

Assessment of Grain Legumes and Dryland Cereals Seed Value Chains

UGANDA SYNTHESIS REPORT

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Acronyms

ACTESA	Alliance for Commodity Trade in East and Southern Africa
AIPU	Agricultural Inputs Platform Uganda
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
CBO	Community Based Organizations
CGIAR	Consultative Group for International Agricultural Research
COMESA	Common Market for East and Southern Africa
EGS	Early Generation Seed
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GLDC	Grain Legumes and Dryland Cereals
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ISSD	Integrated Seed Sector Development
ISTA	International Seed Trade Association
LSB	Local Seed Business
M&E	Monitoring and Evaluation
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MT	Metric Tonnes
NAADS	National Agricultural Advisory Services
NARO	National Agricultural Research Organization
NaSARRI	National Semi Arid Resources Research Institute
NGO	Non-Governmental Organization
NSCS	National Seed Certification Services
OECD	Organisation for Economic Co-operation and Development
QDS	Quality Declared Seed
R&D	Research and Development
REC	Regional Economic Community
TASAI	The African Seed Access Index
UNSP	Uganda National Seed Policy
USTA	Uganda Seed Trade Association
ZARDI	Zonal Agricultural Research and Development Institute

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Executive Summary

The study sought to identify critical areas that can drive sustainability in seed value chains of Grain Legumes and Dryland Cereals (GLDC). Data collected was from major actors in Uganda's GLDC seed value chain using specific questionnaires.

The results show that the seed value chains for GLDC crops have potential for growth laterally¹ and vertically². Further, these value chains has great potential to improve not only Uganda's economy, but also food, income and nutrition security for households. However, a number of challenges continue to impede the growth of these value chains. Seed access by both farmers and local seed businesses is poor especially concerning improved varieties from seed companies and national breeding programs. The difficulty to gain access to adequate markets and stable prices for GLDC grain continue to act as a disincentive for farmers' adoption of the high yielding modern varieties.

Farmers cited drought, pests and diseases as the main reasons for low productivity. These factors also endeared them to their own saved seed. Similarly, access to financial capital was a problem for seed companies, local seed businesses, grain traders and farmers.

Grain (and seed) traders operating within local markets felt that the research system was not doing enough to deliver varieties demanded for by their customers. Most of the respondents appreciated the importance of up-to-date farming and market information. They proposed a better synchrony between stakeholders directly involved in production and market systems development training.

Therefore, to address these challenges and revamp the GLDC seed value chains in Uganda, **we recommend:**

- a) More strategic demand-led breeding supported by the GLDC-CRP, which ensures farmers (and other consumers) access to the right types of seed;
- b) Cost effective capacity building approaches applicable to multiple actors along the value chains (specifically on how to improve seed quality, utilization and access to credit);
- c) Critical review of subsidy programs by government or development partners that seem to create artificial seed demand that cannot be sustained in the long run;
- d) Policies that support additional clauses on easy-to-access seed classes like QDS or standard seed; and,
- e) Holistic extension that embraces models of social inclusion.

¹ Lateral growth will aim at the expansion of business operations through entry to new markets, i.e. new geographical locations and/or business sectors.

² This value chain could benefit greatly if it increased its market share compared to maize and this implies scaling the diverse products in grain legumes and dryland cereals. By venturing deeper into the current market, there is a chance to increase the demand for GLDC crops and their adoption.

CHAPTER 1: BACKGROUND

1.1. Introduction

Grain Legumes and Dryland Cereals (GLDC) are important crops that support the livelihoods of poor farming households in rural areas of sub-Saharan Africa (SSA) and south Asia. These crops are critical in improving income, food and nutritional security of smallholder farmers and other value chain actors (Ojiewo et al., 2015; 2018; Orr, 2018, Das et al., 2018). Therefore, increased productivity and marketability of these GLDC crops (Table 1) holds great promise of eradicating poverty within the agroecologies where they are grown, i.e. semi-arid and sub-humid drylands (Das et al., 2018). These are the agroecologies where incidences of acute poverty, malnutrition, soil degradation and climate change impacts are reported (Mirza, 2011; Gill et al., 2013; Das et al., 2018). However, the productivity of these crops has been hampered over time mainly due to limited adoption of improved varieties; this low adoption is a result of poorly functioning seed systems. It is therefore important to document and understand success stories, challenges and opportunities in the seed value chains of these crops. Such an understanding will help in addressing the bottlenecks in the seed value chains, thereby providing suggestions for revamping it and making it more responsive to the ever changing needs of farmers and other value chain actors and stakeholders. Rural development and poverty reduction in these agroecologies depend heavily on sustainable seed flows of these crops (Almekinders et al., 1994; Almekinders and Louwaars, 2002; Orr, 2018).

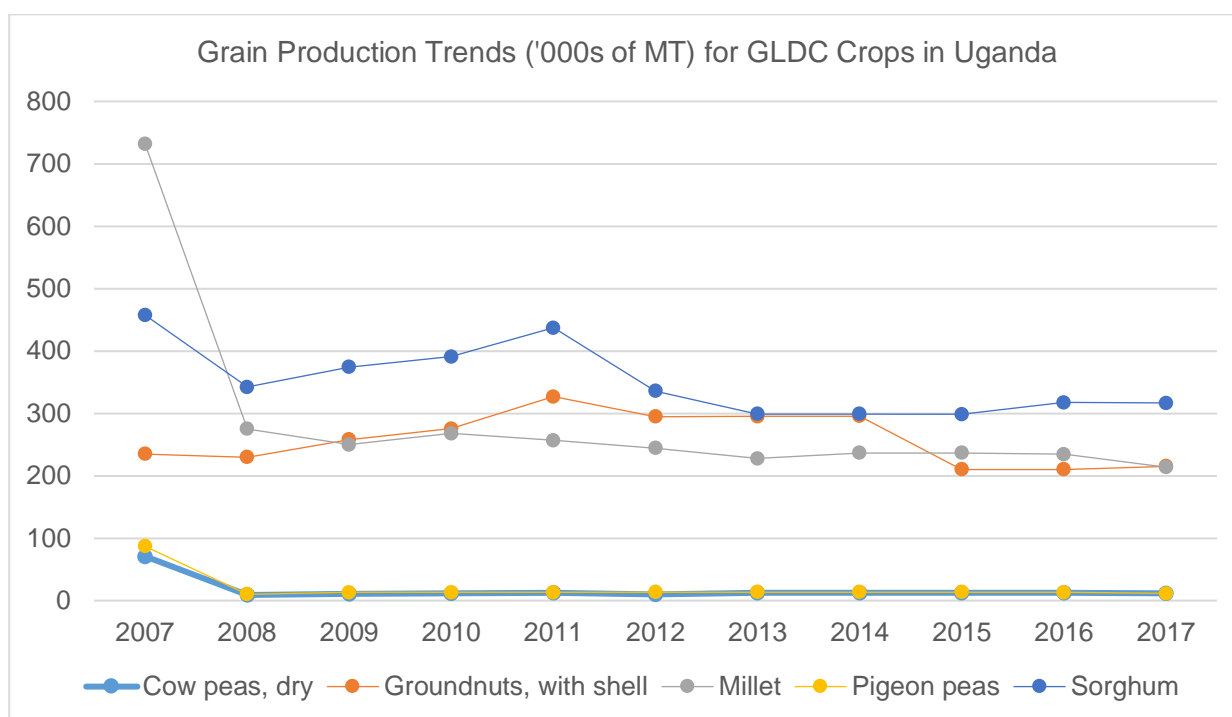
Table 1: Priority crops of the CGIAR Research Program on Grain Legumes and Dryland Cereals

Grain Legumes	Dryland Cereals
Chickpea	Sorghum
Groundnut	Pearl millet
Cowpea	Finger millet
Pigeon pea	
Lentils	
Soybean	

Globally, seed remains an essential element in crop production and represents a valuable resource for sustaining food and feed supply (Chauhan et al., 2016; Das et al., 2018). This implies that there is need to address the bottlenecks that inhibit availability, access and quality of the seed to smallholder farmers. Sustainable solutions can be developed with a clear understanding of the current bottlenecks. Through research, many instances of dysfunction in agro food systems have been revealed. Some of these include: i) inability to meet the annual demand for seeds (CTA, 2014); ii) limitations of the regulatory frameworks governing agriculture (Almekinders and Louwaars, 2002; MAAIF, 2012); iii) high prices and inappropriateness of hybrid varieties in aligning to farmer conditions for example how to link fertilizer complementarity with hybrids (Prasad et al., 2017; iv) level of inputs (and their cost) needed to drive greater adoption of improved varieties (Almekinders et al., 1994; Das et al., 2018) and v) release of only a few varieties that in turn fail to meet small farmers' needs (Prasad et al., 2017).

The case in Uganda is no different with farmers having to contend with sub-optimal quantity and unreliable quality of seed from distributors. This affects their adoption of improved crop varieties, consequently undermining productivity. While seed statistics are not readily available, in the past two decades, Uganda has recorded declines in grain production for the GLDC crops as seen in Figure 1.

Figure 1: Overall Grain Production Trends for GLDC Crops in Uganda, 2007-2017



Source: FAOSTAT, 2019 Accessed on 11-Jul-19

These declines could be attributed to a variety of challenges, i.e. weather variations, low adoption rates of high yielding improved varieties, poor seed quality, limited funding for breeding efforts, among others. Variations in weather patterns, i.e. drought and excessive rains played a major role in yield losses (GOU, 2007). In the context of Uganda, smallholder farmers are constrained to access improved seed varieties because of a poor network of agrodealers that sell quality seed, and because of the inability to buy seed. This makes farmers to rely on informal seed systems (local communities, weekly markets, and/or social networks). In practice, informal seed systems are less monitored/controlled by government policies and regulations and this is likely to compromise the quality of seed flowing through these informal sources.

1.2. Overview of GLDC Seed Systems in Sub-Saharan Africa

The development of any country's agricultural sector is dependent on a vibrant seed sector. In many sub-Saharan (SSA) countries, access to quality seed and adoption of improved varieties by farmers is still low (Shiferaw et al., 2008; Louwaars and De Boef, 2012; Orr, 2018). Like most SSA countries, Uganda's seed industry consists of formal and informal systems. Only South Africa has had a more sophisticated seed industry and has been a net exporter of seed to other African countries like Zambia, Mozambique, and Uganda (Kuhlmann, 2015; TASAI, 2018). For a long time, farmers in Uganda have relied on informal seed systems for their GLDC crops. Farmers mention their ability to get the seed when they want it, e.g. at no-cost and to plant at a time they please, reduced risk of losing a particular variety they love, or the generally cost prohibitive nature of seed from other outlets. This is however changing with the introduction of quality declared seed (QDS) in the formal seed systems. QDS is less costly, easily accessible within local boundaries and it is normally bundled with other inputs and information on agronomic practices and even with possible links to markets for both grain and seed.

1.3. Methodology

To prepare the literature review report, a matrix of key topics was created to organize the notes and information gathered from different pieces of literature. Key elements in GLDC seed systems and value chains were tracked and assessed. Background documents on seed systems with specific emphasis on GLDC in SSA and Asia were reviewed. Several online searches for grey literature and peer-reviewed articles were also conducted using various search terms. These included, but were not limited to: seed systems, seed system models, seed business cases, decision making, seed change, seed choice, variety change, variety choice, orphan crops, non-hybrid seeds, moral economy in seeds exchange, government programs in seed, community seed programs, women's role and youth in seed systems, seed value chain. In this study, the focus was on understanding the seed system dynamics and on finding opportunities for both women and youth in seed system development. Seed production data and statistics were gathered from applicable databases, analysed and results presented and discussed in this report. The literature review becomes a pre-contribution to the final report, and complements field data collected and reviewed.

1.4. Overview of GLDC Seed Systems in Uganda

1.4.1. Characterising the Ugandan Seed Systems

Uganda's GLDC sub-sector is characterized by two main seed systems, i.e. the formal and informal seed systems. These two distinct seed systems cut across most of the crops grown in the country and run alongside each other. The next sections highlight the situation.

1.4.1.1. *Formal Seed System*

The formal seed system in Uganda is responsible for production and marketing of improved, certified seed. This has been possible through a structured system of variety development, release, multiplication, quality control, distribution and marketing. However, this has been mostly true for maize hybrid varieties instead of GLDC crops – a common scenario in other developing countries (UNSP, 2015; ISSD Uganda, 2014). In principle, maize is the most commercialised crop in Uganda with both public and private varieties. This could imply that many investments went into commercialising its seed value chain. Nonetheless, it is important to note that different crops with distinct characteristics need different solutions to their seed systems. For GLDC, formal seed systems are still small, improved varieties are not effectively commercialised, and farmer access to quality seed is limited. Most of the GLDC seeds happen to be sourced locally within communities, own harvests (selected and stored) and even from local open-air markets where sometimes grain is sold as seed. The limited formal investment in GLDC seed systems is mainly due to low return on investment to the private sector given that farmers do not frequently replace their seed with new seed from the markets.

In Uganda, participation of both public and private sectors in the seed value chain is visible. Breeding activities are public sector-driven, and the private sector complements with seed multiplication and distribution to farmers. In terms of vibrancy, the private seed companies' participation in Uganda's seed value chain is still developing. Of more than 26 registered seed companies, less than a third regularly deal with GLDC crop seed. Annual production of seed (all crops) has been estimated at 18000MT (MAAIF, 2012; CTA, 2014) which is, conservatively estimated, less than 50% of the total seed demand in the country. This formal system is estimated to account for about **10-15%** of certified seed used for planting (UNSP, 2015; ISSD Uganda, 2014) of which **80%** is maize and about **5%** is of GLDC crops. Overall, this formal system has been constrained by policies limiting access to early generation seed (EGS), e.g. having one overall policy controlling EGS of all crops (a one-size-fits-all solution).

1.4.1.2. *Informal Seed System*

The informal seed system is what the formal system is not. In Uganda, this system has been uniquely defined based on its flexibility as it encompasses a wider range of seed system variations. It has been characterized by integrated and locally organized activities that allow farmers to produce, disseminate and access seed. The sources could be summarized as directly from own harvest, through farmer-farmer exchanges or bought in local grain markets (Naluwairo, 2006; UNSP, 2015). It is largely an unregulated seed production and distribution system (i.e. unregulated by government rules). Of all the seed planted in Uganda, up to 85% is attributed to the informal system (MAAIF, 2012), with an almost similar proportion of the total being of GLDC crops. For legumes and small-grain cereals, studies depicted over 75% dependence on farm

saved seed sources (Ayieko and Tschirley, 2006). Crop varieties in this system range from local or mixed (local and improved) varieties that have changed over time through (farmer) breeding and/or use.

Quality of seed has been found to be variable with reference to purity, physiological or physical qualities. This system embraces variety choice, testing, introduction, and dissemination albeit embedded in farmers' production systems rather than as discrete activities (Almekinders and Louwaars, 2002). Often, seed quality assurance and control mechanisms are informal (Munyi and De Jonge, 2015). In most cases, there is a very thin distinction between "seed" and "grain" in this system. Local technical knowledge, standards and social structures/norms offer the much-needed guidance in their functioning (Louwaars and De Boef, 2012).

There exists also a sub-category called community-based seed systems. These are characterized by associations of individuals in a group or a cooperative, and often operate through support of NGOs, Community Based Organizations (CBOs) or state agents. This segment undertakes entrepreneurial forms of seed multiplication and marketing that graduates them into a "semi-formal" state. In most cases, this system is an outcome of efforts to help farmers recover from stress (pests, disease, or drought). In Uganda, quality declared seed (QDS) production is moving fast from being semi-formal to formal and bridging the gap in seed access and availability. In addition, QDS is a means to strengthen farmer-based systems with improved varieties or seed quality enhancing techniques.

1.4.2. Highlights on Component of the Seed Systems

1.4.2.1. *Early Generation Seed sub-sector*

The development of any country's agricultural sector is dependent on the vibrancy of its seed sector. In many sub-Saharan countries, including Uganda, access to quality seed and the adoption of improved varieties by farmers is still low (Shiferaw et al., 2008; Louwaars and De Boef, 2012; Orr, 2018).

Five seed classes characterize the seed system in Uganda. These are breeder's seed, pre-basic seed, basic seed, certified seed and standard seed. This follows Uganda's adoption of the OECD³ seed scheme (Mubangizi, 2012; Joughin, 2014). Normally, the breeder's seed is the original nucleus seed that comes from the breeder who may be in the NARI or private seed company. The breeder or his /her agent under supervision then multiplies this into pre-basic seed. The National Seed Certification Service (NSCS) plays a regulatory role in the multiplication of pre-basic to basic seed. This seed is finally multiplied into certified seed, which can be of two or more generations, still under regulation by NSCS.

In Uganda, financial, technical, and institutional challenges have been recorded as hindrances to timely delivery of germplasm to both private sector and smallholder farmers. Unreliable funding streams still pose the greatest risk to the optimal functions of National Agricultural Research Institutes (NARIs), especially concerning EGS/pre-basic/breeder/foundation seed production (Mastenbroek and Ntare, 2016). The failure to meet their mandate due to finances has driven them towards a "mission creep," often in the name of business orientation to compensate for the budget shortfalls.

Local private companies have had difficulties accessing EGS of released improved varieties of crops valuable for improving food security situation in the country. However, efforts from multiple partners including CGIAR Centres have gone a long way in supplying means to address this problem (Orr, 2018). Reviewed literature depicts that an understanding of a country's value chain and market segments for seed becomes a first step in unlocking the business models of the NARIs in EGS (van den Broek et al., 2015; Mastenbroek and Ntare, 2016; Jelliffe et al., 2018). Similarly, strong public research and enabling government policies like in India could become the major drivers to the growth of Uganda's seed industry into dynamism and diversification (Manjunatha et al., 2013). Working down the chain with private sector players could guarantee a sound judgement of present and future seed demands hence correct projections.

³ The OECD Seed Schemes provide an international framework for seed certification with an aim of facilitating the seed trade by reducing technical barriers. This also includes the assurance of varietal purity and identity for international seed trade, and is normally used in conjunction with ISTA seed lot certificates, which also carry the results of other quality tests.

1.4.2.2. *Certified and Quality Declared Seed sub-sector*

Seed value chains begin with seed development and distribution. Both certified and quality declared seed (QDS) are outputs of early generation seed from the breeding programs of seed companies and/or research institutions. These two seed classes often attract different farmer segments especially given the varied cost and geographical spread. QDS costs less compared to certified seed while the former can be sold across the country compared to QDS, which is limited to the district of production.

Uganda's case is far from perfect. The literature points to a consistent lack of regularity in the local seed market. The liberalization of the Seed Act has come with a mixed basket of fortunes for the future market (Vernooy, 2017). The crop seed sector in Kenya, through the Seed Trade Association of Kenya, is undertaking its first study on the seed market, which will include seed sales and the different dissemination channels. The importance of this exercise is that it will add a new parameter to the data, i.e. how much of the certified seed is sold, and through what channels. Adoption of such an analysis by the Uganda Seed Trade Association could assist researchers and seed producers to develop market projections. In Bhutan, for example, access to enough seed by smallholder farmers is ensured through a network of government extension agents supplying seed along with agronomic information in demonstrations (Kobayashi et al., 2017). Having farmer cooperatives and/or groups dealing with QDS production has been a success story in Uganda, showing that a business model around it can exist (Kansiime and Mastenbroek, 2016; Otieno et al., 2017). Additionally, it seems to offer NARIs the required product differentiation within the chain. Important is to carry out a sound financial analysis, which helps find break even selling prices for the GLDC seed. This can also guide a differential pricing to encourage advance orders. The seed supply deficit of over 20000 MT should be bridged to enable meeting the national demand, and make an end to the widespread sales of fake seed (Vernooy, 2017).

1.4.2.3. *Grain market outlook*

Rural communities, the world over, rely on smallholder farming as a primary source for food and fibre (World Bank, 2007). Higher yield often results from the ready access to high quality seed, and good agronomic advice. The natural diffusion process is troubled by barriers that deter adoption of seed even when the agro-ecology is right. Without increased seed demand creation at farmers' level, grain markets local sustainability remains a dream as opposed to reality (Shiferaw et al., 2008). Literature consistently shows that new and available technologies must be complemented by a sufficient outreach and education for adoption to occur. This relies on pre-existing social networks (Conley and Udry, 2010; Cunguara and Darnhofer, 2011; Thuo et al., 2014), implying that any improved seed demand will often follow a robust output market system for grain (Shiferaw et al., 2008; De Boef et al., 2010; Orr, 2018). With entrepreneur's interest in agro-processing and value addition being heightened in these value chains, grain productivity (and GLDC seed adoption) is envisaged. This should be complemented with proper storage facilities especially during surplus seasons.

1.5. Structure, Stakeholder Roles and Linkages, Seed Policy and Regulatory Frameworks

1.5.1. Seed Systems Structure

Small to medium scale and privately-owned companies and a few multinationals make up the diverse landscape of Uganda's seed industry. The seed system is further characterized by five seed classes, i.e. breeder's seed, pre-basic seed, basic seed, certified seed, and standard seed⁴, according to the OECD seed scheme (Mubangizi, 2012; Joughin, 2014). Other actors include: NGOs, farmer organizations, cooperatives, input dealers, processors, financial institutions, and government agencies/officials (Louwaars and De Boef, 2012). The burden of adequate and nutritious food production for populations in sub Saharan Africa and South Asia can be made light with sustainable and well-functioning seed delivery systems. In Uganda, the burden of seed delivery has been on national agricultural research systems and public/private seed companies (Fisher et al., 2015). An agro-inputs dealers' network allows for seed distribution in local markets in the formal system that also includes seed trade in importation of seeds for the domestic market, and

⁴ Standard seed has not been grown under a certification program, but meets laboratory seed testing standards as certified seed; hence eligible for market entry whenever there's certified seed shortage.

export to regional markets. Integration of the main seed delivery systems: formal and informal (including semi-formal/ intermediate), offers hope (ISSD Uganda, 2014).

1.5.2. Stakeholder Roles and Linkages

In the development and promotion of a functional seed delivery system, attention to vertical and/or horizontal integration will help improve effectiveness. This comes with dedicated monitoring and evaluation (M&E), coordination of actors and allocation of responsibilities. A typical flow of roles based on the nature of Uganda's seed system is described in Table 2.

Table 2: Overview of Actors Responsible for Activities within a Seed Value Chain in Uganda

Point in Value Chain	Description	Type of Actors
Research and Development	Research and Development of germplasm with desirable farmer and market traits	Breeders in NARIs ⁵ and International Agricultural Research Centres ⁶ (IARCs) – PUBLIC
Variety Selection and Dissemination	Variety Evaluation using Participatory Approaches and Release	NARIs and IARCs - PUBLIC
Breeder Seed Production and Maintenance	Production of several generations of breeder seed from nucleus seed and Variety Maintenance	NARIs and IARCs (PUBLIC) Some <u>Multinational</u> and <u>National</u> seed companies that have <u>exclusive rights</u> of crops (especially maize hybrids) and varieties (PRIVATE) e.g. SeedCo, Equator, Otis, Victoria, Pearl, FICA, EA Seed
Foundation Seed Production	Production from Breeder Seed	Direct production – NARIs (Public) Direct production – NARIs with contract farmers (Public-Private) Seed companies (Private) Farmer cooperatives and local seed businesses (Public-Private)
Certified and Quality Declared Seed ⁷ Production	Production from Foundation Seed	Seed companies (Private) Farmer cooperatives and local seed businesses (Public-Private) Individual farmers and groups (Private)
Marketing and Distribution	Distribution through agro-dealer networks, farmer groups and local markets	Sales in open markets, agro-input dealers, seed/grain traders, seed exchange through local seed systems (seed fairs, social networks etc.) (Private)
Seed Quality Control and Certification	Variety Registration, Official Inspection and Certification	NSCS of MAAIF (Public)
Seed Trade	Facilitate Regional and Domestic Seed Trade	Uganda Seed Trade Association (USTA) composed of registered local seed companies (Private)
Seed Users/Uptake	Adoption of improved varieties and other agro inputs	Farmers (small, medium and large) (Private) Direct farmer-to-farmer diffusion (Private) Government distribution programme e.g. Operation Wealth Creation (Public)
Education, training and extension	A role with multiple players who ensure farmers know what to do with seed to post-harvest procedures	Seed companies, extension agents, farmers' organizations, NGOs, agro-dealers, USTA

⁵ NaSARRI, NaCRRRI

⁶ ICRISAT (groundnuts, sorghum, millet, pigeonpea), CIMMYT (maize, wheat), CIAT (beans), Bioversity International (millet)

⁷ QDS is a seed class recognized in Uganda's draft National Seed Policy of 2016. It needs minimum field inspection and certification standards for variety, purity and germination. It can only be sold in the area where it is produced.

Efforts that address extension, market and policy remain critical to facilitate seed adoption; and also link research and development (R&D) with seed producers through a continuous loop of information among stakeholders (Orr, 2018; Jelliffe et al., 2018). Robust appreciation of the roles played by both genders in seed delivery will go a long way in streamlining efforts by all stakeholders (CTA, 2014).

1.5.3. Seed Policy and Regulatory Frameworks

In Uganda, the Seed and Plants Act of 2006 has provisions for the establishment of a regulatory unit, i.e. the National Seed Certification Service (NSCS) within the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). MAAIF through NSCS ensures that quality of seed is always standardized and improved through the support of private and public sector stakeholders (MAAIF, 2012). The NSCS plays a regulatory role in the multiplication of pre-basic to basic seed. This seed is finally multiplied into certified seed, which can be of two or more generations, still under regulation by NSCS. The Draft National Seed Strategy of 2015 posits that the formal seed system has managed to contribute up to 15% of seed use in the country. The NSCS regulates the system - from variety listing through to final seed certification. The major players are public institutions (government, international and national research) and the private sector (seed companies, farmers' associations and cooperatives, NGOs, development agencies, community-based organisations, and farmers) as summarized in Table 3.

Table 3: Major Players in Uganda's Seed System with Examples

Major Players	Key Examples	Focus (Activities + Crops)
Government Institutions	NSCS, NAADS	Certification, Extension covering ALL CROPS
International Agricultural Research Centres	ICRISAT	Research, Breeding in Grain Legumes and Dryland Cereals
	CIAT	Beans, Cassava, Rice and Tropical Forages
	IITA	Research, Breeding in Cowpea, Soybean, Bananas and Plantain + Roots and Tuber Crops
	Bioversity International	Research, Breeding in Beans and Millets
National Research Entities	NaCRRI	Root Crops, Legumes, Cereals, Horticulture & Oil Palm
	NaSARRI	Grain Legumes and Dryland Cereals
	ZARDIs	Legumes, Cereals, Root Crops, Horticulture and Oil Palm
Seed Companies	Equator Seeds	Oil Seed, Cereals, Vegetables, Legumes and Seedlings
	NASECO	Cereals
	FICA Seed	Oil Seed, Cereals, Vegetables, Legumes and Seedlings
	SeedCo	Vegetables and Cereals
	Otis Garden Seed	Oil Seed, Cereals, Vegetables, Legumes and Seedlings
	Victoria Seed	Oil Seed, Cereals, Vegetables, Legumes and Seedlings
Non-Governmental Organizations	ISSD	ALL Crops, Extension
	World Vision	ALL Crops, Extension, Links to Markets
	Lutheran World Relief	ALL Crops, Extension, Links to Markets
	ZOA	ALL Crops, Extension, Links to Markets
	World Food Program	ALL Crops, Extension, Bulk Purchases
	Food and Agriculture Organization	ALL Crops, Extension, Bulk Purchases
	Action Against Hunger	ALL Crops, Extension, Bulk Purchases

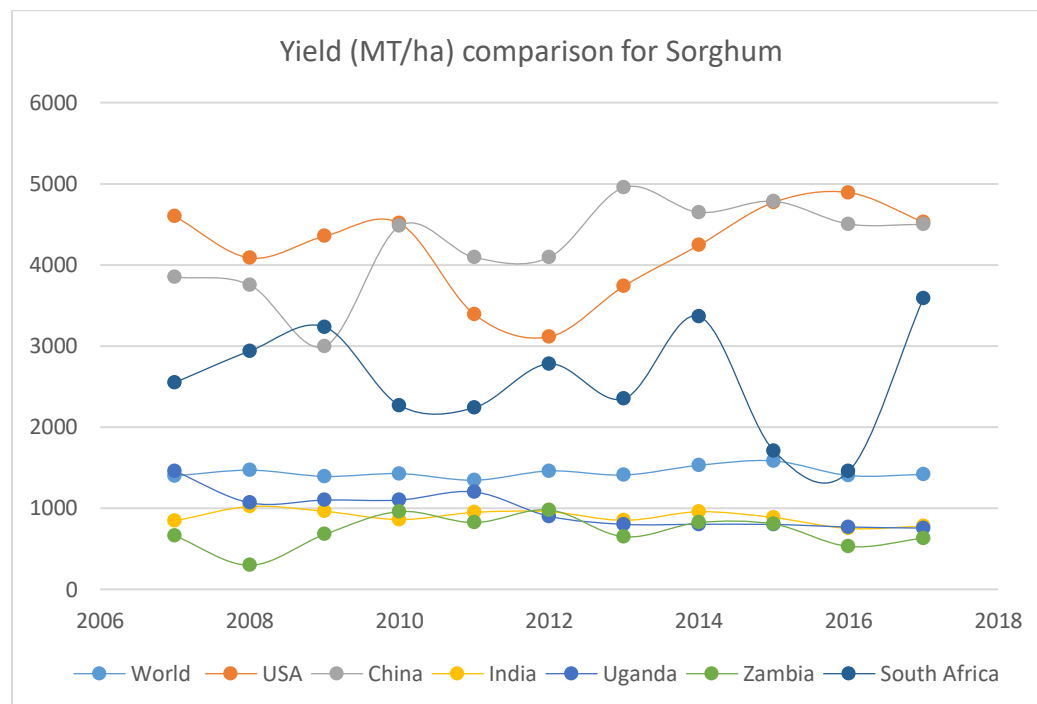
Source: Author compilation based on literature and interviews

1.6. Selected Cases: Sorghum and Groundnuts

1.6.1. Sorghum

The common types of sorghum grown in Uganda are red, white/cream or brown; they are dominant based on marketability or subsistence (Apunyo et al., 2016). Being a multipurpose crop, sorghum offers communities the opportunity for diversified market. More than 35% of it is grown directly for home consumption with the rest finding itself on feed trays as animal feed, for use by breweries and for other industrial products like starch and malt products (Kigozi et al., 2011). To date, nine sorghum varieties (all OPV) have been released in Uganda (AIPU, 2018). Sorghum yields have been low in Uganda compared to other countries (FAOSTAT, 2018). Zambia and South Africa had lower and higher yields respectively in the year 2016 (Fig. 2).

Figure 2: Sorghum yield comparison for Uganda, selected countries and World, 2007-2017



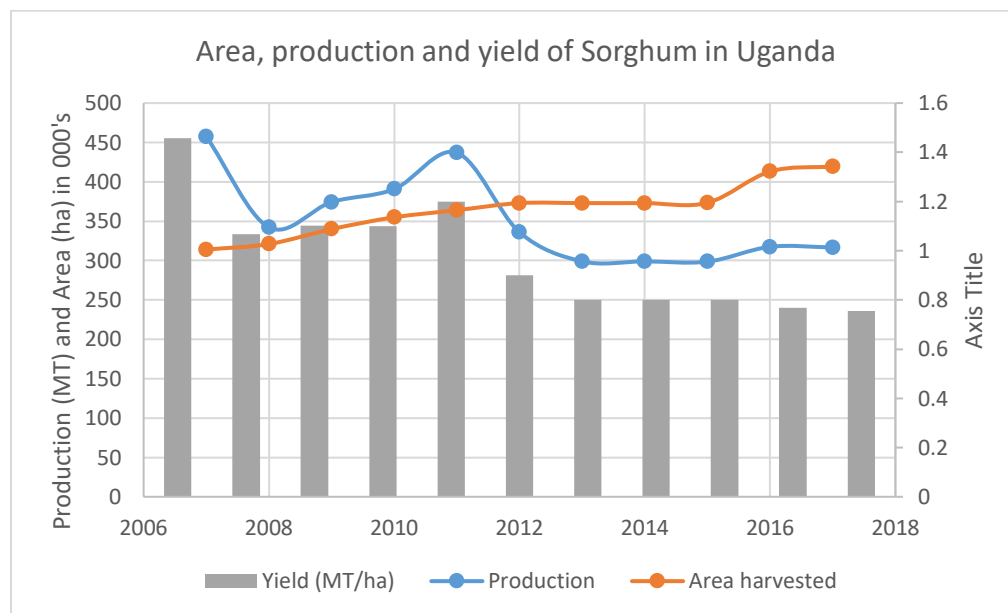
Source: FAOSTAT, 2019 (Accessed on 12-Jul-19)

Sorghum grain yields have been low because of low soil fertility coupled with limited fertilizer use (Figure 3). Other yield-limiting constraints include soil water deficits, the stem borer complex, Striga species, and N deficiency (Wortmann et al., 2009). All these can be corrected with better information flow and partnerships between researchers, farmers, and extension personnel. Kraybill et al., 2012 recorded that agro-inputs enabled yield increments per acre especially when bundled with education and agricultural knowledge of farmers. Structured systems will allow for better market functions and agribusiness demand projections. UBOS 2016 reported that since large amounts of sorghum were sold at informal markets, only 14.3% of produce reached the formal market. Among others, this reduced the targeted amount for purchase of sorghum by Nile Breweries Limited.

Where farmers have practiced collective marketing, there has been great impetus for large scale investments by traders and processors (Nangobi and Mogonola, 2018). While it is a staple crop for a large segment of the population, it also serves as a key substrate base for the locally processed traditional foods and brewed beers (Gierend et al., 2014). New cultivars, as shown by pre-releases in

participatory varietal selection, will go a long way in improving productivity (Awori et al., 2015). However, there needs to be a targeted value chain streamlined all the way to farmers to make effective use of these varieties. This could tilt the scales of increased production due to crop yield enhancing genetics as opposed to area planted (Fig. 3).

Figure 3: Area, production and yield of sorghum in Uganda, 2007-2017

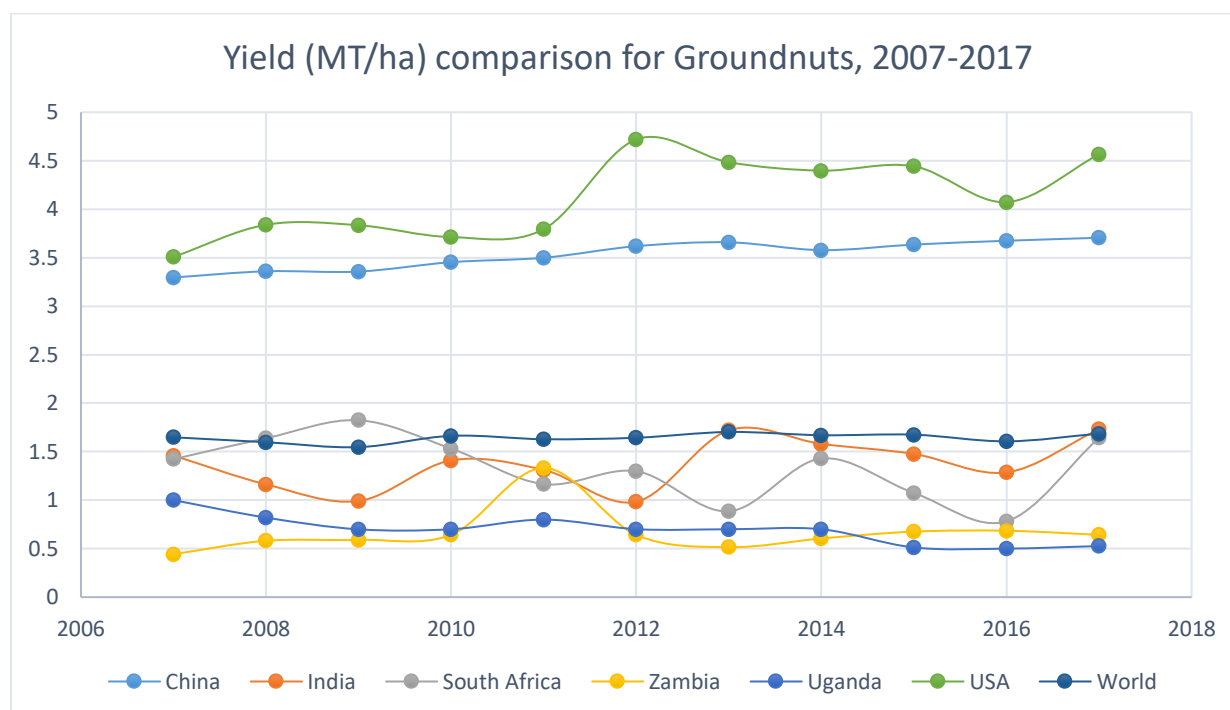


Source: FAOSTAT, 2019 (Accessed on 12-Jul-19)

1.6.2. Groundnuts

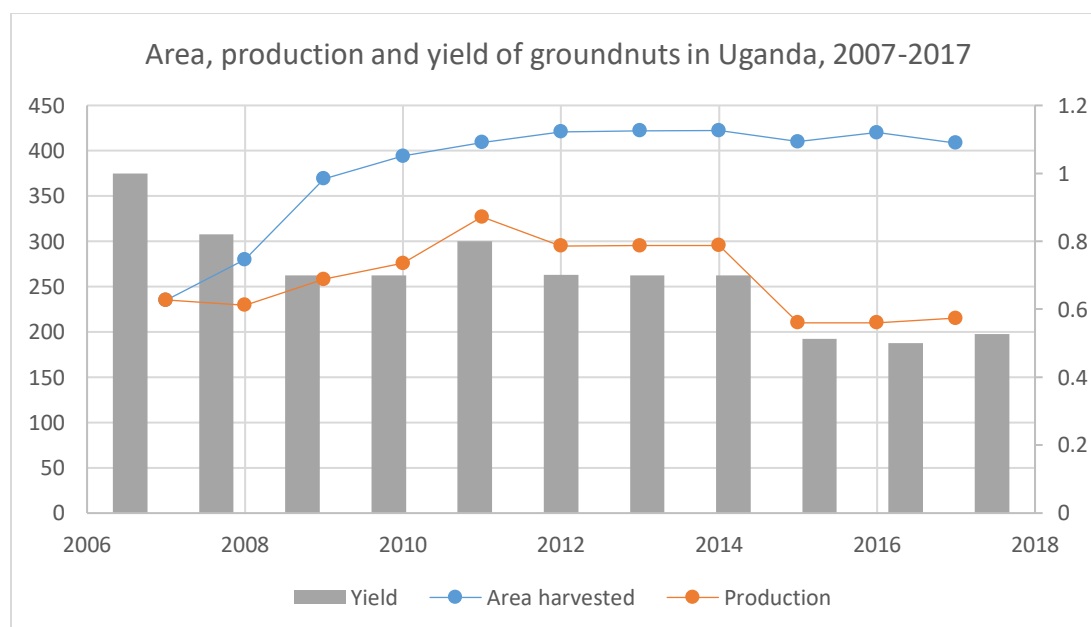
Groundnut is a major, and second most important, pulse crop in Uganda (Kabeere and Wulff, 2008; Okello et al., 2010) and ranks 11th in production and 6th for area harvested in 2013 and 2014 (FAOSTAT, 2018). Smallholder farmers usually grow groundnuts for food and cash income as well as animal feed (Ebanyat, 2009; Kassie et al., 2011). Like most legumes in Uganda, most groundnuts are grown by women farmers (Okello et al., 2014). Compared to selected countries in the world, groundnut productivity in Uganda is still low (Fig. 4).

Figure 4: Trends in groundnut productivity in Uganda, selected countries and World, 2007-2017



Groundnut production in Uganda has been low and the observed marginal increase could be attributed to an increase in area planted rather than productivity improvement (FAOSTAT, 2019).

Figure 5: Area, production, and yield of groundnuts in Uganda, 2007-2017



Source: FAOSTAT, 2019 (Accessed on 12-Jul-19)

In the 2000's, there was a steady growth in area harvested and production accompanied by high yields as the main driver (Fig 5). This has since been on a low in subsequent years. Major constraints to groundnut

production include pests, diseases, lack of improved varieties, credit, and information on both; and droughts (Kassie et al., 2011; Okello et al., 2014). Elevated levels of aflatoxins have had a negative impact on the suitability of groundnuts for both regional and international markets (Kaaya et al., 2006; NARL, 2012). Training on post-harvest handling will help improve farmer care on produce and better premiums at markets. More information on and access to inoculants could also help drive yields. A yield increase has been reported in earlier studies with the inoculation of groundnuts and use of rock phosphates (Nkwiine and Rwakaikara-Silver, 2007; Ebanyat, 2009). Establishment of community seed banks can form part of a key step in addressing shortfalls in seed supply especially when community-based seed multiplication groups are linked to markets and research institutes (Vernooy, 2017; Orr, 2018).

1.7. Opportunities, Constraints and Critical Gaps in Uganda's Seed Systems

1.7.1. Regional Integration

Harmonization of regional seed policies aims at improving the movement of seed across borders so that farmers can get access to improved germplasm for enhanced crop productivity. To create more opportunities, a focus on addressing the low capacity among regulatory agencies, inspectors, and other stakeholders is needed (Seed and Plant Variety Regulations, 2016). This has a long-term effect on being able to effectively oversee regional seed trade on one part but also address local seed demand *viz* quality inspection and certification. A National Seed Policy has been developed that offers a more formal framework upon which the seed industry could evolve in line with the Government of Uganda's objective on wealth creation; and also, into an export oriented seed sector targeting local and regional markets in the EAC and COMESA (UNSP, 2015).

Three key programs/regional economic communities (RECs) were identified from the literature as active in regional integration issues. These are COMESA/ACTESA, EAC and ASARECA. Apart from dealing to some degree with the constraints specific to seed systems, these entities are seen to pull towards addressing trade concerns. High transport costs, for example, make it difficult to access regional markets, and higher fertilizer prices compared to other developing countries drive up the cost of seed production (World Bank, 2012). The development of the QDS market bodes well for the overall demand of certified seed in the region, as it increases farmers' appreciation for quality seed.

1.7.2. Women and Youth

Men and women play distinct roles in any agroecosystem (Carr, 2008); women contribute an average of 43% of the agricultural labour force in developing countries (Doss, 2014). Seed value chains, like other value chains, form of a set of linked actors/activities aiming for a broader objective, i.e. production, delivery and consumption. Segments in any value chain can be affected positively or negatively based on value chain structures (Mayanja et al., 2016). Multiple barriers have been found to sometimes curtail active participation and benefits for specific segments, such as youth and women (Devaux et al., 2016). Women farmers, for example, control less land than men, and have limited access to inputs, seeds, credits, and extension services. Without a detailed assessment of the value chain, these vulnerable groups can easily be overlooked or neglected (Carr, 2008; Haggblade et al., 2012).

Women have been involved in grain production and storage within households, although their attendance in most of the trainings on good agronomic practices is male-dominated. Increasing gender inclusion in the seed value chain thus calls for proper use of quantitative tools that let gender-related questions be assessed. This comes with an identification of the imbalances and design of proper components and/or interventions (Carr, 2008; Mayanja et al., 2016). A consistent challenge with regard to contract farming for seed or grain is the proper administration of payments upon completion of a crop cycle. In most cases, money would be paid to men as opposed to women. But the latter are technically engaged in the process from production to post-harvest handling (Balya, 2006).

1.7.3. Emerging issues

The success in delivery of seeds to Uganda’s farmers will depend on the use of complementary opportunities and comparative advantages offered by various seed systems. A well-organized value chain could function optimally and drive innovation (Hellin and Meijer, 2006; Kaganzi et al., 2009). Most of the challenges reported in seed access are partly due to disengaged seed value chains starting from EGS production, but also in distribution. High yield gaps and crop use at different agro-ecologies could be an effective way to guide design of interventions. This will ensure that strategies to address limited access to markets, high post-harvest losses and limited lending to the sector, are incorporated.

In Uganda, the key bottlenecks that hamper seed sector growth are related to a disconnect between seed demand from farmers and production of required volumes, the lack of diverse and good quality varieties as well as limited quality assurance mechanisms (TASAI, 2015). This has denied farmers the tangible benefits of adopting quality seed. Looking to yield of the target GLDC crops, considerable work still needs to go towards more effective delivery and adoption to help match or surpass world averages (Table 4).

Table 4: Grain legumes and Dryland Cereals in Uganda compared to World average (2016)

GLDC Crop	Production (MT)	Area Harvested (ha)	Yield (MT/ha)	Potential Yield (MT/ha)*	World Yield Average (MT/ha)
Chickpea	5,085	8,313	0.6117	2.5	0.956
Cowpea	12,928	26,354	0.4906	3	0.5676
Groundnuts	210,000	420,000	0.5	3	1.5901
Millet (Pearl + Finger)	234,298	167,261	1.4008	3.5	0.8944
Pigeon pea	13,047	34,173	0.3818	2.2	0.8299
Sorghum	314,553	398,050	0.7902	5	1.4279
Soybean	152,091	121,040	1.2565	2.5	2.7556

Source: FAOSTAT, 2018 (Accessed on 12-Jul-18)

With better linkages in the seed value chains among actors, especially in variety development and distribution, there is hope for enhanced productivity.

CHAPTER 2: FIELD RESEARCH SUMMARY

2.1. Introduction

2.1.1. Background

Grain legumes and dryland cereals play a crucial role in food, nutrition and income security among households in Uganda. However, production of these crops has been faced with several constraints, including limited access to quality seed of improved varieties, knowledge disparity among industry players and unfavourable output markets. Farmers depend more on own saved seed and markets as sources of seed for these crops. The formal system is not well developed especially in moving the certified seed of these crops through distribution networks.

More recently, there has been a drive to adopt a new class of seed called quality declared seed (QDS). This seed class offers farmers higher quality of seed at slightly lower cost and ease of access (TASAI Uganda, 2018). Mostly driven through local seed businesses in a given district, farmers' benefits also include farmer-to-farmer extension and access to demonstration farms.

In Africa, crop yields have either remained stagnant or have marginally risen compared to other parts of the world with similar agro-ecologies (Tittonell and Giller, 2013). While area planted to these crops has been increasing, production volumes for grain have been on a relative decline. The same trend has been observed in yields except for millet, which has remained relatively stable (Appendix 2: Fig. 2, 3 and 1). Reasons for low yields for these crops in Uganda may be four-fold: continuous cropping without crop rotation or external inputs resulting in soil fertility decline; high dependence on rainfall for production with limited to no irrigation capacity; limited access to seed of improved varieties in highest quality; and poor extension network for guiding good agronomic practices and technology adoption.

The next chapters of this synthesis report will present the field research results and propose recommendations to make the seed system of the GLDC crops more sustainable.

2.1.2. Study Objectives

The overall goal of the seed systems consultancy was to “review the status of seed value chains of CGIAR Research Program Grain Legumes and Dryland Cereals target crops in Uganda”. In this in-depth review, attention was given to the current status of structure, conduct and performance of the seed systems. Ultimately, this would provide insights and practical recommendations into the critical bottlenecks along the value chain as well as answer the question “what would make GLDC seed value chains sustainable?”

The specific objectives of the assessment were to:

1. Review models currently deployed in seed delivery of GLDC crops in East Africa and compare them with those used in the rest of the world, in similar geographies
2. Review the grain market outlook for the ‘GLDC grain’ in East Africa focusing on what happens to the GLDC grain once it leaves the farm
3. Review the Early Generation Seed (Breeder, Foundation) sub-sector for GLDC Crops in East Africa including its financing
4. Review of the Certified and QDS sub-sector for GLDC Crops in East Africa
5. Review of the improved GLDC seed delivery mechanism in East Africa highlighting the governing policies, structure and conduct
6. Review the status of opportunities in regional integration for GLDC seed value chains focusing on unique opportunities that can be targeted to the youth and women

2.1.3. Study Methodology and Outcomes

The study involved three phases, namely: 1) literature review 2) field work and data synthesis; and 3) review and production of the final assessment report. This assessment focused on 4 districts (see map)⁸ in Uganda. These districts were selected because they i) represent a significant volume of the current GLDC crops grain trade and seed flow including production; ii) embody great potential with which GLDC crops and seed can be scaled; and iii) somewhat share common agro-ecologies, which allowed for interviews with mixed and specialized producers and other actors.

Groundnut, sorghum, millets, soybean, cowpea and pigeonpea were selected as focus crops for the assessment not only based on their high potential in bolstering food and nutrition security, but also given their unique seed dissemination models. There are several improved varieties of these crops that have been released in Uganda, but farmers still have limited access to them.

Alongside a literature review, key informant interviews were deemed the most appropriate data collection approach due to the specialized nature of seed production, certification, and trade. A second reason was to capture the dynamics in the entire grain trading process. General and specific information was collected from stakeholders in different types of questionnaires. These included i) Focused Group Discussion questionnaires mainly for the seed producer groups and grain aggregators; ii) Seed company, National Research Organization and agrodealer questionnaires; iii) Lead farmer and Community representative questionnaires; iv) Grain and Seed Trader questionnaires; and v) NGO and Special Programs (see Annexes for details).

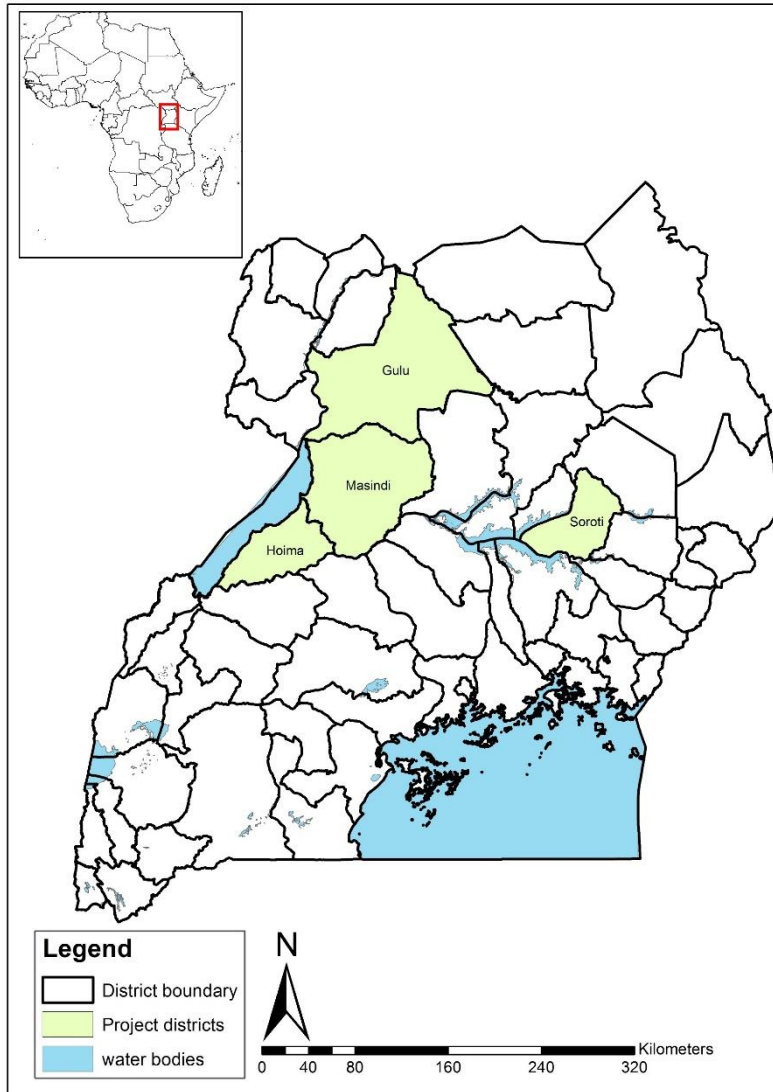
A combination of content analysis and descriptive statistics were used to analyse the interviews for common themes across open-ended questions and yes/no questions. **109** key informant interviews were conducted between September 2 – October 1, 2018 with **12** public sector officials (regulators, breeders), **38** private sector representatives (seed companies, traders, processors, agrodealers), **2** subject matter experts, **11** development partner officials, **33** lead farmers, and **13** focus group discussions (Table 5).

Table 5: Selection of Sample Sites and Number of Respondents in Uganda

Respondents	Sampled sites*					TOTAL
	Kampala	HOI/MAS	Gulu	Lira	SOR/SER	
Traders	0	10	2	3	5	20
Seed companies	4	0	0	1	0	5
Agrodealers	0	1	2	3	3	9
Processors	0	1	1	0	2	4
Government staff incl. breeders	2	5	0	1	4	12
Lead farmers	0	5	7	9	12	33
NGOs, special programs	6	4	2	1	0	13
Focus group - SPGs, GAGs	0	2	3	4	4	13
Total	12	28	17	22	30	109
Note:						
*Sampled sites is herein used broadly to refer locations where interviews were undertaken and do will vary by respondent type						
**HOI/MAS – Hoima/Masindi; SOR/SER – Soroti/Serere; SPGs - Seed producer groups, GAGs - Grain aggregation groups						

⁸ Wakiso. Hoima. Masindi. Gulu. Nwoya. Lira. Agago. Serere. Soroti

Figure 6: Districts from where respondents were drawn in Uganda Map of sites - Further interpretation and analysis is provided in the subsequent chapters.



CHAPTER 3: SEED DELIVERY MODELS

Seed of GLDC crops is delivered in a mix of models across Africa and the world. From the traditional farm saved seed, exchanges between friends and family and purchase at local markets to semi-formal QDS systems and special programs by government and/or NGOs; and the mostly less developed (in terms of reach, access and affordability) formal system of agrodealer distribution networks or direct seed company sales. In Uganda, and for all GLDC crops of focus, farmers cited farm saved seed as the most reliable source and increasingly the QDS system as the best option to access new varieties. Both of these were preferred as they were easy to monitor closely; a second reason was that it is easy to visit the local seed businesses⁹ (LSBs) should there be concerns. The agrodealer distribution system was often maize and vegetable seed oriented with occasional sales of soybean and sorghum seed.

LSBs are in essence group driven and structured within a clearly defined operational framework. The benefits with this arrangement include: i) group trainings; ii) ready access to new material from research entities and iii) ability to bundle other technical services like extension or access to credit. Trainings in LSBs were often offered by NGOs, the Ministry of Agriculture through extension personnel and NARO through their crop specific breeders. The groundnuts seed value chain was one explicit example of a hands-on approach to demand-led breeding, training and linkages to markets. The best crop/seed product was sorghum and groundnuts, both in the East and North with millet (and beans) being preferred in the West. These were considered important for food and income in cultural context and for output markets respectively. There were loosely defined partnerships characterizing the role of the private sector, development partners and government in extension and other farmer activities. The role of agriculture extension in improved farm productivity cannot be overemphasized. Capacities of farmers to embrace modern technologies (including improved varieties) rest on regular awareness. This has been shown as a portent enough impetus for farmers to move towards commercial agriculture from subsistence farming.

In this study, it became also evident that more synergy was desired to ensure better value per dollar invested. All of the 13 NGOs interviewed rated partnerships and good will as a key factor in success of their seed program interventions. While some companies were actively engaging farmers in seed production for the GLDC crops – more could be done. LSBs' model proved a good way to generate a pull mechanism with spill-over effects; and targeted training at group level by all partners. When entities partner proactively to design low cost solutions for the seed industry, farmers will be able to enjoy the good materials developed by breeding institutions. The presence of both humanitarian and development agencies in some of the GLDC crop production hubs could help drive adoption rates further within a market systems development approach. Nevertheless, most of the respondents cited having received a new variety through a special program at one time in the past. This, however, was only project based without links to either a regular seed source like agrodealer, seed company or LSB. Another problem mentioned by NGOs points to “*working in silos*” especially in their livelihoods and resilience programs that deal with seed. The lack of collaboration hampers integrated seed sector development.

Researchers felt they were delivering the right seeds, but farmers tended to stick to their own farm saved seed and could not get replacement for varieties at hand. A major issue, thus, is getting quality seed from a reputable source to ensure repeat buying. Having burnt their fingers before from purchases made at agrodealer outlets or van sales in markets, farmers felt less inclined to go the formal system route. What the QDS system has offered is a ready follow up and recourse mechanism in terms of farmers' close proximity to seed production fields and sales premises. Farmers felt that the quality of seed from companies could not be fully trusted, but had potential to be the best with comprehensive regulation.

⁹ Local seed businesses are basically farmer groups set out to produce/multiply seed through linkages with breeding institutions and regulation by the Ministry for quality assurance.

Breeders have had in place quality assurance mechanisms for EGS production, but with strained staff capacity could not at all times guarantee 100% quality.

Distortion risk was observed with government or NGO special programs specialized in exclusive seed purchases from the seed companies. This has made it less profitable for the agrodealers who are mostly bypassed and not allowed to join in the bidding. In the regulations currently under discussion at the Ministry level, QDS has been touted as “seed close to the farmer”. This has a bearing on how much seed of improved varieties could be effortlessly adopted, in a localized ecologies and at lower cost. Furthermore, QDS creates a new centre of influence for certified seed of GLDC crops.

The growth of the formal seed system is dependent on an integration of stable semi-formal and informal systems to offer complementary messages on need for good seed. Integration will stimulate ease of access to seed, affordability and guaranteed quality. Farmers are in need of stable seed delivery systems that guarantee quality, choices and a recourse mechanism. While the QDS system strives to address some of these, there is much to be done to ensure pricing strategies are not prohibitive to smallholders. To demonstrate that seed suppliers have the interests of the farmers at heart, packaging needs to be done in a way that drives affordability. Practical examples include having up to 100 grams of GLDC crop seed sold with a goal of giving farmers a chance to trial out an improved variety. This was, however, not evident throughout the study, but had been thought through and implemented by some seed companies, government programs and special NGO programs.

CHAPTER 4: GRAIN MARKET OUTLOOK

The fate of grain legumes and dryland cereals is dependent upon the scale of produce and intended use, i.e. if for subsistence or for sale to markets and aggregation centres. Generally, upon harvest, grain is dried, threshed, winnowed and sorted before bagging. Subject to farmer circumstances e.g. in a group or as a lone seller, deliveries are made to markets and grain aggregation centres respectively. In Uganda's seed system, output markets appear to be a key business driver even for the underrepresented GLDC crops. These markets or off taker systems were mentioned as a great immediate need for the respondents interviewed in this study. They felt that adoption of an improved variety could be better complemented by a ready market for the produce. This was exemplified when answering a question on "*why is this variety preferred?*" in which **98%** of respondents said, "*it fetches a premium in the market*".

GLDC grain markets are potentially very large, but in practice, they remain limited when assessed through the lens of how much is delivered from farms. Uganda is indeed one of the top producers of most of the GLDC crops and exports of these play a critical role in its economy. There is a distinctive desire by farmers and traders to have functional output markets responsive to their needs. Respondents could handle orders based on location, i.e. local or regional (Kampala, South Sudan, Rwanda and Kenya) as determined by customer and crop type. From seed planted by farmers to bulked grain by traders, there exists a knowledge gap on quality control. Presently, the organized marketing through groups allowed grain quality to be standardized before delivery of consignments. The need for upfront systems that promote varieties was extensively mentioned, and covered most food security crops. Farmers felt that while they were engaging to feed their families, they could bolster their economic situation by using improved and high yielding varieties. They expressly stated their desire for markets with better produce prices, availability of small seed packs, grain storage facilities at aggregation centres in villages and payment of seed growers on time.

Grain aggregation as a practice was dictated by local group/cooperative by-laws and buyer preferences. For example, when a large institutional buyer like FAO or WFP sought supply, specific standards for quality were employed. These were mostly implemented according to the by-laws to ensure a win-win situation. Groups were clustered based on parishes and then specialized in crops where there was a comparative advantage. A challenge of storage often affected optimal performance of these entities. A myriad of challenges faced by grain traders and (to some degree) aggregation groups were recorded. These included: limited access to capital and/or credit, price fluctuations due to weather or other market forces, low quality grain from farmers e.g. weevil infested, high moisture content, mixed varieties and debris; high market rates by government and transport costs eating into margins, and risk of under supply especially when produce from fields is not desired by market. Paying lower for low quality seemed like a universally accepted method for traders queried.

The village savings and credit groups appeared a competitive source of financing for the traders compared to other formal microfinance institutions. While premiums were not often paid to farmers for grain delivered, special circumstances like high demand for a variety of GLDC crop prompted additional bonus to quantities supplied.

CHAPTER 5: EARLY GENERATION SEED

For the majority of the crops, foundation seed replacement was annual, but access to it was always cost prohibitive. Feedback from breeding institutions on challenges faced in Early Generation Seed (EGS) production included i) low levels of funding for the activities ii) lack of demand forecasting capacity as prospective buyers miss to give timely pre-orders; and iii) limited land with irrigation infrastructure and capacity for year-round production. Local seed businesses mentioned high cost of foundation seed as a challenge to farmers' access of great source material from research institutions. This, at times, was complicated by limited quantities, lack of timely access and low quality, as also consistently highlighted in the literature.

NaSARRI generally lacked ability to run and maintain a comprehensive program compared to NaCRRI, both technically and financially. This could be due to number of active donors and their financial support complementing the little funds from central government; and constrained staff numbers. It was also difficult to produce up-to-date financials on the profitability of the EGS business even though there was a consistent cry that monies remitted from sales went to a central pool and were only occasionally ploughed back to breeding efforts. Proper market information systems were lacking based on respondents' opinions. These were in part the main reasons for limited demand forecasts, apart from inefficiencies witnessed in synchronizing seed production with markets.

Foundation seed production in itself is a tedious process that is capital intensive. Breeders and subject matter experts consulted cited an increasingly difficult operational environment from variety maintenance to development. There was an overly dependence on external donors through project calls since central government funding was barely enough to cover staff costs. There is need therefore for coherent policies that speak globally to investors. A processor and a large seed trader mentioned their frustration in mapping out a value chain to produce what they need locally and regionally for their clients. Having them work in synergy with breeding institutions will enable development of varieties that address investor needs. Further, the cost transfer to smallholder farmers was a deterrent to rapid adoption leading to consistent dependence of farm saved seed throughout the seasons.

Despite all the challenges, most of the LSBs interviewed were confident that they could deliver within their targets by adopting a "seed box" savings model. This worked by encouraging group members to save and allow making pre-orders with breeders well in advance possible. In some instances, the breeder was paid after seed sales. This is known as the concept "foundation seed on credit". Without adequate understanding of customer preferences, it will be difficult to drive demand of improved seed of GLDC crops. This is because operations beyond the breeding facility are dependent on widely adapted, but market/farmer-preferred varieties.

An opportunity for NaSARRI seems to lie within organized local seed businesses especially with the QDS regulations (now enacted) and seed companies given better terms and flexibility in licensing. LSBs are equally investing in demand creation at grassroots level and have continually learned the art of prebooking EGS. This partnership could be explored and scaled in a way that drives demand for grain at the farthest end of the chain and quality seed at LSB-NaSARRI level. The move towards a multi-stakeholder platform will also guarantee better matching of supply and demand of specific varieties. Here, the digitization of information, group training, participatory farmer evaluations and linkages to input/output markets will occur. Common practice is that when seed is highly profitable and generates significant and stable demand, involvement and investments by the private sector in EGS will follow. An example is the creation of demand for *Epurpur* sorghum through Nile Breweries to make a low cost beer.

There is need for synergy among seed related projects aimed at developing more robust value chains. In this systemic adjustment, duplication of efforts will be minimized and better integration of seed systems will be realized. Strategic programming, emerging trends and implementation of policies play a critical role in defining farmers' field and household productivity. With an understanding of the seed needs at the smallholder level, and across industry stakeholders, it will be easy to design interventions that are sound and sustainable. As a focus, NaSARRI should relook at their strategies of sustainable seed production and demand creation. This will enable them establish a more robust working relationship with value chain actors, build market skills for seed producers and create an environment to try out new varieties. The renewed interest by NARO Holdings to venture in certified seed production of GLDC crops is welcome. However, there needs to be a line drawn on the key mandate of EGS production. There is also a challenge of adequate land (with irrigation infrastructure) for seed production. This concerns government research entities, local seed businesses and seed companies.

CHAPTER 6: CERTIFIED AND QUALITY DECLARED SEED

Agriculture development in Uganda currently enjoys a level of optimism drawn from growth of “market-oriented” agriculture. This was visible in the horticulture and field crops agribusiness drives. Sorghum, for example, has grown to be an income generator getting households the much-needed income from farming. Farmers’ demand for improved varieties of GLDC crop seed is high and increasing, but easily eroded by the limited access to quality seed of improved varieties. Farmers often know what variety is good for them after they witness its productivity and resilience on farm; and its post-harvest condition for home consumption or sale in markets. In this study, evidence of increasing demand for improved varieties, but low access to them was documented. There was a general fear in depending on the formal system for the improved varieties. This leads farmers to keep a large proportion of farm saved seed for the GLDC crops. However, local seed businesses were seen to play a pivotal role of filling in the gap in quality, timely supply and affordable cost of seed, thus helping in partly meeting the demand.

Crosscutting issues recorded in the field for both subsectors ranged from lack of access to quality seed, limited to no agronomic information and credit; and over regulation of the seed industry. The presence of institutional buyers, mainly relief agencies and government, has also led to huge procurements of some of the certified seed from seed companies. This poses a risk in terms of sustainability as seed companies are tempted to serve these markets instead of smallholder farmers. Community seed banks presented an opportunity for conserving genetic diversity especially of beans and millets. Existing national legislation on seed is shifting the landscape for both the seed classes available to farmers and the way certification of seed will be structured. LSBs are one such addition, that ensure QDS can be produced within a locality and sold to farmers having met set standards, thus driving integration of seed systems. All of these changes have been set against a promising growth of the seed industry, opportunities for regional integration and desire for food, income and household food security.

Breeder seed is normally sourced from NaSARRI to produce certified seed and maintenance breeding undertaken whenever low volumes were anticipated. Production costs for certified seed were relatively higher than those of QDS given the extra regulation and value addition activities involved. Mark up to production cost was made after payments to out-growers whose management was found to be tedious. The main reason for this was added costs of the regular trainings on seed production and maintenance. Similar to the maize seed system, which is mostly formal, there were significant weak links cited, i.e. seed quality assurance systems and certification; and lack of “cheap” fiscal amenities to back investments. This subsector was largely private sector driven, but a government entity expressly stated its strategic move to target sales of certified seed of GLDC crops that private companies were less interested in, in addition to producing EGS for other crops. Companies interviewed preferred certified seed sales on pre-orders for the GLDC crops and applied for loans or overdrafts to supplement cash flow on a needs basis. Packaging for seed companies had a bearing on their market penetration strategies, especially for millet and sorghum that were sold in packets of ≤ 2 kilograms.

Currently, the QDS seed class is being discussed at the ministry level having been recognized in Uganda’s draft National Seed Policy of 2016. This presents a ray of hope for alternatives to both certified seed and seed from informal sources. Most of the local seed businesses interviewed presented profitability scenarios that looked positive and did justify their activities. The crops dealt with include sorghum, beans, cowpeas, sesame, millet, pigeon pea and groundnuts. A major thrust to this semi-formal system aside from the regulations is the fact that there are entities involved in capacity building and building market linkages. This in itself ensures sustainability and promotes a culture that embeds professionalism in all activities.

Farmer organizations by far remain a fundamental unit to wellbeing of smallholders. In this study, it was observed that those farmers organized in groups had lower transaction costs when obtaining new agricultural information, adopting new technologies or accessing input and output markets. Most of the groups expressed satisfaction in customers making purchases at their stores as opposed to deliveries to them. Major hurdles cited in the production of this seed class are i) the restrictive nature for sale, i.e. it cannot be sold beyond its production district and ii) timeliness and access of quality and sufficient volumes of EGS from breeding institutions.

Overall, more partnerships between stakeholders, i.e. NaSARRI, farmers, international research organizations, cooperatives and NGOs is needed. Activities will range from provision of technical services to farmers by scientists, supporting strong links to agro-based industries and encouraging technology dissemination in rural areas.

CHAPTER 7: IMPROVED SEED DELIVERY MECHANISMS

In East Africa, informal farmer-to-farmer seed exchanges characterize farmer seed acquisition. These sources have been shaped over time around individual (farmer) growing and maintenance of varieties. Adoption of technologies, such as improved varieties of GLDC crops in Uganda, are heavily influenced by the level of access to relevant training. This is with cognizance to farmer status, i.e. what crops they grow, their level of resource endowments and capacities to tolerate risks. Information on seed, including special attributes, reached respondents mainly through peer-to-peer conversations, producer group meetings, demonstrations or radio. In Uganda, the seed companies dealing in GLDC crops are few, but they have explored production and sales at a higher level, often indirectly to farmers. Five seed companies were interviewed, three of which were largely private sector driven and two semi-government based (NARO Holdings and Makerere University Seed Unit, both parastatals). The private sector driven companies preferred to have their seeds sold through large consignments, pre-ordered by government through special seed programs or incorporated by NGOs in livelihoods programs.

The current seed systems, especially the formal one controlled by the government, appears to somewhat overlook seed access especially when distance to source, timeliness and affordability are concerned. Agrodealer locations were often in bigger town centres and farmers often had to incur travel cost to get seed. Alternatively, seed companies that managed to have demonstration farms for non-maize crops utilized the field days as points of sale. These offered the needed publicity for new varieties, but are limited by seasonality and location. Given these circumstances, seed produced cannot be sold at low cost without infusing subsidies continually.

The preference to work with pre-orders for GLDC crop seed comes with a direct need for large payments that help boost company cash flow. Even with established agrodealer distribution networks for maize, sorghum, rice and vegetables, the companies somewhat considered this a lucrative delivery mechanism to repeat sales at farmer level. All of the NGOs interviewed had seed interventions that focused on support for production (mostly grain) and the provision of affordable (sometimes free) quality seed for the smallholders. This was mainly achieved through farmer mobilization, i.e. creation of cooperatives, group training and extension, lobbying and policy advocacy, but also availing credit.

Defined by considerable regulatory control, the formal system appears more restrictive and retards the process of germplasm release to farmers while also narrowing their seed choices. While some farmers are able to make purchases of hybrid seed, many more would be satisfied with good quality seed of modern varieties readily accessed from neighbours. In Uganda, farmers were seen to dominantly use the informal system as it offered their preferred varieties on time enabling them to plant immediately when the season starts. The semi-formal system i.e. QDS system, also provided a steady source of seed of improved varieties at a lower cost.

Improved GLDC seed delivery mechanisms can be anchored on a basket of strategies in seed production and marketing to meet farmer needs. These include i) promotion of a structured, but integrated trading platform that links smallholders to grain buyers and ii) development of an enabling environment that supports micro-policy reform of systemic issues in the seed sector. The first strategy will help in achieving an efficient access to markets, inputs and credit while pulling more, preferred seed of improved varieties. Engagements with the national seed trade and agrodealer associations will help achieve impact through the second strategy, especially when it comes to more awareness and capacity building.

CHAPTER 8: OPPORTUNITIES

There is a continuous need for awareness creation, proper implementation of policies that create an enabling environment and linkages between all stakeholders in the GLDC crops value chains. Opportunities, locally and regionally, exist for gender and youth involvement in these chains. There is a need to ascertain actual roles of each stakeholder and their complementary values. If, for example, companies would pay more adequate attention to the next generation and women farmers, many opportunities could be converted into food, income and nutrition security. In the GLDC crop value chains, aggregators, off-takers and traders are crucial in driving seed demand. Most lead farmers, who felt there is much to lose with a broken output system, highlighted this. Nile Breweries giving farmers the seed to plant and following up by buying the grain for the manufacturing of beer, is one example of what motivated some farmers to grow sorghum varieties *SC Sila* and *Epurpur*.

Uganda enjoys a year-round favourable climate with two seasons experienced in most of the agro-ecologies. This already puts it at a vantage position compared to its neighbours in the region on matters related to seed production and trading. The GLDC crops under consideration in this study all have potential as multiple use crops. Their value chains have the ability to be extended into regional and international output markets. With the coming into force of the harmonization of seed regulations by COMESA, market uncertainty of seed is going to be reduced. The East African Community is relying on opening up countries to opportunities by reduced non-tariff barriers. The countries in the subregion are at the point of enjoying a similar set of seed laws and regulations following reviews and alignments to COMESA requirements. A caveat, however, in this is that these regulations have been in existence since 2014, but seed industries in the market bloc still face many challenges. These include inadequate awareness and inefficiencies at the border crossing points and a lack of trust in the seed certification and quality assurance processes in the bloc. Significantly, the regulations point to notable steps that have been made to lay the foundation for seamless regional trade. Additional work is inevitable if the seed industry is to be assisted in adopting a market systems approach to seed sector development. To achieve this, reforms will need to be market-driven, with private sector players (companies and seed associations) playing a lead role.

The low business in seed sales for GLDC crops, which are open and/or self-pollinating, due to farmers recycling seed, continues to exist. The act of concessionary distribution by special development programs or relief agencies cement farmers' dependency. Contextually, the harmonized regulations seek to promote a seed supply approach anchored on economies of scale. This will ensure the region has sufficient seed stocks produced and available for sale. Specifically, it will incentivize all who are trading in specific varieties to sell in different countries. The presence of standards or rules within these markets will most likely help enhance timeliness of seed supply and its overall quality. With more entrants going into local seed entrepreneurship in Uganda, the greater investments in seed production backed up by competition in seed supply will drive cost of seed down to the benefit of smallholder farmers. Youth and women currently form a major segment of seed producer groups and grain aggregation associations. With more training and access to capital, they could venture further in value addition and target lucrative markets both locally, regionally and internationally. A couple of the large traders interviewed mentioned they were well established in grain supplies to South Sudan, Rwanda and Kenya. They had agent models of grain aggregation linked to a pool of farmers who grew GLDC grain. A challenge remains at seed access level since different customer segments prefer specific varieties that sometimes are hard to come by.

Role of researchers remains valuable especially in light of demand-led breeding that addresses processors' needs. This comes at a time when financing for EGS production is not at the desired level; this constrains sufficient quantities at seed producers' level. This presents youth and women a chance to

become seed producers, i.e. in local seed businesses to grow QDS or be out-growers for seed companies. Models around an alliance like the Pan African Bean Research Alliance (PABRA) could offer lessons on scaling technologies across borders. PABRA's focus on thematic areas of sustainability, nutrition, food systems and resilient agriculture draws its success from enhanced partnerships among stakeholders in the bean value chains including linkages to markets.

CHAPTER 9: CONCLUSION AND RECOMMENDATIONS

9.1. Conclusion

Many efforts are currently ongoing towards seed system development. Some are informed by past success and/or failure while others as addendums to livelihoods programs. These have not adequately addressed the bigger question of sustainable and reliable supply chains for quality seed of improved varieties. Most of the recorded impact has been dependent on funding streams and a focus on “what could be the next big seed supply strategy?” There is great potential for business in demand-led breeding, local seed producer groups and seed companies trading in more GLDC seed. Profitability and sustainability, however, are dependent on understanding needs at the different segments of the value chain and getting most if not all of donor or government seed projects to be market-smart.

There is great potential for modern varieties adoption if farmers’ access to basic seed is increased, especially through the local seed businesses trained and set up professionally. Seed companies coming up with strategies to produce, market and sell seed according to farmer needs could succeed in the medium to long term. It was abundantly clear from interviews that future investments should be made on what ensures reliability in early generation seed supply, working capital for producers and traders; and relevant data or information localization. Based on proper needs assessment, farmers can participate in evaluation of quality and suitable varieties within their agro-ecologies. Unforeseen challenges that include climate change could be easily targeted for pro-active capacity enhancements, e.g. irrigation infrastructure or demand led breeding for special attributes like drought, disease and pest tolerance. Digitization could be very useful if farmers were better organized and would have access to technology.

This report thus concludes that farmers’ sustained access to a steady flow of high quality seed of improved varieties for GLDC crops could be best enhanced through competitive, but commercially oriented seed systems. If government and development partners would focus their attention to the strengthening of private sector’s capacity to produce and distribute GLDC crop seed, considerable traction will be gained. The solution to farmers stuck in a subsistence trap of low yields and limited grain supply, is access to improved varieties that raise yields and increase grain demand by improved supply at reduced prices. Furthermore, any attempt to crowd-out or create disincentives for private sector seed businesses will promote the status quo.

For future studies, prior identification of (viable) local seed businesses within a given location is proposed. Such studies should be well-prepared.

9.2. Recommendations

This study focused on what could make the GLDC seed value chain more sustainable. Constraints were identified across the value chain, some more specific while others broad. Strategies to move the chains to the next level will need multi-pronged approaches. These are clustered by institutional strengthening, policy and policy dialogue, and trade.

9.2.1. Institutional Strengthening

9.2.1.1. Capacity Building

All stakeholders need to have proficiency enhancements in all they do. Regulators need to understand the dynamics in agriculture and specifically in the seed industry in order to embrace refresher training. There was a general urgency among respondents to have more boots on the ground to promote improved seed. From more trials and demonstrations on-farm to designated purchase points of seed, farmers demanded to be able to “see and believe” special seed system attributes.

Women traders and farmers highlighted the need to have **focused training on bundling of technologies**. They further expressed the need to be in the specialized women groups that will allow them to voice their concerns and needs devoid of “cultural lay back” occasioned by culture and tradition, especially in mixed focus group discussions. This sums up the strategy of “adoption of technologies is greatly influenced by access to training”.

Exchange visits for regulators and breeders accompanied with private seed producers to appreciate seed systems in other countries that function well, is encouraged. A unanimous need to gain insight in effective systems in place that address farmers’ seed demand for improved varieties, was raised. These could be done through private-public sector partnerships to ensure sustainability upon implementation of good and discarding of bad practices. Investments in climate smart complementary technologies, such as efficient irrigation practices, are preferred, but not yet adequately studied locally or funded at scale.

Farmers conveyed their expectations of seed suppliers/producers in summary:

1. Seed in small and affordable packages should be available in outlet stores at any given time.
2. Agrodealer trainings to ensure they are competent enough to advise farmers on best practices for any varieties they stock.
3. Countrywide demonstrations that allow farmers to appreciate new varieties in the field.
4. Engage farmers in both participatory and demand-led breeding in order to factor in their preferences.
5. Train lead farmers to become model farmers for experiential learning in communities.

9.2.1.2. Financing

Finances in any given project determines success rate. From the interviews with selected respondents, access to finance to meet cash flow obligations was highlighted. For researchers, the desire to have liquidity so that next season’s activities are not affected, is key. Government, for example, should look at **a decentralized way of putting money from seed sales back into active demand-led breeding**. With this comes a guarantee that a variety loved by farmers can be available next season at desired quality and quantities. There was an indication of lack of prioritization on ploughing back funds generated from early generation seed sales by breeding institutions, leading to an underfunded subsequent process. Professionalism in business dictates an intentional setting aside of funds to help improve processes.

Traders believe in supplying their produce and receiving returns almost immediately. While credit may be advanced to loyal customers, the same is not true when traders look to stock. This impaired nature of transactions often affects how much they can take from farmers. A drive to get a market surplus is

reduced by either post-harvest losses or low selling prices on farmers' side. **Having a microfinance institution (including village level ones) could help improve the cash situation.** The thinking around these institutions is better if embedded in trainings in group formation.

All seed companies interviewed felt that local banks did not treat agribusiness as a lucrative point of operation. Their interest rates were high and often compelled them to consider overdrafts as opposed to loans. This remains an important concern especially when they need to pay and get seed from their out-growers. More **partnerships between government, agricultural research institutions and other private sector entities could help demystify and isolate eligible, but low risk ventures for financing.** This will ensure that segments of the seed value chain have reduced cash flow challenges.

9.2.2. Policy and Policy Dialogue

9.2.2.1. Seed Certification and Classes

An effective legal framework is key to support a country's economy, which, in the case of Uganda, is very dependent on agriculture. There have been many positive elements in getting improved seed certified for sale through agrodealers as recognized entities for seed distribution by law. However, this has cut off many smallholder farmers due to lack of knowledge on their availability and use, cost prohibitive nature and at times low quality of the seed, and absence of farmer relevant varieties that can replace own saved seed. The issue of distance to reliable and reputable agrodealers also bothers farmers, especially when asked about "why not improved seed?" A deliberate effort by development partners and the ministry has seen the drafting of regulations on quality declared seed. This seed has been produced over time by local seed businesses closer to farmers and has helped integrated the formal and informal seed systems to an extent. There is need for **more awareness on this seed class as a complementary one to certified seed.** By building capacity of the seed businesses and suppliers, they will embrace the professionalism required in the industry. This remains of importance since any free enterprise globally that propels a nation's growth is driven by decency.

Developing a farmer recourse mechanism especially when they purchase seed from dealers is required. The confidence a farmer builds to the point of being loyal to a brand is easily eroded with an experience with counterfeit or low quality seed. Stiffer penalties and tamper proof mechanisms should accompany seed counterfeiting and packages respectively. With a regular update on their list of registered seed suppliers, the industry could look forward to searchable database available to all to boost transparency and counter "briefcase seed companies". An additional way forward is to develop varieties that could be replanted at least for three seasons before being replaced with fresh seed. This becomes an alternative for any cash strapped smallholder.

9.2.2.2. Extension and Other Input Services

In practice, agricultural extension services is expected to drive and fulfil many desires, i.e. reduction of rural poverty to increase export earnings. The level at which these can be achieved depends on prevailing circumstances. Farmers (and traders) felt the extension system was weak compared to 10 years ago. A major reason expressed was lack of adequate financing to move across far-flung districts. As upstream activities, extension works fairly well in developed input systems. This allows for the creation of understanding on why and how to use a technology. **More funding to extension, but in a structured framework, is welcome to ensure farmers get up-to-date information.** An array of digital tools or visual aids could be developed (and then disseminated) with the needs of farmers kept in mind. An avenue for availing credit through cooperatives is another important strategy. Government policy to enhance access to technology is also vital to promote agricultural development.

Access to quality seed by smallholders can be improved by getting rid of unscrupulous dealers in the seed value chain. This has been trialled in other countries like Kenya through a coin scratch verification technology, but with an additional component of calls directly to a regulator hotline. Seed

companies could also have authorized stockists and share this information with farmers regularly. By supporting farmers to operate their own seed banks and local seed businesses, informal and formal systems could be integrated. Encouraging the formal seed system to venture more in GLDC crop seed; and sales through small seed packages will also help drive demand for quality seed of improved varieties. Farmers also reiterated the need to have seed companies, the Ministry of Agriculture and agrodealers (and special programs) organize regular meetings to discuss seed related concerns. This will help unravel any underlying constraints to quality seed access and variety adoption.

9.2.3. Trade

9.2.3.1. *Output Markets*

Demand-led breeding will often produce what is needed by the consumers, i.e. farmers, processors and special programs run by non-governmental organizations. **Designing value chain analysis that depicts needs at different segments of the value chain has to be prioritized.** Uganda's geographic position in the region and its relatively stable climate allows it to be a hub for both seed and grain production. Currently, large amounts of seed and food relief (mainly pulses and cereals) for troubled countries, e.g. Central African Republic, South Sudan, are sourced from Uganda. Seed companies could play an additional role of linking farmers to grain/output markets after they identify a private sector entity interested in their variety.

Clear policies presenting incentives to the value chain actors to build this system, are needed.

This will improve production efficiency for both seed and grain. The size of a seed package becomes a clear indicator of whether industry has the needs of smallholders at heart. It was not evident among larger seed producers (companies) that they would package in smaller quantities. For grain, getting a clause that ensures mandatory blending of flours, e.g. sorghum + maize, would help drive demand for sorghum seed. In addition, school programs could curb the double burden of malnutrition through integrating grain legumes in diversified diets.

9.2.3.2. *Regional Integration*

Harmonized seed regulations on trade offer hope for sales volumes in both seed and grain. By virtue of being a member of COMESA, Uganda could tap into the benefits upon subscribing to the regulations that will largely dictate seed movements. The country is in the process of setting up an ISTA accredited laboratory for seed tests. This will further reaffirm its bargaining power in the seed trade within the region given the attention trading partners attach to accreditation. A consideration could be made to develop regional grain hubs that share standards backed by clear policies.

Comparative advantage cuts across all business models. Uganda exports a lot of grain legumes and dryland cereals which often are not well marked. In this regard, Uganda's position is dependent on **ensuring effective, efficient and appropriate laws that enhance a viable business environment.** Small efforts at branding will help it position itself as a market leader and earn itself loyalty. In the context of grain aggregators and even local seed businesses, there is a decisive move towards branding and getting it right on weights and measures. An example is the use of electronic weighing scales that encourage their customers to trust technology and get weights of any size sold. Women and youth opportunities are evident with respect to seed and grain production (there were more women and youth in the interviewed groups). With the African Continental Free Trade Area currently underway, potential opportunities for Uganda, and especially in relation grain from GLDC crops, is high. The government's commitment to this by being a signatory and participating in its ratification puts the country on a promising trajectory. With a seed market that is still developing, more seed system strengthening work needs to be done to ensure farmers' access to quality seed.

ANNEXES

The following sections describe the targeted pool of respondents and questions asked to them. The framework was adopted to ensure both qualitative and quantitative data is collected.

Annex 1: Targeted KEY Informants

1. EGS Informants
 - a. Government breeder programs
 - b. University breeder programs
 - c. Private company breeder programs
 - d. CGIAR breeder programs operating in the country?
 - e. Etc.
2. Certified and QDS informants
 - a. Seed companies (Public? Private?)
 - b. Special seed systems projects/programs
 - c. Seed producer organizations (community etc.)
 - d. Certification and quality assurance bodies
3. Seed Delivery mechanisms
 - a. Seed companies (Public? Private?)
 - b. Special seed systems projects/programs
 - c. Seed producer organizations (community etc.)
 - d. Seed traders/agro vets, agro-shops, any other seed outlets
 - e. Open air market traders (trusted for seed source)
 - f. Relief seed distribution programs/actors (fairs et al?)

Annex 2: List of questions for actors involved in production of various seed classes (breeder, foundation, certified and QDS seed producers)

1. Describe the sorghum/groundnut/millet/chickpea seed system for your region (this question will be specific to the actor, depending on the crop they are dealing with)?
2. What role do you play in the seed system?
3. Who are the main players you are collaborating with?
4. How many crops are you producing seed for (latest past season + name/variety)?
5. What varieties do you produce (crop wise)?
6. Why only these varieties (list reasons in order of most importance)?
7. What class of seed do you produce? Do you sell or distribute for free? If you sell, then to whom do you sell?
8. How much seed do you produce for each of the crops mentioned above per year (specify variety where applicable)?
9. What are the most important seed varieties currently in farmers' hands?
10. Who are your main sources of breeder/foundation seed?
11. Do you buy or you are given for free?
12. If you buy breeder/foundation seed, how often (how many years it takes to renew the same variety)?
13. What challenges/constraints do you face to produce the seed class(es) you are involved in? (technical, infrastructure, institutional, financial)
14. How do you cope with these challenges?
15. What specific challenges do you face to get your early generation seed? And what have been your coping strategies?
16. What opportunities do you see (have you taken up) in the production of the seed class(es) you are involved in? (technical, infrastructure, institutional, financial, cultural)
17. How would you describe the seed market?

18. What is your seed supply capacity? And what does it represent in terms of meeting farmers seed demand in your area?
19. What specific marketing challenges do you face? And what have been your coping strategies?
20. How would you best describe the profitability of your seed business by crop and Variety?
 - a. Annual total production by crop and variety
 - b. Detailed production costs by crop and variety
 - i. Fixed costs
 - ii. Variable costs
 - iii. Amount sold by crop and variety
 - iv. Average prices of sold quantities
21. What kind of external support are you receiving so far that keeps you in the seed business? [If negative, move to Q. 24]
22. What would happen if this support is withdrawn?
23. What should be done for you to self-run your seed business without external support?
24. What are you uniquely doing to ensure you can meet your customer's/client's needs in the long term?
25. What are your seed delivery models? And which ones work best?
26. Any other important subject/s for you but not covered so far?
27. Your concluding remarks

Annex 3: Overall key informants' questions list (seed producers, seed traders, agro vet)

1. Would you be able to describe the sorghum/groundnut/millet/chickpea seed system for your region (this question will be specific to the actor, depending on the crop they are dealing with)?
 - a. Who are the main players?
 - Why are they critical players for the seed systems?
 - What class of seed do they supply?
 1. What role does your organization play in the seed system?
 2. What are the most important seed varieties supported by the seed system?
 3. Why are they important?
 4. Have the most important varieties changed over time? [Yes] [No]. If Yes, what do you think are the reasons? [List at least 3 reasons in order of importance] *If No, move to Q. ix.*
 5. Do you know of varieties that were important that were dropped from the seed system? [Yes] [No]. If yes, which ones? *If No, move to Q. ix*
 6. Why were they dropped? [List at least 3 reasons in order of importance]
 7. Does your organization gather information of farmers' preferences for seeds? [Yes] [No]. *If No, move to Q. x*
 - a. If Yes, what are your processes of getting the information from farmers?
 - b. How is the information processed for company/organization utilization?
 - c. Is the information used to guide decisions or priorities?
 - d. Have there been major changes in priorities based on this kind of information?
 8. What ways do you employ to stay abreast with farmer seed needs?
 9. What are your seed distribution options?
 10. What is your seed adoption rate? Do you have challenges meeting demand for seeds in your area?
 11. What varieties of crop x are you promoting? Why?
 12. What do you think of 'own saved seeds' used by farmers as a source of seed?
 - a. Any positives about it?
 - b. Any negatives about it?
 - c. What percentage of seeds used at the farm are 'own saved seeds'?
 13. How are seeds saved in the community?
 14. What varieties do the farmers maintain in the 'own saved seed process'? Why?
 15. What is the role of women in the management of 'own saved seeds'?
 16. Would women be a market for improved seeds? Why? Why not?
 17. What are your avenues for communicating to farmers? Women farmers?

18. Do you have marketing programs/strategies that are specific for reaching to farmers that are not through the stockists/agrovet shops?
19. What informed the starting of such models? Are they successful?
20. Is there any model that is designed to reach out to 'women' as a market segment? If yes? How does it work? What has been its impact? If not, why?
21. Have there been massive disruptions to seed access in this community? If yes, please describe, when, what was the cause, what was the impact, how did the community get around this.
22. In-case of political instability, how is seed recovery organised in the community?
23. Any other remarks?

Annex 4: Questions list for Community representatives (this could be lead farmers, leaders of farmer organizations, chiefs, District Local Government, etc.)

1. Would you be able to describe how members of your community access sorghum/groundnut/millet/chickpea seed, main suppliers and the overall process (this question will be on a specific crop type, depending on the crop the community grow)?
2. What are the most important varieties of crop x that the community grows?
3. Why are these varieties important?
4. Are there varieties of this crop that you used to grow but don't grow anymore? [Yes] [No]. *If No, skip to Q. v.*
 - a. If yes, please list them
 - b. Why don't you grow them anymore?
5. Do you get all the varieties you need to grow of this crop from the formal seed systems (shops)?
 - a. If not, which varieties do you like that are not in the formal seed systems?
 - b. Where do you get these other varieties from?
6. If a farmer in your community is growing 10kg of seed, how much of this seed is 'own saved seeds'? How much is from other sources? What would those sources be?
7. What are your processes of getting the information from seed distributors/promoters?
 - a. How does the seed information reach you?
 - b. Is the seed information you receive useful in guiding decision making or prioritization at the farm level? At the community level?
 - c. Are there members of the community that don't access this kind of seed information? [Yes] [No]. *If No, skip to Q. viii.*
 - d. If yes, where do they get information on new seeds or new varieties from?
8. What do you think of 'own saved seeds' used by farmers as a source of seed for crop x?
9. How are seeds saved in the community?
 - a. Who saves the seed?
 - b. What equipment do they use for saving the seeds?
 - c. What methods do they use for saving the seeds?
 - d. Is there any household that doesn't use own saved seeds? [Yes] [No]
10. What is the role of women in the management of 'own saved seeds'? What role do men play in 'own saved seeds'?
11. What varieties do the farmers maintain in the 'own saved seed process'? Why?
12. Would women be a market for improved seeds? Why? Why not?

Annex 5: Questions list for actors involved in specific seed systems intervention/project (project managers, relief program managers, seed companies, researchers, government officials, farmer organizations)

1. Describe the seed systems initiative/intervention in few sentences
2. List the main issues that led to the idea of implementing the initiative/intervention
3. Who along the commodity value chain were the main targets of the initiative/intervention?
4. Describe the different stakeholders involved and their respective roles
5. What were the crops targeted?
6. What varieties were involved/targeted per crop and why?

7. Describe in few sentences the way the initiative/intervention was implemented
8. List key activities the initiative/intervention focused on
9. How would you describe the success of the initiative/intervention?
10. List top key factors that make the initiative/intervention successful (mark them on 7-point scale)
11. Was the seed systems initiative more successful for some crops than for others? [Yes] [No]. *If No, move to Q.xii.*
12. How many primary actors were reached? What is the proportion of last mile farmers?
13. What specific steps were taken to reach the last mile smallholders with improved seed?
14. Describe what way the seed systems initiative integrated the formal and the informal sectors?
15. List main constraints/challenges that hindered the progress/delivery of the initiative/intervention
16. How did you deal with the different challenges?
17. What are the critical areas to consider for future initiatives to move GLDC seed systems to the next level?
18. Describe characteristics/components of the ideal and functional seed systems for GLDC

Annex 6: Question list for government officials, seed certification and quality assurance body on opportunities for regional integration

- i. Describe the national sorghum/groundnut/millet/chickpea seed system
- ii. Who are the main players you are collaborating with?
- iii. What role do you play in the seed system?
- iv. Describe any unique opportunities that can be targeted to enhance the national seed systems for GLDC
- v. Describe the regional (E.g. EAC, COMESA) sorghum/groundnut/millet/chickpea seed system
- vi. Describe any existing regional initiatives that facilitate seed business and key areas for interventions
- vii. Highlight key gaps between national and regional (E.g. EAC, COMESA) seed policies and subsequent areas for harmonization

Annex 7: List of questions (Processors, Traders, Exporters)

- i. What specific GLDC crops (sorghum/groundnut/millet/chickpea) do you trade/process?
- ii. List specific market traits you look for per GLDC crops?
- iii. Which specific traits do you miss so far? Specify per crop?
- iv. Who are your suppliers?
- v. Do you have any formal contract with your suppliers? Or any specific arrangements with them? If yes specify
- vi. What are the major challenges you face in your business to have your desired products?
- vii. How do you cope with the challenges?
- viii. Do you pay premium price for quality or desired specific traits? If yes elaborate with specific cases
- ix. What is your purchasing capacity per year (in metric tons)? Specify per crop?

APPENDIXES

Appendix 1: Production, Yield and Area Harvested for GLDC Crops in Uganda

All figures based on data from FAOSTAT, accessed on 12 July 2019

Figure 7: Yield of GLDC Crops in Uganda for Period 2007-2017

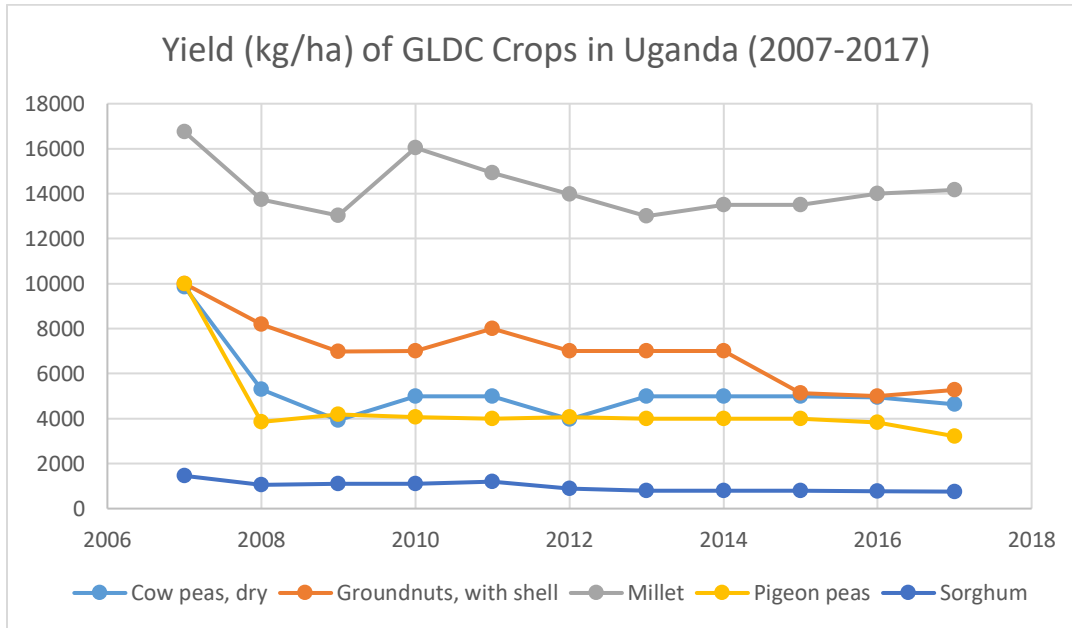


Figure 8: Area of GLDC Crops Harvested in Uganda for Period 2007-2017

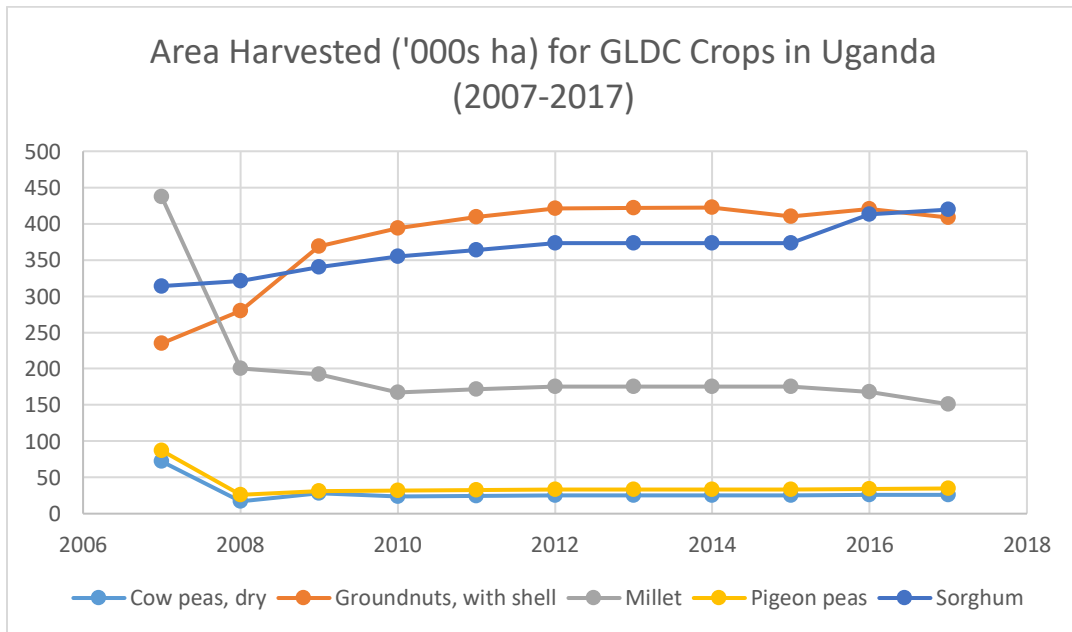
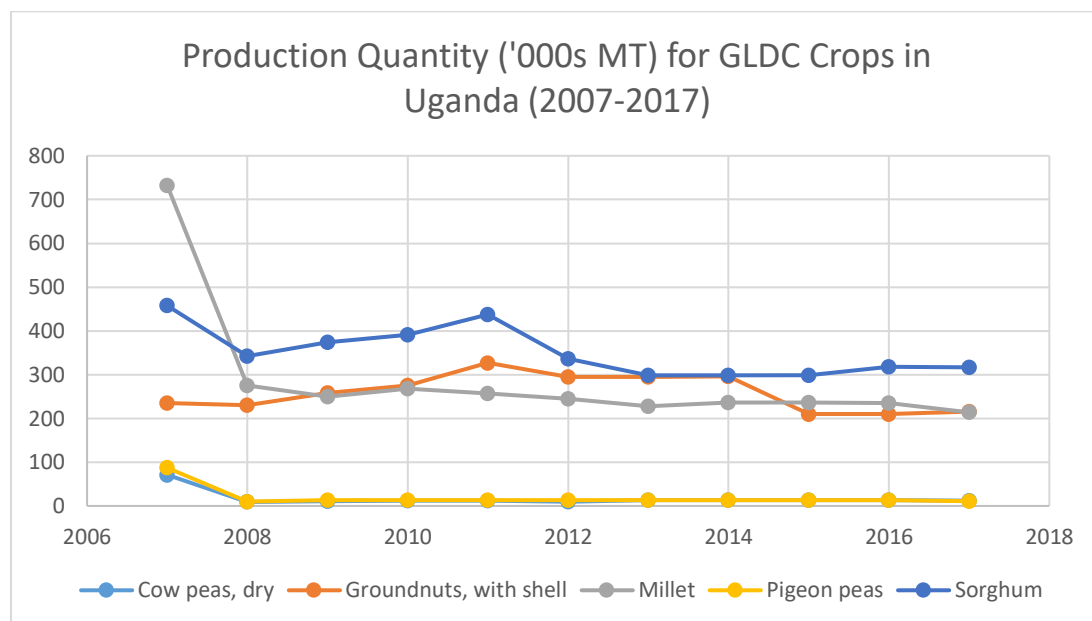


Figure 9: GLDC Crops Production Quantities in Uganda for Period 2007-2017



Appendix 2: Cost-Benefit Analysis for Seed Production for GLDC Crops in Uganda

Table 6: Production Budget for Seed Multiplication - Alito Joint Farmers Group (Soybean)

S.No	Items	Unit	Quantity	Rate	Amount (UGX)
1	Seed	kg	25	7,000	175,000
2	Rhizobia		1	10,000	10,000
3	TSP	kg	10	3,000	30,000
4	Rope	Roll	1	18,000	18,000
5	First Land Opening		1	90,000	90,000
6	Second Land Opening		1	90,000	90,000
7	Planting		1	80,000	80,000
8	Bird Scanning		1	30,000	30,000
9	First Weeding		1	60,000	60,000
10	Second Weeding		1	60,000	60,000
11	Rouging		1	5,000	5,000
12	Spraying Pump Lease		3	2,000	6,000
13	Chemical		1	15,000	15,000
14	Labour/Spraying		1	15,000	15,000
15	Harvesting		1	40,000	40,000
16	Transport Home		1	20,000	20,000
17	Threshing/Cleaning		1	40,000	40,000
18	Gunny Bags Purchase		8	1,300	10,400
19	Sorting/Bagging		8	5,000	40,000
20	Labour/Packing		8	10,000	80,000
21	Rope	Roll	1	2,500	2,500
TOTAL AMOUNT REQUIRED PER ACRE					916,900
	Production per acre	kg	1	800	800
	Price per kilogram	UGX	1	1800	1800
TOTAL POSSIBLE AMOUNT AT HARVEST PER ACRE					1,440,000
	Profit per acre	UGX	1	523,100	

Source: Alito Joint Christian Union Farmers' Cooperative Society, September 2018

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