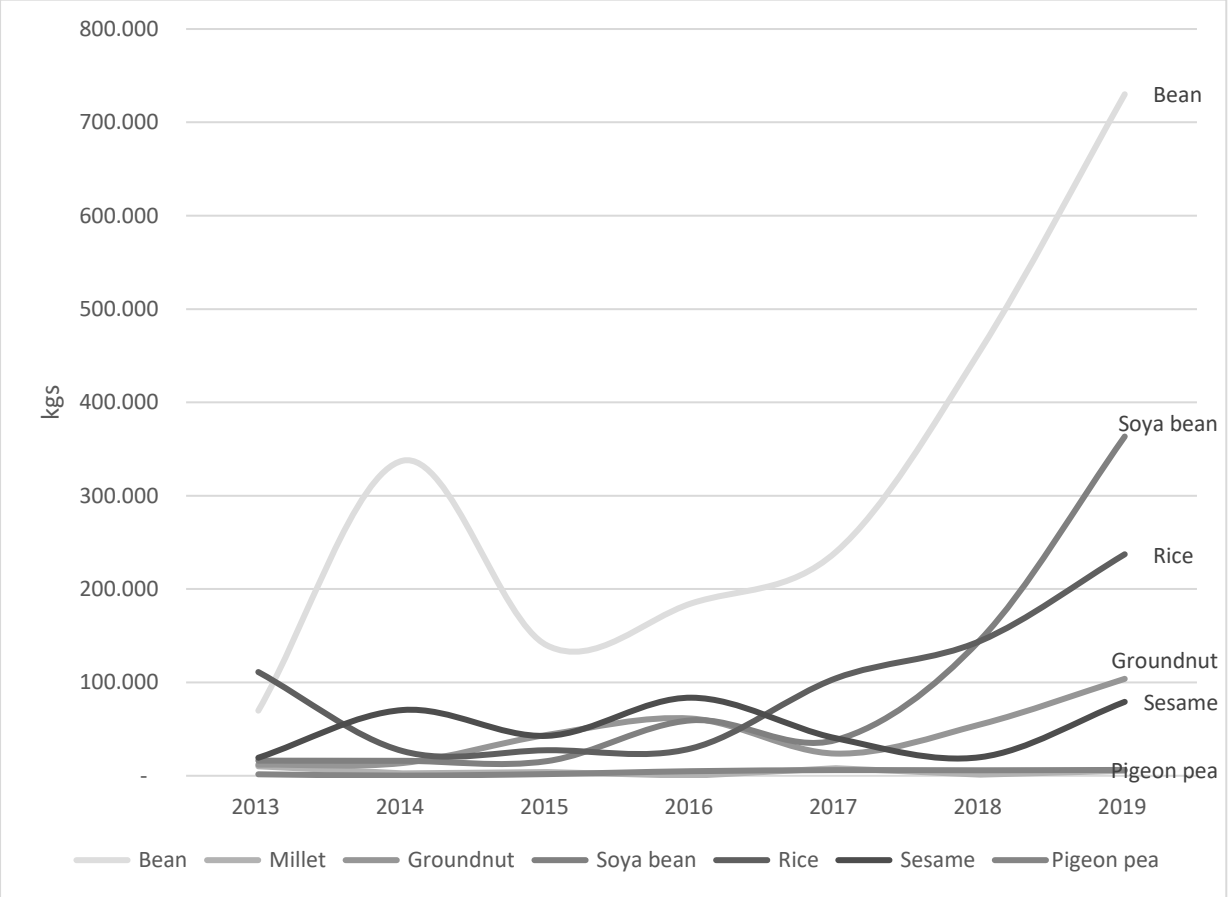
4.3.1 QDS production in Uganda

QDS seed in Uganda is produced by LSBs that are registered by the NSCS. The guidelines for the production of QDS are spelled out in the draft Seeds and Plant (Quality Declared Seed) Regulations (GOU, 2019). By the end of 2019, 229 registered LSBs produced QDS for 13 crops – bean, cassava,

cowpea, green gram, groundnut, millet, pasture seed, pigeon pea, potato, rice, simsim (sesame), soya bean, and sweet potato.

QDS production in Uganda started in 2012 with support from the ISSD Uganda program.[23] The ISSD supported the formation of LSBs, their training as business entities, linking them to research institutions for basic seed and training them in seed quality control. Figure 7 shows the increase in the aggregate volume of QDS produced between 2013 and 2019. QDS production has increased steadily, especially after 2015.

Figure 7: Trend in QDS production between 2013 and 2019



Source: ISSD Uganda

ISSD Uganda works with over 300,000 farmers across the country to provide them with access to affordable and superior varieties. It focuses on the entire seed value chain and works closely with the MAAIF and NARO. ISSD Uganda was established in 2012 to support the development of a vibrant, pluralistic, and market-oriented seed sector in Uganda. Working with 30 LSBs in selected districts at the start, the organization now works with 256 LSBs across the country. This growth in QDS production coincides with the increase in the number of LSBs, from 27 in 2012 to 256 in 2020. This section profiles two LSBs: the Namunasa Stream Rice Farmers Cooperative Society Ltd, which is located in Butaleja district and sources breeder seed from Ikulwe-Bugi ZARDI, and Aye Medo Ngeca LSB, which is located in Lira district and sources breeder seed from Ngetta ZARDI in northern Uganda.

The profiles of the two LSBs (Table 5 and Box 3) provide an example of how LSBs in Uganda operate, their structure and challenges. The two LSBs are legally registered as cooperatives, which enables

[23] https://issduganda.org/about/

them to conduct business transactions as organizations. The LSBs are both connected to the ZARDIs in their respective regions, which supply basic seed. In addition to the production and sale of QDS, the LSBs either currently provide or are planning to provide several support services to their members, including farmer training and mechanization.

Performance of QDS production in Uganda

Since the formation of LSBs in 2012, there have been several notable positive results in the seed sector in Uganda.

Increased availability of quality seed to farmers: QDS production has increased significantly since 2012. Over the last five years, that is, from 2015 to 2019, QDS production has increased substantially. As a result of this increase, farmers now have access to quality seed.

Increase in the number of QDS producers: The number of LSBs has increased from 27 in 2012 to 256 in 2020, providing clear evidence of a growing interest in QDS production. The high number of QDS producers bodes well for the seed system in Uganda, as these groups receive training in seed production in line with seed quality standards.

However, despite the notable growth over the last eight years, QDS production in Uganda is still quite low. Table 11 shows the difference between QDS and certified seed production for crops that were produced and sold under the two quality control systems in 2019. The volume of certified seed produced in 2019 was significantly higher than QDS production that same year.

Table 11. Difference between QDS and certified seed production in 2019

	Seed production in metric tons in 2019	
	QDS production	Certified seed production
Sesame	59.9	505
Soya bean	356	1,209
Bean	692	4,424
Rice	321	1,405
Groundnut	84	792
Green gram	8	40
Millet	5	198

Source: ISSD Uganda, USTA and TASAI

Box 4: Profile of the Namunasa and Aye Medo Local Seed Businesses

The Namunasa Stream Rice Farmers Cooperative Society Ltd LSB is located in Butaleja district in eastern Uganda. The LSB is registered as a cooperative society under the Cooperative Societies Act and is owned by its 115 members, who are farmers. The LSB's objectives are to produce, process and market QDS seed, as well as other crops and livestock.

As per the guidelines for cooperatives, the highest governing body is the Annual General Meeting (AGM), which elects the board members. The LSB has nine board members – a chairperson, vice chairperson, secretary, treasurer and five members. The board implements its mandates through several committees. One of these committees hires a manager to run the day-to-day operations of the LSB. The LSB only produces two varieties of QDS rice seed - Winter 9 and ARU 1189. In 2019, the LSB ordered 600 kg of basic seed from Ikulwe ZARDI, but only bought 300 kg. This was mainly due to the fact that the LSB did not have sufficient financial resources to purchase all the seed it had ordered.

The LSB offers various services to its members, including the marketing of QDS seed and grain, training in farming practices and agribusiness management, tractor hire services and water pumps, and linking the farmers to the DAO and the District Commercial Officer.

Namusana's main challenges stem from its insufficient financial resources. As a result, the LSB in unable to procure enough basic seed, which is its main raw material. The LSB is unable to refurbish its current seed storage facility, which cannot be used to properly store the seed that is produced. Further, the LSB is unable to increase its production, as it will not have any place to store the output. In addition to inadequate storage, another challenge is the quality of the basic seed. For three seasons, Namunasa purchased basic seed of the AUR 1189 rice variety from the Ikulwe ZARDI. However, the germination percentage was only 20%.

Over the next three years, the LSB plans to increase rice QDS production from 27 tons to 80 tons. To manage this increase, in 2020, the LSB is constructing a seed storeroom, which will also be used as a grain store. In addition, it intends to diversify its product range by introducing aromatic rice and soya bean seed.

The Aye Medo Ngeca LSB is in Lira district in northern Uganda. The LSB is registered both as a cooperative society under the Cooperative Societies Act and as a farmer organization at the sub-county level. The cooperative is owned by its 120 members who form the Annual General Meeting. The LSB is managed by a chairperson, vice chairperson, secretary, treasurer and committees for production, quality control and marketing. Currently, the LSB only produces three varieties of groundnut seed - Serenut 8R, Serenut 11T and Serenut 14 R. The main services offered by the LSB include the marketing of QDS seed, training members in QDS production and financial services under a savings and credit scheme. In 2019, the Aye Medo Ngeca LSB bought and paid for 1,218 kg of groundnut basic seed from the Ngetta ZARDI.

Like Namusana, Aye Medo Ngeca's main challenge is the lack of a seed storage facility. As a result, the LSB sells its QDS seed immediately after harvest. In addition, the members of the LSB occasionally report the presence of counterfeit agrochemicals in the market. The use of these counterfeit chemicals negatively affects seed production. As part of its future plans, the LSB intends to construct a storage facility, deploy tractor services (a tractor has been obtained from one of the government projects), and add value to its rice.

Source: Authors' compilation

4.3.2 QDS production in Tanzania

In Tanzania, QDS is produced by individual farmers, farmer groups, or cooperatives. QDS production is monitored by the district councils where the producers are located. This section profiles two district councils – Babati and Karatu.

QDS production in Babati

QDS farmers in Babati district council currently only produce sesame and paddy rice seed. Prior to 2017, the farmers also produced QDS for common bean, maize, sunflower, and pigeon pea. The production of maize QDS failed because of the lack of a market for it, as most farmers prefer hybrid

maize seed. QDS production of other crops ended between 2016 and 2017 for a variety of reasons. Firstly, QDS production was supported by donor projects such as Farm Africa for sesame and World Vision for pigeon pea, as well as the government's District Agricultural Development Plans, which are special government programs for rice and maize. Once the funding from these projects ceased, production was also affected. Second, the decline was caused by an inadequate supply of basic seed from TARI and ASA. This was partly due to poor planning and coordination between the farmers and these two institutions. Thirdly, QDS production was affected by a sudden change in the market demand for pigeon pea seed. Prior to 2017, Tanzania was the leading exporter of pigeon pea in Africa, and India was the leading buyer of this seed. However, in 2017, India banned pigeon pea grain imports from Tanzania. This ban significantly affected the viability of crop production. QDS producers resorted to selling the seed to neighboring farmers.

QDS production in Karatu

Karatu is another district where QDS – in this case, common bean, chickpea, and pigeon pea seed – is predominantly grown. Like in Babati, QDS production for maize failed because of a preference for hybrid seed. The major driver of QDS production in Babati was the establishment of Kilimo Market Ltd, which focuses on buying pigeon pea and chickpea for export and wanted uniform and quality grain. Kilimo Market Ltd had two wings, the company and a wing dealing with corporate social responsibility, which received funding from development partners. Through this wing, the company developed strong producer marketing groups with two main functions - producers of chickpea and pigeon pea grain and a small group within each group to produce QDS. The groups were trained in group action and quality control, and seed producers were trained in the production of QDS. The production of pigeon pea and chickpea declined drastically after an Indian ban on pulse imports in 2017. However, some farmers continue sourcing good seeds from TARI to produce QDS, which they sell to their fellow farmers.

Examples of QDS farmers and farmer groups

Three individual QDS farmers and one extension agent from Bashnet village in Babati district were interviewed (Annex 2). These farmers cultivate QDS for common bean and Irish potato. They prefer the bean seed variety Lyamungo 90 because it grows well in their environment, and there is a reliable market for it. The farmers receive basic seed from ASA and TARI, and extension officers from the district council supervise seed production. A TOSCI-trained district extension officer carries out inspections. Once the seed has been approved, the farmers market it on their own.

In Mawemairo village in Babati district, a group of farmers belonging to the Boresha Kilimo Ushinde group is involved in rice QDS. Two farmers from this group and one extension agent were interviewed (Annex 2). The group has 12 members (seven male and five female). It was started in 2015 and was registered in 2018. The aim of the group is to produce quality seed that can be sold to rice farmers. They offer other farmers training on good agronomic practices. The group's challenges include limited capital to make QDS production investments and a lack of marketing skills, which forces individuals to sell QDS as grain. In addition, farmers source early generation seed from TARI and ASA in Morogoro, a distance of about 600 km. The fact that the group is still active indicates that it has a future. It needs to develop stronger ties with TARI and ASA for basic seed, and extension staff have indicated their willingness to act as brokers.

Mbugwe Agricultural Marketing and Cooperative Society (AMCOS) is engaged in the production and marketing of pigeon pea, sesame, and sunflower QDS. Five farmers and one extension agent were interviewed (Annex 2). Mbugwe AMCOS was started and registered in 2011 and had 113 members (74 male and 29 female). In 2013, a small group of 10 members (six male and four female) was formed from the big AMCOS. The new group is engaged in the production of sesame QDS. They source basic seed from TARI Naliendele and then produce and sell QDS to farmers. In addition, they also train the farmers in good agronomic practices. The challenges they face in QDS production include the fact that

the local market is unreliable since farmers do not purchase new seed every season. If sales were at the district level, farmers would have a wider choice of seeds, while QDS producers would benefit from wider markets.

Magara QDS farmers were involved in the production of pigeon pea QDS. During the survey, five farmers and two extension agents were interviewed (Annex 2). The challenges they face are limited capital to expand their seed businesses. They also encountered a challenge in the shrinking of the market immediately after the Indian ban on pigeon pea imports in 2017. Fortunately, demand for pigeon pea seed is growing steadily beyond the district and region and the farmers are still producing pigeon pea seed and market it through individual farmers or agro-dealers.

Examples of organizations involved in QDS production

Kilimo Market Ltd[24] is a social impact business partnering with smallholder farmers in Tanzania to export their pigeon pea and chickpea grain. It has a seed and commodity business. To ensure its pigeon pea grain quality, the company formed producer marketing groups and trained farmers in good farming practices. Selected groups were then trained in pigeon pea and chickpea QDS production and in financial management. The groups were supported in the creation of storage facilities and were registered as legal entities. The QDS produced was sold to pigeon pea and chickpea grain producers, who sold their grain to Kilimo Market Ltd. This approach worked extremely well for farmers due to the existence of good pigeon pea and chickpea markets where they could easily sell the grain. However, following the Indian government's ban on pigeon pea and chickpea imports in 2017, QDS production ceased. The company went bankrupt, and owners who were foreigners left the country.

Islands of Peace is a non-governmental organization that collaborates with Research Community and Organizational Development Associates (RECODA), Kilimo Endelevu organization, and Karatu District Council to facilitate farmers in the production of bean QDS. The variety that farmers produce is Selian 13 (yellow type) because it is marketable locally and within the district. They initially sourced basic seed from TARI Maruku, where they obtained 200 kg in 2019 and produced 1.6 MT of QDS. Although initially many farmers signed up to produce QDS, after field inspections, only four farmers qualified, and only two farmers continued to produce QDS in 2019, across a total of 4.5 acres. This shows that most farmers are struggling to fulfill the required standards for QDS production.

The testimonies of producers interviewed in Babati and Karatu show that QDS is thriving in the region. The system was well established through various projects for different crops across the region. Since QDS is well known, farmers and groups of farmers are guaranteed to have local markets, as long as they maintain the expected quality. Farmers and groups of farmers can grow if they can safeguard the quality and open traceability of the seed. There are strong links with basic seed (TARI and ASA) sources, which are decentralized in the production regions. Accessing basic seed does not appear to be a problem. The regulator has decentralized inspection to production regions and in close collaboration with the local governments. The regulator and local government bear the costs of inspection.

However, the growth of QDS is constrained by delays in obtaining approval for the production of seed as well as delays in the results of laboratory tests for the harvested seed from TOSCI, both of which affect sales. This happens if the planting season has passed. QDS producers are required to seek to retest the viability of the seed, which has not been sold for over seven months, and this incurs extra costs. Further, the limitations on the sale of QDS to the ward in which it is produced are a hindrance to the scaling up of production and the specialization of farmers and groups of farmers. These factors limit farmers and groups of farmers to small enterprises that cannot benefit from economies of scale.

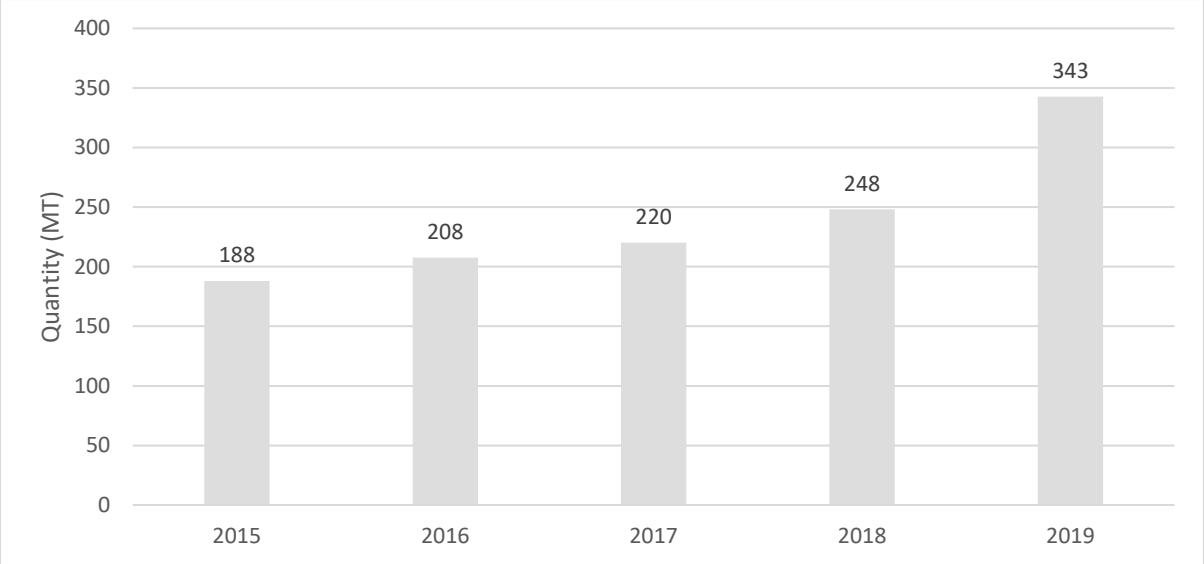
Performance of Quality Declared Seed (QDS) in Tanzania

[24] https://www.kilimomarkets.com/

The Government of Tanzania established QDS production in 2003 to enhance the accessibility of improved seed in areas where farmers could not easily access certified seed. It was also intended to stimulate the production of improved seed of underutilized crops and legumes whose seed is not readily available. Some key facts related to QDS production in Tanzania are:

Tanzania has seen a steady increase in the production of QDS: QDS production has increased steadily, from 188 metric tons in 2015 to 343 metric tons in 2019 (Figure 8). Possible causes of this are the efforts of projects to promote the production of QDS by individual farmers and groups of farmers. Another reason could be the growing demand from farmers who appreciate the benefits of QDS when compared to farmer-saved seed. Lastly, relatively good access to TARI's basic seed may have contributed to the increase in production over the years. However, despite this growth, production levels are significantly lower than expected. This is because QDS production was initially supported through donor-funded projects. Such projects paid transaction costs for sourcing seed, production supervision, and marketing. These costs were not passed on to QDS producers. Over time, many farmers' groups became reliant on external support, and when these projects closed the farmers' groups were not prepared to bear the full costs of the production and marketing of QDS.

Figure 8: Total quantities of QDS produced in Tanzania between 2015 and 2019



Source: TOSCI

Rice is the most important QDS crop: Rice QDS accounts for about 75% of the total QDS produced in 2019. The reasons for this dominance are a high level of demand for rice grain in urban areas, and the availability of suitable areas where smallholder farmers across the country can produce rainfed rice. The growing importance of rice as a major staple crop is supported by the National Rice Development Strategy that is now in its second phase (URT, 2019). This strategy aims at reducing dependence on rice imports by promoting self-sufficiency.

Steady growth only recorded in rice QDS: Rice QDS production grew steadily between 2015 and 2019. Not only was the growth in rice QDS production steady over this period, it was also significant – 352%. QDS production for most other crops, by contrast, saw only minimal growth during this period. Except for a single outlier – sunflower QDS between 2018 and 2019 – QDS production among the other crops (sesame, soya bean, sorghum, bean, pigeon pea, and finger millet) did not noticeably increase over this period. Moreover, the production of maize QDS declined steadily over this period (Table 12).

Table 12: Total QDS production (in metric tons) by crop between 2015 and 2019

	2015	2016	2017	2018	2019
Maize	17	24	17	12	3
Rice	57	82	118	139	256
Sesame	13	8	-	8	6
Sunflower	20	12	7	9	52
Soya bean	11	9	20	-	-
Sorghum	36	45	33	35	-
Bean	22	10	24	39	26
Pigeon pea	9	10	0	5	-
Finger millet	4	1	1	2	-
Groundnut	-	5	-	-	-

Source: TOSCI

QDS is cheaper than certified seed: The production cost of maize QDS and rice QDS in Morogoro and Dodoma is three times lower than that of certified seed, and the seed is often of similar quality (Laizer, 2017). A comparison of spot prices in August 2020 revealed that rice QDS in Arusha costs between USD 0.6 to 0.8 per kg, while certified seed for rice costs USD 1.5 per kg at an agro-dealer shop. A similar comparison for maize was not possible since no maize QDS was produced in Arusha. QDS is cheaper because the seed is not subjected to rigorous processing and inspection procedures, which increases the unit cost of production. In addition, QDS is sold locally in the area where it is produced. On the other hand, the certified seed is marketed nationwide, and its price includes additional marketing and distribution costs.

Trust in local QDS production: QDS is produced and sold at the village level, which means that most of the customers know the producer. This supports the seed quality control system, as clients trust the producer even without the usage of separate packaging material provided with official quality guarantee stamps. Most farmers observe the quality of the crops in the field. Production at the village level is also beneficial in terms of the accessibility of the seed to buyers (Laizer, 2017).

QDS covers a wider crop scope than certified seed: Farmers appreciate QDS as it focuses on some crops that are not covered under the formal system, for example, indigenous African vegetables. Without the QDS system, farmers cannot access improved seed of varieties of such crops.

Challenges facing QDS production

Requirement to sell within the local ward: Across the four farmer groups interviewed, it was felt that the restrictions on selling QDS through agro-dealers and beyond the ward are limiting sales.

Long distances to access seed: The distance farmers are often required to travel to TARI or ASA in Arusha, and the costs associated with this, render QDS unprofitable.

Inadequate storage facilities: A major constraint that farmers face is a lack of proper storage facilities for QDS. Most QDS producers are small-scale farmers with limited access to capital and are unable to store and sell seed at the beginning of the cropping season (the period of time from the moment of harvest to its sale can range from four to eight months). This forces farmers to sell QDS soon after the harvest as grain instead of waiting for the planting season. In extreme cases, this has led to the discontinuation of QDS production.

Noncompliance with technical specifications: Seed inspectors who were interviewed in this study indicated that seed producers did not comply with the specifications for isolation distances, which are necessary to ensure that pollen from other similar crops cannot pollinate the seed plots. This was

because they plant seeds during the cropping season, with neighboring farmers cultivating similar crops. This compromises the production of quality seeds.

Delays in getting services from local government: Seed inspection by local government agents is often hampered by a lack of the resources needed to visit fields. The number of seed inspectors has declined over time due to a lack of new officers trained to replace retiring agricultural staff. On the other hand, TOSCI inspectors are overstretched, and this constrains the timing of field visits that they are required to make.

Sustainability of seed inspection: Currently, farmers are not paying for seed inspection and certification. The cost has either been covered by projects promoting QDS or the local government. This limits the ability of TOSCI and local governments to deliver these services to growing numbers of producers.

Delays in getting information from farmers: TOSCI receives information on planting time from seed producers late. Since the seed is only released for sale after approval by TOSCI has been granted, late approval forces producers to buy other seed.

Delays in giving feedback: Although laboratory tests are decentralized and carried out by TOSCI in one of its five centers, the period between sending samples and receiving the feedback can take up to three months. Seed producers are not allowed to sell their seed during that time and must store it in good conditions. The release of seed for sale is delayed by belated official approval from TOSCI, delayed sampling, delayed laboratory testing, and inefficient communication of the results.

Unreliable seed supply: The basic seed needed for seed production is bought from ASA or received from the District Authorities. The District Authority is not reliable and consistent in its supply, which can delay seed production activities. Seed producers purchasing starter seed from ASA cannot always purchase the crop variety they prefer because it is not available.

4.4 Decentralization of seed inspection services

The purpose of seed inspection is to ensure that the seed sold to farmers meets the required quality standards. For certified seed, all seed inspections are conducted by the national seed regulatory agency, which is under the authority of the Ministry of Agriculture. This agency is mandated, by law, to regulate the formal seed system from variety listing and seed inspection through to certification. It is expected that if seed inspection and other related services (like seed testing, analysis, and certification) are undertaken effectively, the output will be quality seed that is true-to-type, and that the variety will perform as is expected.

Based on this study's definition of decentralized services, there are two ways in which seed inspection services can be decentralized. The first option is decentralization from the national seed agency to sub-national (e.g., district or provincial) government agencies. In this case, seed inspections are conducted by this sub-national agency, sometimes under the supervision of the national agency. This is the case in Tanzania and Uganda. In both cases, the agencies are governmental. The second option is the decentralization of seed inspection from the national government agency to a private entity. This is more commonly referred to as authorization or accreditation, as the government authorizes another private entity to undertake this task on its behalf. This is the case in South Africa, Zambia, Zimbabwe, and Kenya. South Africa is unique in that seed inspection is led by the private sector through the South Africa National Seed Organization (SANSOR). In 2016, there were 180 seed inspectors in South Africa (Mabaya et al., 2017a). Zambia has 118 licensed seed inspectors – 83 private and 35 working under the Zambian Seed Control and Certification Institute (SCCI) – that have been licensing private seed inspectors since 1995 (Mabaya et al., 2017b). The SCCI allows seed personnel from the private and public sectors to be licensed to perform seed quality control services, such as

seed inspection, sampling, and analysis. Zimbabwe had 61 seed inspectors in 2016 – 14 public inspectors and 47 from the private sector (Mabaya et al., 2017c). The example from Kenya is explained below**Fehler! Verweisquelle konnte nicht gefunden werden.**

Box 5: Decentralization from public to private seed inspection in Kenya

The Kenya Plant Health and Inspectorate Service (KEPHIS) is the seed regulatory agency in Kenya. The Seeds and Plant Varieties Act (Cap 326) of 2016 empowers KEPHIS to authorize third parties (either individuals or institutions) to carry out some or all aspects of seed certification. To implement this provision, in 2017, KEPHIS developed a document to guide the process of authorization. The document outlines the different services that third parties could be authorized to conduct, including seed field inspection, seed processing inspection, seed sampling, seed testing and analysis, and seed labelling and sealing. In addition, the guidelines outline the conditions for authorization, including minimum qualifications, and requirements for training and assessment; the authorization process; KEPHIS's role in monitoring the authorized personnel; and guidelines for re-examination.

Individuals or entities that would like to be authorized by KEPHIS are required to apply in writing, make a payment and then undergo training. Once all the requirements are met, the names of authorized individuals and institutions are published in the official gazette. In 2018, there were 18 seed companies that produced and marketed certified seed for the four main cereal and legume crops in Kenya. Of these, 10 had had at least one member of their staff trained as a private seed inspector. Most of the remaining companies (7 out of 8) planned to train their staff in 2019 or 2020 (Waithaka et al., 2019) Further, seed companies' rating of the adequacy of seed inspections has increased from 62% in 2015 to 69% in 2018. It is expected that the companies' satisfaction with these services will increase once the private seed inspection arrangements have gained a foothold in the industry. The initiative to train private seed inspectors is not without its challenges. By 2019, 35 private seed inspectors had been authorized and gazetted. However, of these, only two seed inspectors had conducted any inspections. Most of the authorized inspectors had not yet been deployed. The main reason for this was that some of the seed companies had not yet developed internal guidelines to protect these inspectors from interference. That is, it was not clear that seed companies would respect all decisions of their private inspectors, especially if consignments were rejected. Secondly, the seed companies were content with the services offered by KEPHIS and did not see the need for engaging their own inspectors. Nevertheless, the seed companies indicated that they would likely deploy their authorized inspectors in the course of 2020.

Despite some problems, this initiative has picked up. By January 2020, KEPHIS had authorized and gazetted 34 private inspectors, all of whom are attached to private seed companies (ROK, 2020). They had also authorized 14 private seed analysts, all of whom are attached to private seed companies, and 2 private seed laboratories that belong to private seed companies.

Source: Authors' compilation, January 2021

4.4.1 Decentralization from national to district seed inspection in Uganda

In Uganda, the NSCS is mandated to conduct seed inspections. Under the QDS system, the NSCS has decentralized this service to the districts, to be conducted by the DAOs, who are also government officers. The NSCS only employs 19 national seed inspectors, who are responsible for inspections of the 42 registered seed companies in the country (Erongu, 2020). The scope of inspections includes field inspections, using agreed national standards, inspections at the processing plants, inspections of retail outlets for seed, and inspections at border points of entry and exit. In 2018, Uganda produced 22 MT of maize seed (Mabaya et al., 2018). The number of national seed inspectors in Uganda is notably lower than in other countries that have a similar or smaller seed sector in terms of the volume of seed production. Based on TASAI studies[25], Mali had 60 inspectors in 2018, Tanzania had 47 inspectors in 2016, Burkina Faso had 45 inspectors in 2018, and Malawi had 37 inspectors in 2016.

[25] https://tasai.org/wp-content/uploads/TASAI-Appendix-CURRENT.pdf

Ghana had 43 inspectors in 2019 (Quaye, 2020). Given the small number of inspectors in Uganda, one of the purposes of decentralizing this service is to improve the availability of seed inspection services to QDS producers. By decentralizing inspection services to district headquarters, these services are expected to be more readily available and less costly to use. The second, but related reason for decentralizing this service is to improve the quality of QDS that is produced and sold to farmers. The officials inspect the seed following the agreed standards. QDS that does not meet the standard is rejected.

4.4.2 Conduct of the QDS inspections

Depending on the number of QDS producers in the district, the DAO may also work with the district agricultural extension officers (DAEs), who are based at the sub-county level - Lira has 13 sub-counties Butaleja district has ten sub-counties (UBOS, 2020). The DAOs train the DAEs to monitor seed production in the farmers' fields.

There are notable differences between the centralized seed system for certified seed and the decentralized seed system for QDS (Table 13). The DAOs follow the standards outlined in the ISSD QDS seed inspection handbook (ISSD Uganda, 2015). These guidelines are mainly informed by the United Nations Food and Agriculture Organization (FAO) QDS guidelines. The performance of inspections based on these guidelines is discussed in the next section.

Table 13: Differences between seed inspection procedures for certified seed and QDS in Uganda

Aspect of seed inspection service	Under the centralized system (certified seed)	Under decentralized system (QDS)
Who conducts seed inspections	NSCS inspectors	DAOs with occasional support from DAEs
Number of seed inspectors	19	135 (one in each district)
Cost of seed inspection per field visit (USD)	300	20
Seed inspection standards followed	National standard and COMESA standard	QDS FAO guidelines and ISSD guidelines
External technical support to seed inspectors	None	NSCS, Bioversity International, NARO, ISSD Uganda

Source: Authors' compilation, ISSD Uganda and FAO

Performance of district seed inspections

The National Seed Certification Service (NSCS) has authorized all DAOs to conduct QDS inspections in their respective districts. The DAOs have received several rounds of training, the first of which took place in 2016. The training sessions are both theoretical (conducted in classrooms) and practical (conducted in farmers' fields). QDS field inspections follow three steps:

Paying for seed inspection services: The LSBs in Butaleja district incur a cost of USD 20 for every field inspection visit. This is paid to the DAO and covers the cost of fuel. However, this amount is inadequate as most LSBs are located far from the district headquarters where the DAO is based. The DAO intends to double this charge. In Lira district, the cost of seed inspection is covered by the district agricultural extension fund. On some occasions, external partners, like ISSD Uganda and SNV Netherlands Development Organization[26], have helped cover this cost.

First inspection*:* The LSBs initiate the process by submitting a written request for a seed inspector. The request should include the planting returns, that is, the area planted and the number of fields to

[26] https://snv.org/country/uganda

be inspected. The DAOs follow the standards outlined in the ISSD QDS seed inspection handbook. The FAO QDS guidelines mainly inform these guidelines. The guidelines recommend two field inspections at flowering and maturity stages for bean, rice, soya bean, and potato, and sampling of three fields (if the number of fields exceeds 10).

Second inspection*:* The second inspection is conducted in the middle of the planting period, after flowering. The purpose is to approve the field for harvesting. Other random inspections are conducted by ISSD seed specialists and the NSCS. In addition to the DAO seed inspector, the LSBs each have their own internal quality assurance committees that also conduct field inspections.

Other standards: Minimum germination of 60%, varietal purity of 98% and maximum of 20% off-type[27]. The seed that does not meet these standards is usually sold as grain.

The threshold for certification is higher for certified seed than for QDS. As such, the standards for the two classes of seed are different (Table 14). For example, only 30% of the fields need to be inspected under QDS. However, all (100%) fields with certified seed must be inspected. In addition, each QDS field only needs to be inspected twice, compared to three times for fields with certified seed. Another distinct difference concerns the maximum percentage of off-types – 2% for certified seed but 20% for QDS seed. This means that out of a sample of 100 seeds, only two off-types are accepted for certified seed, while up to 20 will be accepted for QDS seed. Laboratory standards are also different. QDS seed only needs to achieve 60% germination, compared to 80% for certified seed.

Table 14: Comparison between QDS and certified seed standards for bean seed in Uganda

	Certified seed	QDS standards	
	COMESA standard	Recommended by FAO	Standards observed/ reported during research in Uganda
Isolation of seed fields from other crop species (in meters)	5	5	3
Percentage of fields to be inspected	100%	30%	30%
Number of inspection visits per field	3	2	2
Presence of weeds	Free from weeds	Reasonably free from weeds	Reasonably free from weeds
Minimum germination	80%	60%	60%
Varietal purity	99%	98%	-[28]
Maximum off-type percentage	2%	20%	20%

Source: Authors' compilation, COMESA and FAO

4.4.3 Decentralized seed inspection in Tanzania

TOSCI is the official seed regulator under the Ministry of Agriculture (MoA). TOSCI's head office is located in Morogoro. The other four branches are located at Tengeru in Arusha, Maheve in Njombe, Ukiriguru in Mwanza, and Naliendele in Mtwara. TOSCI performs the following activities before the basic seed is ready for the market: seed field registration; seed field inspection; issuing transport orders after harvesting; issuing work orders to allow seed processing; supervision of seed processing; seed sampling; laboratory seed testing; issuing seed testing certificate; issuing TOSCI labels; and

[27] Off-types are seeds that deviate from the original in terms of the color of the seed coat or the shape of the seed. These deviations can be identified by physical observation.

[28] No field observation as this is a laboratory standard.

supervision of the labeling process. Seven months after seed testing, the seed owner is required to request TOSCI to sample carryover seed for laboratory testing before it can be sold.

Seed certification of released varieties includes field inspections, seed sampling and testing. TOSCI trains seed producers, seed inspectors, and seed analysts. It issues certificates for qualified seed lots to package and market seed. In short, it ensures that standards for QDS production are followed.

TOSCI's operationalization of QDS production is explained in Box 6 and Table 15. It involves the registration of seed producers, field and laboratory inspections, the certification of produced seed, and labeling with the TOSCI logo and security mark for traceability. QDS producers in Tanzania do not incur any costs for field inspection and seed certification, as these are borne by TOSCI and the local government.[29] This explains farmers' interest in QDS, as it is more affordable to produce than certified seed. For example, in Magugu, Babati district, the cost per kg of certified rice seed from a private seed company is USD 1.5. From ASA, it is USD 1.2, while QDS costs USD 0.8 per kg (Boresha Kilimo Ushinde Group, 2020).

Through QDS, a market-oriented local seed trade delivering quality seed to farmers has been developed. Since 1998, 18 pilot districts were introduced through the DANIDA program, and in 2007, more than 90 percent of the districts in Tanzania supported and introduced QDS production in their areas (ASARECA/KIT, 2014). A country-wide training of district extension officers of QDS production was carried out in 2007/2008. Other district extension officers have also been trained as authorized district seed inspectors/samplers (ASARECA/KIT, 2014).

The requirement that QDS be only sold within the village where it is produced is a hindrance to both farmers who use the seed and the seed producers. This means that local farmers are not exposed to varieties from other parts of the district. This limits their choice of improved varieties. For the seed producers, a village does is small and may not allow for the production of larger quantities of seed to encourage commercial production.

Box 6: Highlights of QDS application in Tanzania

QDS is produced by registered, trained small-scale farmers or groups of small-scale farmers, who produce seed for their own use or for sale to neighboring farmers within the ward in which the QDS is produced. Any farmer who wishes to become a QDS producer must apply to TOSCI.

To avoid conflicts in the marketplace, QDS producers are advised not to produce crops or varieties already successfully sold by seed companies in that market area. They are also advised to produce quantities that can be sold the same year.

Only OPVs that are on the official national variety list can be produced as QDS – this excludes F1 Hybrids.

After a QDS producer has been trained in QDS production of a crop, he/she can decide to add additional crops or varieties to his/her seed production at his/her own risk if the market exists.

Authorized district seed inspectors carry out seed inspections and a minimum of 10 per cent of a district's registered QDS production is inspected by TOSCI. Seed sampling is done by an authorized seed inspector, in accordance with QDS and International Seed Testing Association (ISTA) rules. The seed lots are tested by TOSCI, following ISTA Rules and procedures. Lots passing the quality test are registered as QDS and can be sold. A declaration is completed for each seed lot and the producer labels the QDS bags.

The sale of QDS normally totals a few tons of a maize or rice variety, or a few kilos of a vegetable variety. QDS addresses the key gap area between the formal seed sector and small-scale farmers, as QDS is sold at affordable prices that are generally lower than those for certified seed.

Source: Granqvist, 2009

[29] The new costs for QDS inspection (URT, 2020) are expected increase the cost of QDS, but not to the level of certified seed.

Tanzania's seed law allows for the accreditation of private laboratories and private seed inspectors to test and certify seeds. TOSCI is preparing guidelines for accreditation, training materials, and auditing procedures (Ngwediagi, 2020).

TOSCI insists that QDS producers source seed from TARI or ASA to guarantee that they only use officially released varieties. The producers are required to present seed inspectors with a purchase receipt that indicates the source and quantity of seed. When the seed inspector is satisfied, he/she will complete a form with these details and submit them to TOSCI. This is supposed to happen within 30 days of the time of planting. The authorized seed inspectors conduct inspections of seed production fields and verify isolation distances, cultivar characteristics, pests, and disease scores. Field visits are conducted two to three times during the cropping season, i.e., at flowering, maturity, and harvesting, depending on the crop. QDS inspection is done by sampling 10% of registered fields. After farmers have harvested and cleaned the seed, the inspectors collect seed samples and send them to a TOSCI laboratory in one of its five testing and certification centers. Apart from training seed inspectors and QDS farmers, TOSCI also provides training to agro-dealers to provide quality services in seed sales.

Table 15: Differences in seed inspection between the centralized and decentralized system in Tanzania

Aspect of seed inspection service	Under the centralized system (certified seed)	Under the decentralized system (QDS)
Who conducts seed inspections	TOSCI inspectors	District Extension Officers with Divisional Extension officers and farmers
Number of seed inspectors	One in each district	One in each district that was visited
Cost of seed inspection, per field visit	50 USD for fields 10 ha or less, 140 USD for fields between 11 and 100 ha and 190 USD for fields greater than 100 ha	13 USD per acre[30]
Cost of certification per variety (USD)	215	Nil
Sticker labels per variety (USD)	0.1	0.1
Germination, purity, and moisture tests (USD)	50	22 USD per kg of field crop seed and 43 USD per 100g of vegetable seed
Soil health (USD)	35	This is optional and costs 4.3 USD per sample, 2 USD for repeats
Training per person (USD)	Not indicated	22 USD per person.
Seed inspection standards followed	National standards and SADC standards	QDS FAO guidelines and ISSD guidelines
Key challenges in the delivery of seed inspection services	Low number of inspectors in the country. Most of them are in one place, e.g., in the Northern Zone. They are based in Arusha	A low number of inspectors per district (one or two) and the lack of resources

Source: URT 2020 and URT 2017

Performance of decentralized seed inspection services

The decentralized seed inspection services take two forms: (i) In Uganda and Tanzania, the NSCS and TOSCI respectively have decentralized seed inspection services to the district level, to be undertaken by DAOs, who only inspect QDS; (ii) in Kenya, KEPHIS has authorized private seed inspectors to inspect fields for certified seed. The positive outcomes of seed inspection include:

[30] The Seeds (control of Quality Declared Seeds) Regulations, 2020 (URT, 2020)

Increase in the availability of quality seed to farmers: In Uganda and Tanzania, district seed inspectors play a central role in quality control of QDS before it is sold to farmers. The inspectors train QDS growers and then inspect the fields to ensure that they meet QDS standards. Only seed that meets the required standards is provided to farmers. Laboratory tests confirm the quality of the QDS. In Uganda, all the QDS that was sampled for laboratory testing in 2014 passed the minimum requirements (ISSD, 2015).

Reduction of the workload of government seed inspection services: In Kenya, private seed inspectors have reduced the seed inspection burden that was wholly undertaken by the government agency, KEPHIS. Now, KEPHIS can deploy seed inspectors to the seed companies that have not employed seed inspectors and focus on supervising the authorized inspectors. The presence of both private and public inspectors has increased the number of quality control officers available across the country.

4.5 Decentralization of seed processing

Seed processing is sometimes called seed conditioning and includes the following operations (FAO, 2018):

- **Reception:** The seed is received. The seed ownership and lot number are clarified at this stage. If bagged, the seed is removed from the bags.
- **Drying:** Moisture content is reduced to the recommended standards. Seed can be dried mechanically or through sun-drying.
- **Cleaning and grading**: The removal of foreign matter and contaminants. After this process, the seed is graded.
- **Treatment**: The application of chemicals to protect the seed against insects and disease infestation during storage.
- **Weighing, packaging and storage**: The seed is packed in bags of the appropriate size and standards. Thereafter, the seed is labelled according to government regulations.

Seed laws and regulations require that all classes of seed meet the relevant required standards. The processing of the seed is intended to enhance its quality in conformity with these standards.

4.5.1 Decentralized seed processing in Uganda

All seed companies operating in the formal seed system process their seed before it is marketed and sold. Certified seed goes through all the processing steps – reception, sorting, threshing, drying, cleaning and grading, treatment, packaging and storage. In most cases, all these operations are conducted using machines. However, for QDS, seed processing is undertaken by the QDS producers at the district level. Not all QDS goes through all the processing steps before being sold to farmers. The two LSBs, Namunasa Stream Rice Farmers Cooperative LSB in Butaleja district and Aye Medo Ngeca LSB in Lira district, do not undertake all the processing operations that are employed by seed companies. In addition, the operations that are undertaken are mainly conducted manually (Table 16).

Namunasa LSB uses machines for two of the processing steps, that is, seed sorting and threshing. However, the threshing machine is not in good working condition. All other processing operations such as drying, treatment, and packaging are carried out manually. Aye LSB does not have a moisture meter, does not treat the seed, and does not weigh the seed. The other operations are carried out manually.

Neither of the LSBs regularly treats the seed. Instead, seed treatment is only done on the demand of the client, which is usually the government. The government purchases QDS to supply to farmers. It prefers the seed to be treated as this deters the farmers from consuming the seed as grain.

Table 16: Use of machinery for seed processing at the two LSBs in Uganda

Seed processing machine/ facility	Purpose of the machine	Namunasa Stream Rice Farmer LSB	Aye Medo Ngeca LSB
Seed sorter/ grader/ cleaner	Cleans and sorts the seed by grade		Manual
Thresher	To remove the kernels from the cob	Machine is not in good working condition	Manual
Dryer	Drying the seed to remove moisture	Sun-drying	Sun-drying
Moisture meter	Measures the moisture content in the seed	Manual moisture meter	No moisture meter
Seed treatment machine	Various treatments (e.g. crop protection)	On demand	No treatment
Packaging machine	Packages seed in bags. Includes a stitching machine to seal the bag.	Manual	Manual

Source: ISSD Uganda

Before the seed is packaged, the LSBs submit a request to the NSCS to sample and test their seed in a laboratory. This testing follows QDS standards for germination and purity. If the results are satisfactory, the LSB is issued with a QDS certificate. In most cases, the cost of seed testing is fully covered by ISSD Uganda. In some cases, the LSB covers up to 25% of the cost. The LSB obtains packaging materials of 3 kg, 5 kg, and 10 kg sizes and QDS seed labels from ISSD Uganda at no cost. The seed is packaged, and the labels are affixed at the LSB's premises.

Priorities for intervention

To improve their processing capabilities, the LSBs would need to purchase the following machinery:

- *Namunasa Stream Rice LSB*: Threshing machine, seed sorter, digital moisture meter, stitching machine for the seed bags, weighing scales, and a machine for seed treatment.
- *Aye Medo Ngeca LSB Lira*: Seed sorter and cleaning machine.

4.5.2 Decentralized seed processing in Tanzania

At ASA and other seed companies, the packaging is carried out manually. The packaged seed is then distributed through agro-dealer networks. Crop Bioscience sells common bean seed to farmers and agro-dealers. Irish potato seed is sold through farmers who are mobilized by extension staff. For other crops, farmers sell seed on their own to individual farmers confined to wards within districts where the seed is produced. The seed is packaged in 2 kg plastic bags, and a TOSCI label is affixed. The 2 kg packs are repackaged into between 12 and 25 packages.

Priority for intervention

To improve the sale and spread of QDS, seed sales should be permitted to expand beyond the wards in which the seed is produced. Farmers should be allowed to sell seed within a district, so long as the agro-ecological conditions are suitable. This way, QDS producers will be motivated to produce larger

quantities of seed, and farmers will benefit from a wider choice of similar seed and alternative varieties.

4.6 Decentralization of seed marketing

In the business sector, decentralized marketing refers to a situation in which a company's seed marketing functions are not centralized in one location, but rather decentralized to different locations, usually where operations are conducted.[31] In the context of this study on seed systems, decentralization is considered in a different way. The focus is on the seed marketing arrangements for QDS because of the system through which QDS is produced.

4.6.1 Decentralized seed marketing in Uganda

According to the draft QDS Regulations, only registered QDS growers (referred to as LSBs in this report) are permitted to market QDS. The QDS seed must be inspected and certified by the NSCS. QDS can only be sold within the district where it is produced. This location is stated in the certificate issued after the seed has been certified. Seed sales between districts are only permitted if the seed is sold from one QDS grower to another. In addition, the QDS Regulations forbid QDS from being sold from the same sales point as certified seed. This means that registered agro-dealers who usually sell certified seed and other agricultural inputs are not permitted to also sell QDS.

Marketing of QDS*:* The LSBs market their seed in various ways - advertisements on local radio stations that are paid for by the LSBs or other organizations, and farmer field days where the LSBs occasionally demonstrate the cooking qualities of the seed through cooking demonstrations.

Distribution of QDS*:* QDS is distributed and sold to three categories of buyers. The first category consists of farmers within the community. In this case, QDS is sold directly to farmers who live close to the LSBs' premises. These farmers collect the seed directly from the LSB. The second category consists of large buyers, including seed companies, NGOs or other LSBs. These buyers are sometimes located in other districts. For buyers in other districts, the seed is packed in large sacks of 70 kg, loaded onto buses, and transported to the respective buyers' locations. The buyers meet the cost of transport. Thirdly, the LSBs participate in weekly farmers' markets and seed fairs in various districts. At these events, farmers buy seed from LSBs. In 2019, most QDS produced by Namunasa LSB (65%) was sold to seed companies in Bugiri district, while about one-third (30%) of the seed was sold directly to farmers, and only 5% was sold through farmers' markets and seed fairs. All seed from Aye LSB was sold to farmers within the district.

4.6.2 Decentralized seed marketing in Tanzania

In Tanzania, once QDS has been inspected and certified by TOSCI, farmers package it and sell it to farmers in the neighborhood and within the local ward. QDS producers are not allowed to sell seed through agro-dealers.

[31] https://www.business2community.com/marketing-automation/centralize-decentralize-marketing-automation-02033706

5 Innovations and priorities for intervention

Several innovations in Uganda have contributed to the successes of its decentralized seed system. These innovations consist of new ideas or initiatives that were implemented to address one or more gaps in various seed services.

Setting up a coordinating entity. The growth in the production of QDS in Uganda has been largely due to the central role played by ISSD Uganda as a coordinating organization. The reasons why the ISSD Uganda model is innovative are:

- *Integrated approach*: The organization has adopted an integrated approach to seed sector development that includes the establishment and strengthening of local seed producers, linking seed producers to ZARDIs, working with the government to empower district agricultural officers as seed inspectors and advocating for a policy framework conducive to a decentralized seed system.
- *Emphasis on a business approach:* ISSD Uganda emphasizes the importance of taking a business approach when setting up LSBs. ISSD trains and coaches the leadership and management of LSBs on business topics such as business planning, market analysis, and record keeping. The intention is that the LSBs would pursue enterprises that are financially viable.
- *Emphasis on building the capacity of LSBs:* The LSBs are a central player in the ISSD model. One of the objectives of the program is to ensure that they are technically equipped in terms of seed production and management; professionally organized in terms of group management and leadership; market-oriented, and strategically linked to inputs, extension, credit, and markets.
- *Emphasis on knowledge management*: ISSD Uganda has implemented a comprehensive knowledge management strategy that includes the documentation of the different aspects of their approach in policy briefs, study reports, and newsletters, systematically monitoring the performance of their work at the farm level and LSB level, and through the production of short videos highlighting the various successes and challenges.

District-level seed inspection services in Uganda. Seed inspection is carried out by the NSCS and is implemented centrally from the NSCS offices. All national seed inspectors in Uganda are employed by the NSCS and report to the NSCS. The NSCS has agreed to delegate QDS inspection activities to district agricultural officers, as it does not have the human resource capacity needed to inspect the fields of seed producers in over 200 LSBs. The district seed inspection arrangements have been relatively successful for the following reasons:

- *Technical support from the NSCS*: The NSCS has trained the DAOs on how to conduct seed inspections of the key crops.
- *Technical and financial support from other partners*: Organizations like ISSD Uganda, NARO, Bioversity International and the DAO's respective local governments have occasionally provided financial and technical support to the DAOs to conduct the seed inspections.
- *Proximity to the seed producers*: The DAOs are based relatively close to the farms that they inspect. This reduces the logistical costs of conducting the inspections.

5.1 Priorities for intervention

The decentralization of seed services and activities has yielded mixed results in both countries. Table 17 presents a summary of the status of decentralized seed services in the two countries. The status is

divided into three stages – seed service not decentralized, seed service partly decentralized, and seed service fully decentralized. The table shows the key areas where challenges persist.

Table 17. Summary of the status of decentralized seed services in Uganda and Tanzania

Management (collection and conservation) of plant genetic resources	Community Seed Banks (decentralized)	National Plant Genetic Resource Centre (PGRC) (not decentralized)
Production of breeder and basic seed	ZARDIs (decentralized)	TARI and ASA (decentralized)
Production of certified seed	LSBs (decentralized)	Farmers and farmer groups (decentralized)
Seed inspection	District Agricultural Officers (decentralized)	District Agricultural Officers (decentralized)
Seed testing	NSCS (not decentralized)	TOSCI (not decentralized)
Seed processing (sorting, grading, treatment & packaging)	LSBs, but not done consistently (partly decentralized)	Farmers and farmer groups partly decentralized)
Seed marketing and distribution	LSBs (decentralized)	Farmers and farmer groups (decentralized)
Seed support services (agricultural extension)	LSBs, NGOs, DAEs (decentralized)	DAOs, NGOs (decentralized)

Source: Authors' compilation

Various reforms need to be implemented to realize the full benefits of a decentralized seed system. These reforms cover the policy, institutional, and industry-related aspects of the seed system and include the following:

5.1.1 Priorities for Uganda

1. *Finalize and implement QDS Regulations*: The National Seed Policy was passed in 2018 and provides for the development of regulations to guide production and quality control for QDS. The MAAIF has started the process of drafting these regulations. The process needs to be completed and the regulations implemented. Once implemented, the regulations will formalize all the actions currently being undertaken without a legal basis, including the registration, production, seed crop inspection, conditioning, testing, labeling, and sale of QDS.
2. *Increase the government funding allocation to ZARDIs*: As part of NARO, the ZARDIs are government institutions that receive public funding. Most of the challenges faced by the ZARDIs, including the inadequacy or shortage of equipment, the need to refurbish storage structures, and the need to increase staffing, can be addressed through an increase in their budget allocation.
3. *Establish seed sector platforms at the district or zonal level:* Seed sector platforms are needed to bring together the key players such as ZARDIs, LDBs, CSBs, DAOs, and district agricultural

extension officers. The purpose of these platforms is to strengthen coordination and collaboration between these actors, which is expected to lead to enhanced planning in the areas of production and distribution of basic seed and QDS, quality control, and seed utilization.

4. *Increase laboratory testing capacity:* Before any class of seed is certified, it must undergo laboratory testing for purity and germination, in line with government guidelines. QDS is certified following FAO QDS standards. In Uganda, all the laboratory testing is conducted at the national laboratory. The government should increase laboratory testing capacity by either expanding the current laboratory or by establishing at least one other laboratory in the country to conduct these tests. A second laboratory would increase the efficiency of testing, which would limit the occurrence of low-quality seed (of all classes) in the seed system.

5. *Strengthen the CSBs' governance and management:* The management and leadership of the CSBs need to strengthen the CSBs human resource capacity by hiring and retaining key staff who would undertake tasks that are currently carried out by volunteers or external project staff. They should also ensure that each CSB has sufficient space to store conserved seed, store commercial seed, store equipment, and hold office functions.

6. *Improve the CSBs' financial capacity by* establishing a financial arm of the CSB, which may take the form of a VSLA or a savings and credit cooperative society (SACCO), which can serve as a vehicle for increasing the members' savings and improving the members' access to credit. They can also expand the CSBs' membership base to improve their financial base. CSBs need to engage in other income-generating ventures, such as the production of others crops or an enterprise like beekeeping and hiring out of office spaces as training or social facilities, as in Ethiopian CSBs. Finally, CSBs should advocate for government funding since they provide public goods in the identification and conservation of genetic resources that are evidence of a country's diversity. This funding could be used to cover some of the infrastructural costs, such as the construction of storage units.

7. *Develop guidelines for the establishment of CSBs*: The MAAIF needs to develop guidelines for the establishment and operationalization of CSBs in Uganda. These guidelines should outline the management, governance, and infrastructural requirements for setting up and operating a CSB. These guidelines should be designed in close collaboration with the PGRC, NARO, the existing CSBs, and institutions that have supported the process from the beginning, like Bioversity International.

8. *Improve the financial performance of LSBs*: One of the challenges reported by the LSBs is the lack of sufficient financial resources. This affects both the efficiency and capacity of their operations. The leadership and management of these LSBs are aware of this challenge and have identified priority investments that will help make the business more sustainable: a new storage facility, tractors to be used in the field, and diversifying the product range. The LSBs plan to source additional funding to enable these developments.

9. *Institutionalize the ISSD model*: The ISSD model encompasses the following aspects: the formation of LSBs, training LSBs in business management, improving LSB capacity in seed quality control and linking LSBs to research institutions. This model has contributed to the growth of QDS production. However, the model is currently being implemented by a development agency. There is a need to institutionalize the model within an appropriate governmental or private sector agency to ensure that LSBs will continue to receive support if ISSD Uganda were to cease its operations in Uganda.

10. *Strengthen district seed inspections services*: The government of Uganda should:
    a. *Train district agricultural extension officers* to perform this function and equip the officers with motorized vehicles that would allow them to easily reach the different farms. The focus should be on the districts where QDS is produced.
    b. *Increase the funding for DAOs*. The main challenge facing the DAOs is the lack of vehicles, which are the main logistical requirement for field inspections. However, both DAOs do not have access to vehicles which limits their ability to conduct timely inspections. They currently use motorcycles which are insufficient for long distances. The DAO in Lira occasionally uses the ISSD vehicle.
11. *Guidelines for private seed inspection services*: the NSCS intends to introduce private seed inspection into the formal seed system. To do this, the MAAIF needs to develop guidelines for private seed inspection services. These guidelines would include requirements for private seed inspectors, specific procedures for private inspectors, guidelines on the NSCS's role in the surveillance and auditing of private inspectors, and conditions for the withdrawal of inspectors, among others.

5.1.2 Priorities for Tanzania

1. *Decentralize the management of plant genetic resources:* The NPGRC has only one branch, based in Arusha, which serves the whole country. It has limited trained personnel, a low budget and lacks basic facilities. Steps that need to be taken to reverse the situation include collaborating more closely with TARI in germplasm collection, evaluation, and preservation. The NPGRC needs to speed up the development of strategic and business plans and use them for resource mobilization.
2. *Encourage the establishment of community seed banks***:** The District Extension Officers who were visited indicated their districts do not have CSBs. Farmers prefer to conserve seed at the household level. There is an urgent need to establish CSBs. This will require farmers to be organized in groups and be made aware of the benefits of their local germplasm. The groups should be trained in identifying beneficial germplasm, and its collection, processing, and preservation.
3. *Promote farmers groups:* Many community-based seed production businesses collapsed with the closure of donor-funded projects. While projects are useful in catalyzing the uptake of technologies, they should integrate the transaction costs in sourcing seed, production supervision, and marketing that local businesses will eventually have to absorb in developing business plans. This will ensure that local seed businesses will be sustainable.
4. *Improve distribution system for basic seed:* Both ASA and TARI produce basic and certified seed of OPVs which is sold to local seed companies and QDS producers. However, the production of basic and certified seed by both ASA and TARI causes unhealthy competition and confusion in the seed market.
5. *Improve coordination between ASA and TARI:* ASA and TARI should coordinate on basic seed production with a focus on strengthening the distribution system for basic seed across the country. The two institutions need to work more closely with seed companies and agro-dealerships to determine the required quantities of basic seed and ensure that these quantities are provided at the right time.
6. *TOSCI could decentralize seed services further:* This could be done through the accreditation of private inspectors in high-production areas. This will reduce the reliance on the stretched TOSCI staff and district extension agents. This way TOSCI can focus on follow-up inspections

and put more emphasis on speeding up the approval process, sampling and reporting back on laboratory tests.

7. *Implementation of the QDS regulations released in 2020*: TOSCI should implement the newly released rates for QDS certification, inspection, etc. This will ease pressure on its funding and allow it to respond to the current delays in inspections and results reporting and would also fund its supervision duties using the resources allocated for the QDS system.
8. *Accreditation of private seed inspectors*: TOSCI should consider options for the decentralization of quality control services, e.g., through the accreditation of private inspectors. This will reduce delays faced by QDS farmers in getting services from TOSCI. TOSCI could adapt the approach adopted by KEPHIS in Kenya (discussed below).
9. *Revamp follow-ups on seed production*: There is a need to revamp close follow-up controls on seed production to ensure that seed producers follow the technical requirements. This calls for an increase in routine inspections as well as extension services.
10. *Allow sales in district*: Allowing sales within the district in which QDS is produced would increase the quantities of QDS produced.
11. *Expand the distribution of basic seed:* TARI and ASA should expand their distribution networks to reach more production areas.

5.2 Shortcomings of the study and areas for further research

This study commenced in April 2020, just as lockdowns occasioned by the covid-19 pandemic were instituted in Kenya, Tanzania, and Uganda. The implication of the lockdowns was that TASAI staff could not travel to join the researchers in Tanzania and Uganda. In both Tanzania and Uganda, local travel restrictions and bans on large gatherings reduced the researchers' mobility beyond meeting with interviewees.

Areas that can be considered for further research on how to further decentralize seed services include:

1. What needs to be done to promote the healthy growth of QDS business alongside certified seed business? This needs to start from the regulatory environment to the scope of sale of QDS seed and related seed distribution arrangements. What are the implications of expanding the sale of QDS beyond administrative regions to areas with similar ecological conditions?
2. What is the impact of QDS in countries where it has been in operation for several years? What lessons can be drawn to improve current operations?
3. Evaluation of CSBs, LSBs, and QDS farmers performance and viability in the absence of donor or project funding
4. Research is needed on how to decentralize services under the National Plant Genetics Research institute and The Tanzania Official Seed Certification Institute so that the two institutions can sustainably fulfill their mandates while offering services closer to the farmers.
5. Further research is needed on sustainable ways of ensuring consistent processing and packaging of QDS

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APPENDICES

Appendix 1: Questionnaire guide for data collection

The objective of the assignment is to assess the extent, nature, successes, innovations and shortcomings of decentralized seed services in Tanzania and Uganda. Below is a list of aspects of the seed sector that our analysis will focus on, followed by questions that will shed light on how these elements behave and interact and the resulting performance of the seed sector in the given country.

1. **National legal and governance structures relevant to the seed sector:** The extent to which a country's seed sector is (de)centralized may be guided by governance and administrative structures that are defined in the constitution of the country. Guiding questions include:
   a) What national legal and governance structures influence the national seed sector and/or specific seed services in the country?
   b) How is the level of (de)centralization affected by the national legal and governance structures?
2. **Seed policy framework**: The policy frameworks include the national seed policy, seed law, and the various implementing instruments such as seed regulations, ministerial orders, as well as relevant regional seed regulations, e.g., the COMESA Harmonized Seed Regulations which are applicable to Uganda. Guiding questions include:
   a) What is the status of the policy frameworks in these countries, e.g., adopted and being implemented, under review/amendment, not yet adopted?
   b) How do these frameworks allow for the decentralization of various seed services?
   c) How do these frameworks define the scope of the seed actors within the system?
3. **Management of plant genetic resources**: This includes the collection and conservation of plant genetic resources of various crops. The analysis will cover the existence of seed banks across the country. Guiding questions include:
   a) How are plant genetic resources collected and conserved at the national and community levels?
   b) What are the logistical requirements for conservation (that is, seed banks) of these resources at the community level?
4. **Production of breeder and basic seed**: In most countries, the National Agricultural Research System (NARS) is the main actor in the production and supply of breeder and basic seed. However, in others, this function has been decentralized to the sub-national level, through zonal research institutions. In yet other cases, this function has been outsourced to private companies. The guiding questions will be:
   a) What is the profile of these sub-national research institutions that are producing breeder or basic seed?
   b) What is the step-by-step process through which basic seed is supplied to the different buyers, from ordering to delivery?
   c) How are these institutions performing, in terms of volume of seed produced and supplied, and improving access and availability of basic seed to seed companies or seed producers?
   d) What are the main challenges facing the production of basic seed on behalf of the NARS?
5. **Seed production and multiplication**: Depending on the country's legislation, seed production and multiplication may be undertaken by a combination of individual seed producers, seed growers, seed cooperatives and seed companies. The guiding questions include:
   a) Human resource capacity requirements for seed producers: What minimum skills should seed producers have to meet the threshold for quality seed production? How do these differ when looking at different classes of seed?
   b) An overview of the performance of Quality Declared Seed (QDS) production in terms of the quantity and quality of seed produced.

6. **Seed inspection, testing and certification**: The purpose of seed inspection, testing and certification is the assurance of quality of the seed that is provided to farmers. The guiding questions include:
   a) To what extent is seed inspection decentralized?
   b) What are the logistical and human resource requirements to decentralize seed testing services?
   c) What are the challenges pertaining to the different options of decentralizing seed inspection services and how do they affect seed quality?
7. **Seed processing:** Seed processing includes drying (sun-drying vs mechanical drying), cleaning (pre-cleaning and basic cleaning), grading and seed treatment (if required). Guiding questions include:
   a) How do the seed processing methods used by producers of QDS and seed companies (producing certified seed) compare for the same crops?
   b) What are the machinery requirements for the various stages of seed processing? Are these requirements available in the various country contexts? If not, what are the alternatives?
   c) How much does it cost to purchase and install seed processing machinery that will allow small- and medium-scale seed processors to operate successfully?
8. **Seed packaging and labelling**: The criteria for seed packaging and labelling are defined in the seed regulations. Guiding questions include:
   a) What are the different forms of seed packaging that are adopted in the target countries?
   b) What are the main factors limiting small seed producers from packaging and labelling their seed?
   c) What are the packaging and labelling requirements for QDS?
9. **Seed marketing and distribution**: The main actors in the marketing and distribution of seed include seed producers, seed companies and seed dealers also called agro-dealers. The guiding questions include:
   a) What are the guidelines for the sale of certified seed?
   b) Who are the main actors involved in the distribution of certified seed?
   c) How is seed distribution structured to increase farmers' access?
   d) How are seed dealers organized?

Appendix 2. Production of seed by local seed businesses

1. What are the objectives of the LSB?

_____
_____
_____
_____

2. Does the LSB have legal status? YES NO
If yes explain:

_____
_____
_____
_____

3. Who owns the LSB?: _____

4. What is the leadership structure?

_____
_____
_____
_____

5. What services are offered?

_____
_____
_____
_____

6. What are the focus crops and varieties?

_____
_____
_____
_____

7. How many members are there? Males _____ Females _____ Total _____

8. What are future plans?

_____
_____

9. What are challenges/constraints?

_____
_____

10. Please provide the following information in the Table below (performance)

Crop	Variety	Volume of breeder seed booked from research (kg)	Volume of breeder seed bought from research (kg)	Volume of foundation seed produced (tons)	Volume of foundation seed sold (tons)	Number of farmers receiving foundation seed

11. What minimum skills should seed producers have to meet the threshold for quality seed production?

_____
_____
_____
_____

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