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Review

Institutionalizing quality declared seed in Uganda

Astrid Mastenbroek[1,*], Geoffrey Otim[2] and Bonny R. Ntare[2]

[1] Wageningen University, Development Economics, Hollandseweg 1, 6709KN Wageningen; astrid.mastenbroek@wur.nl
[2] ISSD Uganda Programme, Studio House, Plot 5 Bandali Rise, Bugolobi, Kampala Uganda
* Correspondence: astrid.mastenbroek@wur.nl

Abstract: Farmer-led seed enterprises can produce good quality seed and market it. However, for them to thrive they need a conducive policy and regulatory framework that is inclusive and less stringent than existing national regulatory frameworks. One option to provide a more enabling environment for farmer-led enterprises is the Quality Declared Seed (QDS) system. In Uganda, this seed class is specifically introduced for farmer-led enterprises to produce and market quality assured seed of crops and varieties not served by the private sector. The system is anchored in the Ugandan national seed policy and seed regulations and its operationalization plan. We identified a combination of three strategies that enabled the QDS system to be incorporated into the National Seed Policy. These were: i) Generate evidence to demonstrate that local seed businesses (farmer groups) can produce and market quality seed; ii) Engage stakeholders towards an inclusive seed policy; and iii) Develop a separate QDS regulatory framework. By 2021, institutionalization has reached a critical mass. Areas of attention for full institutionalization are decentralization of inspection services, awareness and demand creation for quality seed, increasing the number of seed producers, and solving shortages of basic seed (starting material for producing seed).

Keywords: QDS; seed policy; seed regulations; seed systems; farmer-led seed enterprises**;** Uganda

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1. Introduction

Smallholder farmers in sub-Saharan Africa access 90% of their seed needs from informal seed systems [1–4]. Open-pollinated crops are traditionally grown using seed from these informal systems. This seed is generally saved from preceding harvest or routinely purchased in local markets. This 'seed' grain may or may not have undergone some level of selection, sorting, and cleaning for a small premium on top of the grain price [5]. It is referred to as 'implicit seed' or 'potential' seed.

Low adoption rates of improved crop varieties and quality seed are well-known issues in Sub-Saharan Africa and have been for decades [3,6–9]. Over the last ten to fifteen years, numerous development partners and implementers (public sector, private sector, and non-profit actors) actively tested and implemented various seed delivery models, addressing the supply/access side of farmers' adoption of quality seed and improved varieties [7]. Many of these input delivery investments focused on maize seed (especially hybrids) and fertilizer [10–13]. These public and private sector investments have had limited effects. From a development perspective, this raises a growing concern that after decades of funding by developing partners, formal seed sector interventions are not delivering [9].

Seed delivery models which reach smallholder farmers in remote areas are necessary. For seed companies operating at the national level, the demand for certified seed of crops other than hybrids - and exotic vegetables - represents a difficult business case. It is costly for established seed companies to deliver seed to the last mile due to poor market infrastructure (roads and the network of agro-dealer shops). Variety preference is locally specific, distribution is complex and costly, and margins on seed from crops such as cassava, legumes, sesame, minor cereals, and potatoes are much lower than for hybrid seed [14]

and thus not attractive to seed companies. This renders the formal seed system less effective in providing timely and adequate access to quality seed of crops other than hybrids and exotic vegetables [15].

Farmer-led seed enterprises offer several benefits that help address these bottlenecks just mentioned [16–18]. It may be one of the effective seed delivery mechanisms, particularly for open-pollinated varieties. Farmer-led enterprises operate with low transaction costs and are better aware of and capable of responding to specific local demands. Nationally operating seed companies are not able to produce seed at the same prices as the farmer groups. Furthermore, farmer-led enterprises can choose crops of interest for their local markets and target areas where commercial seed is not available. This makes seed produced by farm enterprises more accessible and affordable. These farmer-led seed enterprises are thus better adapted and suitable to satisfy the local demand for seed of the targeted food crops.

David (2004) [18] evaluating farmer-led enterprises in Uganda concluded that such enterprises can produce and market good quality bean seed. However, for them to thrive they needed an enabling policy and regulatory framework that is less stringent than the existing national regulatory framework.

One option to provide a more enabling environment for farmer-led enterprises is the Quality Declared Seed (QDS) system; a concept first introduced by United Nations Food and Agricultural Organization (FAO) in 1993 and updated in 2006 [19]. QDS is recognized as a seed class in Tanzania and Zambia. It offers an alternative to certified seed. QDS can be used for those crops, areas, and farming systems where highly developed seed quality control activities are difficult to implement. In particular, it may accommodate open-pollinated varieties of legumes, minor cereals, and roots and tubers more easily. These crops are important for food security but have low commercial seed value [14].

This paper describes the institutionalizing process of QDS in Uganda and shows how QDS can fill the gap between formal seed sold by seed companies and (potential) seed sold at grain markets. We draw on data from the Integrated Seed Sector Development (ISSD) Uganda project (2012-2020) which aimed at empowering smallholder farmers to produce and access quality seed of improved varieties of crops not adequately covered by the formal seed supply system. The material used to (re)construct the policy process in this paper includes several Integrated Seed Sector Development (ISSD) briefs [20–25] published in 2015, annual National Seed Sector Stakeholder reports, Annual Project progress reports, preparatory notes for discussions with the Ministry of Agriculture Animal Industry and Fisheries (MAAIF), internal communications and various versions of the seed policy and related documents.

In this paper, we focus on seed systems for food crops and leave out those for cash crops and closed value chains as they are outside the scope of the QDS system. Chapter two provides a short description of the seed sector and major actors in Uganda to set the scene in which QDS was adopted as a seed class. Chapter three describes the QDS system as implemented in Uganda, whereas chapter four describes the key strategies that supported the institutionalization process. Chapter five concludes with reflections on the achieved level of institutionalization and highlights four challenges that need to be addressed for a sustainable QDS system.

2. Seed sector in Uganda as of 2012

Farmers in Uganda access approximately 85% of their seed from informal seed systems; largely through home saved seed and local grain markets [26]. In between formal and informal systems, a myriad of projects supported individual and farmer groups to multiply improved and/or farmer varieties, grow (potential) seed, and conserve varieties in-situ. As David (2004) [18] observed, most of these community-based schemes were not sustainable after project support ended as legal embedding was lacking. The experiences in this intermediate system created the space to introduce QDS in to increase the quality and quantity of seed available to farmers.

Until 1968 the Ugandan seed system was informal. In 1968 Uganda started a publicly led seed program, which was privatized in the early nineties. The privatization attracted international seed companies but due to the absence of a legal framework they did not have incentives to invest in seed business [27]. The government responded to this challenge through the enactment of seed-related laws such as the Seed and Plant Act of 2006, Agricultural Chemical Act of 2006, Plant Variety Protection Act of 2014, and Plant Protection and Health Act of 2015. However, the lack of a policy framework and regulations to operationalize these laws limited their effective implementation.

By 2012, the formal seed system included about twenty-three Ugandan seed companies producing and selling mainly maize seed, and some legume and sunflower seed. Systematic records on seed sector functioning were scarce and incomplete. The market of national seed companies predominantly consisted of institutional seed buyers that bought in bulk, predominantly maize and legumes. Institutional buyers included the public agricultural extension service that distributed seed for free and relief agencies, mainly active in Northern Uganda, that either distributed seed for free or under voucher schemes. Seed companies sold only a small portion of seed directly to farmers. Direct marketing was hampered by poor rural road networks, causing high transport costs, and by a thinly spread agro-dealer network with a ratio of one agro-dealer to 3,400 farmers. As a result, few companies had developed a loyal customer base [9,14,21,25,28,29].

Although the 2011 draft seed policy did recognize formal and informal seed systems, it was tailored towards converting the informal system into the formal system, whereby all seed produced needed to go through formal certification of the 'certified seed' class. Only in case of emergency or acute shortage, 'standard' seed that had not gone through formal certification could be sold. Most seed sector stakeholders perceived the seed sector narrowly as the seed industry, companies producing seed, and support organizations that enable companies to operate. The Seed and Plant Act of 2006 and its regulations of 2009 were similarly tailored towards supporting and strengthening a vibrant seed industry. As a result, the formal maize seed system was well developed, yet the policy documents did not address other seed needs of smallholder farmers [21]. Though the law was in place, enforcement was limited due to understaffing and under-resourcing of the National Seed Certification Service (NSCS) and low levels of awareness amongst stakeholders in the seed sector [24,29].

The limited financial and human resources in the seed certification service, with just four inspectors at the time, made it impossible to inspect each production field (three times as per the regulations) of the many out-growers that seed companies engage to produce seed. In addition, seed companies depended on the National Agricultural Research Organization (NARO) for parental lines and/or basic seed, which was in short supply, leading to the recycling of commercial seed to produce adequate volumes. The limited control and availability of starting material contributed to low quality and/or counterfeit seed perceptions in the market. Subsequently, farmers lost faith in the formally produced seed. Between 2012 and 2014, newspapers regularly reported public outcries over poor quality seed and the inability of MAAIF to regulate the sector [9,14,24,28–32].

The seed sector situation in 2012 proved a fertile ground for the introduction of the Quality Declared Seed class. A combination of factors such as donor weariness supporting existing structures, a strong desire from MAAIF to improve and enforce quality assurance, public outcry over counterfeit and fake seed, and the release of several new legume varieties by NARO created momentum for stakeholders to work together to address challenges around accessing quality seed.

3. Quality Declared Seed system and local seed businesses

As background to the process of institutionalizing quality declared seed in Uganda, we provide a brief overview of the QDS system and local seed businesses that are the producers of QDS.

3.1. Quality Declared Seed System

The pre-existing commercial seed class in Uganda is certified seed. We first present the major differences between the two seed classes to appreciate the additional value of QDS to the seed inspection system already in place. Thereafter we briefly describe the seed certification process for QDS. Table 1 summarizes the main characteristics of certified seed and QDS. QDS applies to self-pollinating and vegetatively propagated crops, for which the formal seed sector has little or no interest. Such crops include cereals (sorghum, finger millet, rice), pulses (beans, pigeon pea, cowpea, field pea, green gram), oil seed crops (groundnut, soybean, sesame), roots and tubers (cassava, sweet potato, solanum potato), indigenous vegetables and pastures. QDS is not meant to compete with the formal certified seed, but rather to complement it. It contributes to provision of adequate quantities of quality seed on the market. The starting material for producing QDS is basic seed, which is generally produced by NARO. This list of crops shows that QDS offers an opportunity to pull public breeding and dissemination of publicly improved varieties of food crops.

Table 1. Summary characteristics of certified seed and QDS classes in Uganda

Characteristics	Certified seed	Quality declared seed
Crops	Cereals, legumes, oil seed crops, roots, and tubers	Same as certified, except for Maize and sunflower, which are excluded
Producers	Registered national and multinational seed companies	Registered farmer groups and individual farmers (local seed businesses)
Marketing	Direct marketing and through agro-dealer networks	Sold within the communities where seed is produced and NOT stocked with agro dealers
Input material	Basic seed	Basic seed
Field inspection	Minimum 3 field inspections of all seed fields	Maximum 2 field inspections of 10% of seed fields of the same variety
Inspectors	Government seed inspection and certification agency	Authorized field inspectors at the district level
Seed testing	Multiple seed lots, depending on volume	1 seed lot per variety, after bulking
Standards	Germination, genetic purity, moisture content and seed health	Same standards as certified seed
Government Agency issued quality mark		

Source: Seed and Plant Regulations (2018) [33], Seed and Plant (QDS) Regulations (2020) [34]

The main differences with certified seed are the marketing channels and the field inspection procedures. Certified seed is sold countrywide and through agro-dealer networks, while QDS is sold in the vicinity of the producers. The quality standards for certified seed and QDS are the same. However, the number of field inspections is different.

The QDS regulation requires that QDS producers obtain basic seed from authorized sources. Seed producers register fields planted for QDS production to authorized field inspectors by submitting planting returns[1] within two weeks of planting. This submission starts the QDS certification cycle (see also Figure 1). Under the QDS system, the authorized inspectors are the district agricultural officers (DAOs). For each producer, they inspect approximately ten percent of fields with the same variety once or twice during the season. Seed producers pay a small fee for inspection services to cover some of the expenses of seed inspectors that are not covered in their institution's annual budget. In addition, this payment stimulates mutual accountability whereby services can be demanded.

Note: LSB (local seed business) is a QDS producer group
Source: ISSD Plus project

Figure 1. QDS certification cycle

When the fields pass inspection, the crop is harvested and further processed as seed. After processing and storing, an authorized sampler takes a seed sample and sends it to the national seed laboratory for germination, purity, and moisture content tests. Only seed lots that have passed the minimum quality standards are issued with tamper-proof green QDS labels. This label is a quality seal to assist in marketing the seed to build confidence among the seed buyers. Seed producers pay a small amount for the labels. Once the seed passes the quality tests, the seed is packed in packs with clear branding and labeling and sold in village stores or directly by the producers.

3.2. Local Seed Businesses

The Integrated Seed Sector Development (ISSD) project introduced the Local Seed Business (LSB) model in 2012. ISSD was a two-phase project of four years each (2012-2016 and 2017-2021) to support the development of a vibrant, pluralistic, and market-oriented

[1] Form detailing crop and variety under production, size of the field, quantity of basic seed planted, planting dates and field location/map to be used by the inspector.

seed sector, and empowering smallholder farmers to access affordable quality seed of superior crop varieties.

Local seed businesses are existing entrepreneurial smallholder farmer groups. LSBs differ from community-based seed producers in that in the latter case seed is often not externally certified and marketed. ISSD in collaboration with the district agricultural office and Zonal Agricultural Research and Development Institutes (ZARDIs) under NARO, selected an initial batch of thirty farmer groups; 10 each in three agroecological zones (Norther, South western and West Nile). For the concept of local seed businesses as entrepreneurial entities, four selection criteria were important. These were pre-existence of the group, experience in crop production for seed or bulk gain sales, good governance structures, and interest to invest in the seed business.

Support to local seed businesses focused on building their skills in seed production and handling, linking them to seed markets, strengthening governance structures, and linking them to key stakeholders that provide the necessary services such as the sale of basic seed and inspection services. ISSD developed a support and training methodology around four building blocks as presented in Figure 2. The methodology centered around comprehensive season-based participatory training and coaching focusing on skills, empowerment, and confidence of groups in doing business.

Source: [22]

Figure 2. Building blocks used for shaping and training local seed businesses.

The building blocks have two dimensions. The first dimension is product and organization and the other one is an inward and outward focus. Inward focus is on the quality of the seed produced and the professional setup of the local seed business. Outward focus is on market demand, understanding customers, and connections with key actors in the seed value chain.

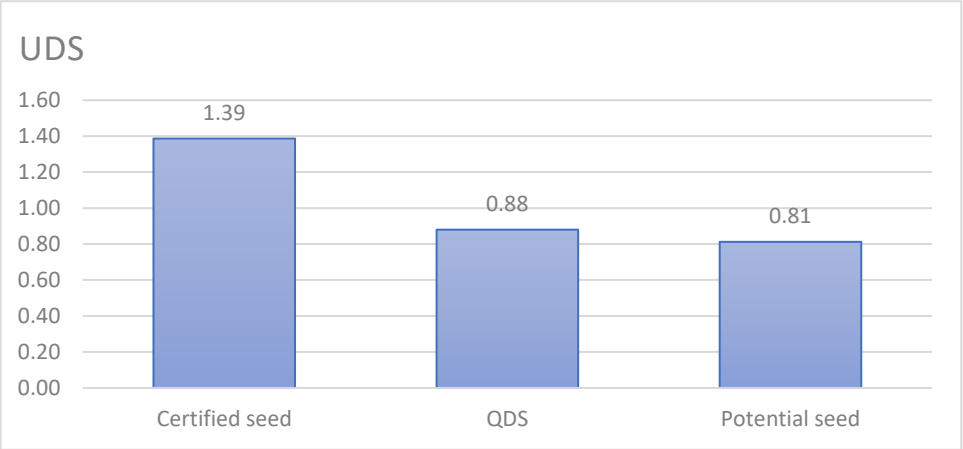
The first building block focuses on LSBs being technically well equipped. Two seasons long, the groups are intensively trained on all production, harvesting and post-harvesting practices. Particularly the internal quality control committee receives training on how to inspect fields of LSB members and recognize off-types.

The second building block covers market orientation. The LSBs are trained in marketing and marketing strategies so that they can produce what they can market. In market orientation, they gained skills in developing a unique value proposition, price setting and customer profiling, among others.

The third building block deals with becoming professionally organized. Groups are guided in setting up relevant committees to support decision-making and monitoring of the seed business activities. Key committees that define the local seed business professionalism include finance, production, marketing, and quality control committees. Good governance and inclusiveness are part and partial of this training. Women are stimulated to take up leadership roles.

The last building block involves strategically linking LSBs to access relevant services that support the well-functioning of the seed business. LSBs are linked to agricultural research institutes to access quality basic seed, a regulatory requirement to produce QDS in Uganda. The seed producers are also connected to the District Local Government for quality assurance services and to the National Seed Certification Services (NSCS) of MAAIF for laboratory testing of seed and issuance of tamper-proof green QDS labels. After the pilot phase ended, the number of LBs increased to 106 in 2015. 'New' and 'old' LSBs were actively linked to improve collaboration. These linkages and exchanges were crucial for fast peer-to-peer learning by new groups and creating a strong zonal network amongst LSBs.

Local seed businesses can sustain their business by satisfying local demand with seed of consistently high quality and by being close to their customers. This requires an entrepreneurial attitude and free seed hand-outs must be avoided. The sustainability of QDS is based on its business logic in which the producers minimizing costs of production and marketing making it possible to sell QDS at an affordable price. We use an example of beans to show how QDS can fill the gap between certified and potential seed. Figure 3**Error! Reference source not found.** provides an overview of the sales prices for common beans for certified seed, QDS and potential seed (local market grain). As shown in the figure, the gap between certified seed and QDS is much larger than the gap between QDS and potential seed.



Source: [35]; exchange rate 1 USD = 3,500 UGX

Figure 3. Sales prices for certified seed, QDS and potential seed (grain) for beans

For certified bean seed the main cost factors for seed companies that determine the seed price are transport due to its bulkiness and formal certification whereby every field needs to be inspected three times in a season. This provides a disincentive for seed companies to invest in producing certified legume seed. If a seed company produces one kg of certified beans, the cost of production, treatment, certification, and marketing is roughly USD 0.81 per kg [14]. If a local seed business produces one kilogram of quality declared bean seed, the cost of production, treatment, certification, and marketing is roughly USD 0.58 (ISSD Uganda project data). This is 28% less and therefore the sales price is also much lower as shown in Figure 3.

4. Strategies towards institutionalizing the Quality Declared Seed system

We identified a combination of three strategies that enabled the QDS system to be incorporated into the seed policy. These are:

1. Generate evidence to demonstrate that local seed business model (farmer groups) can produce and market quality seed;
2. Engage stakeholder towards an inclusive seed policy; and

3. Develop a separate QDS regulatory framework.

The strategies combined generated proof of concept, a pathway to scale-out (more numbers of LSBs) and scale-up (embedding in the regulatory framework), and buy-in from a wide range of stakeholders. These strategies carved out a niche that was not in conflict with the existing structures. We elaborate on each of these strategies in the sections below.

4.1. Local seed businesses producing and marketing quality seed

The introduction of 'local seed businesses' was a deliberate choice to distinguish them from seed multiplication groups that worked on community-based seed saving and sharing principles. Few of the initial groups selected turned out to have more social objectives rather than entrepreneurial spirit and we parted with these groups. The participatory training was based on discovery, experimental learning, and adult education principles, with a particular focus on and reinforcement of entrepreneurial skills and the four building blocks.

Twinning[2] well-established LSBs and newer groups improved collaboration and the learning process. This farmer-to-farming learning helped farmers learn and see practices from other farmers, which they found easier to replicate. This made it easier to build the capacity of the new LSBs. In addition, the twinning approach helped groups to get to know each other and build a network, which in turn led to the establishment of zonal local seed business associations. The associations were formed out of demand from LSBs for more coordination and advocacy for institutionalizing QDS.

The collaboration with existing national and local governance structures from the beginning proved vital for the embedding of local seed businesses as viable entities within the district. The district agricultural office was involved in the selection of groups and groups registered at the offices as seed producers. Groups that did well, were promoted by the district creating visibility in the governance structure. District local governments also contributed to protecting their farmers from fake seed (see also chapter 4.2 on multi-stakeholder processes).

The establishment of the local seed business in the agricultural zones of Uganda was facilitated by the partnership with NARO through the ZARDIs. The institutes hosted the ISSD seed and agribusiness experts, who formed a team with the relevant ZARDI scientists to train the LSBs. This embedding of the LSB development activities with the ZARDIs contributed to its successes. This also eased fostering connections between the LSBs and NARO crop breeders to access basic seed, a regulatory requirement to produce QDS.

As a result of the low number of groups per zonal team, it was possible to provide in-depth training and tailor the process to the needs of the groups. Once the LSBs passed the proof-of-concept phase, we looked for ways to increase the number of local seed businesses to enhance recognition and convening power. Rather than doing it ourselves, the nature of ISSD has been creating as much ownership with like-minded organizations as possible. As a result, organizations wanted to be part of the movement for QDS.

Out-scaling the LSB methodology countrywide was possible through working with these like-minded partner organizations. We prepared an intensive training-of-trainers program using a Local seed business manual that was prepared by the ISSD team through several write-shops. The partner organization staff were taken through training-of-trainers to gain knowledge and skills in LSB development. They then used the same approach to identify and mentor additional LSBs. ISSD staff continued to provide technical backstopping to partner organizations and groups. These partnerships tripled the number of LSBs to 106 within one year. This demonstrated the success of the out-scaling approach in increasing the number of LSBs producing and marketing QDS. In the second phase (2017-

[2] Purposeful exchange visit to learn specific skills and best practices identified in another fast-growing group.

2020) the number of local seed businesses increased to 256 spreading over 6 agro-ecological zones of the country.

In 2020 the Integrated Seed Sector Development Plus project commissioned a study to assess the contribution of local seed businesses to the seed sector. The study showed that LSBs increased the availability, access, and affordability of quality seed, albeit to a limited scale. LSBs are only operating in 68 out of 146 districts in Uganda and usually one LSB serving a sub-county. They generally focused on one or two crops. As a result, QDS is only available in limited quantities in those sub-counties where LBS are operational and trained. This has implications for smallholder access to QDS. On average farmers that have bought QDS traveled 4.4 kilometers to buy the seed, while they are comfortable with three kilometers at most. As shown in chapter 3, QDS is sold much cheaper compared to certified seed, however, farmers still perceive the seed as expensive. In terms of quality, QDS is of high quality according to farmers as well as key informants. A lack of awareness on access points, benefits of using QDS, and in general on potential yields of crops was noted as demand side bottlenecks of increasing use of QDS by smallholder farmers [35].

4.2. Stakeholder engagement towards inclusive seed policy

From the start in 2012, we promoted a multistakeholder partnership in which ISSD represented an approach with guiding principles rather than the implementing organization featured itself. As ISSD, we contributed to sector transformation, and achievements were attributed to stakeholder engagement rather than as the organization's wins.

Stakeholder collaboration was an important part of institutionalizing QDS in Uganda. We invested efforts in these stakeholder engagements at national, agro-ecological zonal, and community levels.

4.2.1. National processes

Stakeholders' engagement is a critical process in building consensus towards a joint action in addressing a common challenge in the seed sector. One of the key strategies used to cause a change in the policy and regulatory environment in the seed sector in Uganda was engagement and dialogue with important stakeholders who had alternative views about the seed sector. In 2013, we conducted a stakeholder analysis and mapped out five important categories of actors with influence in the seed sector. These actors are the public sector, private sector, development partners, farmer groups and NGOs. Each of these interest groups had different and sometimes opposing interests. We, together with others, provided several spaces for dialogue, bilateral engagements and negotiation rounds which contributed to actors working together.

Stakeholder collaboration followed several stages of multistakeholder participation (Sam's Kaner's diamond of participation [21]). Initially, discussions would follow the same pattern, the problems were widely known, and the 'blame' put on another actor. For example, shortage of basic seed is caused because "breeders are not producing sufficient quantities" or "seed companies are not booking basic seed at least two seasons in advance". Another example is that the blame for counterfeit seed was put either on seed companies or on the government for not regulating the sector depending on which actor group was making the statement. In addition to these blame games, solutions identified were broad-based solutions, that were not always actionable. Some examples of the proposed generic solutions are ""the seed sector needs a semi-autonomous national seed inspection service", "the seed sector needs to know the seed demand", and; "seed companies and others need to order basic seed at least one season in advance"" [21] (p6). These became recurrent at every meeting without finding actionable pathways for implementation.

To break this pattern, ISSD, amongst others, contributed to the process to generate new and actionable ideas and solutions by organizing a visioning workshop in 2013 that used different facilitation tools, such as mind mapping. Fundamental problems, such as

fixed positions, participants not understanding each other, wish to maintain the status, and win/lose mentality became clear. By providing a safe space (through professional facilitation and using the right tools) new ideas and approaches emerged, converging reasoning towards solutions in the realm of existing and new information. These processes resulted in the introduction of Quality Declared Seed (QDS) as a new seed class, joint work on the seed policy, and reaching consensus on ZARDIs producing basic seed (in 2015). The latter is an important achievement as well because sufficient volumes of basic seed are necessary to produce certified seed and QDS.

While the development of a national seed policy was initiated in 2002, it was only in 2013 when the joint efforts of several seed sector stakeholders that the process was reinvigorated. It took two more versions and five years for the National Seed Policy to be approved by the Cabinet in 2018.

4.2.2. Zonal and district level processes

Together with the ZARDI's, we organized stakeholder meetings at the zonal level to make sure that the voices of stakeholders at lower administrative levels were also heard. We organized these meetings at least twice a year to deliberate on issues affecting quality seed access in the zone and what action could be taken. In these zonal multistakeholder platforms, we used similar facilitation skills as in the national meetings, such as mind mapping, to engage in processes to break patterns that were stuck and come to actionable new ideas and solutions. Through meetings, stakeholders recognized shortage of access points for quality seed for most food security crops and the importance of LSBs, inadequate availability of quality basic seed, and poor enforcement of regulations to reduce fake seed in the markets.

At the zonal levels, we facilitated stakeholders to pilot new solutions to some of the recognized challenges. A particularly successful pilot was the pilot on by-laws against counterfeit seed. Actors at the district level proposed the development of by-laws to give the district authorities a better framework to deal with fake seed in their market. The pioneer by-law was passed by Koboko district local government. Using the by-laws, the district, through the DAO, conducted physical verification and germination tests on a consignment of 30MT of bean seed that was delivered through the government's seed distribution program in 2015. The DAO found that the viability of the seed lot was below 50%. Using the district by-law in place, the DAO was able to reject the seed consignment. The by-law was then taken up by more districts to facilitate enforcement on seed quality control.

Another example of a successful pilot was the engagement with the national bean and groundnut breeding programs to pilot basic seed production at ZARDI's to increase the availability and proximity of basic seed to the seed producers. Prior to this pilot, breeding programs were the only source of basic seed without external quality control.

4.3. QDS regulatory framework

The third strategy that contributed to the acceptance of QDS as a seed class was to create a separate space for QDS in the regulatory framework, whereby the status quo of certified seed was not challenged. To achieve this, we worked with the Ministry of Agriculture Animal Industry and Fisheries from the start. Jointly we piloted how QDS could work before officially making it part of the seed sector regulatory framework.

The first pilot, initiated in 2013, was focused on providing evidence that local seed businesses produced in fact quality seed that would pass the minimum standards of germination, purity, and moisture content. With the MAAIF through its National Seed Certification Services (NSCS), we tested a separate quality assurance system for QDS based on the FAO QDS guidelines for inspection. This involved instituting and training an internal quality control committee (IQCC) within each Local Seed Business. The IQCC is responsible for routinely performing inspections of fields of its members to ensure that

QDS production procedures are adhered to. They provide guidance to individual QDS producers. They also have the mandate to reject a QDS field based on the level of contamination that may make it invalid as a seed field. For example, when the QDS crop is intercropped with another crop, this will automatically lead to the rejection of the field by members of the IQCC. Such fields are also reported to inspectors from NSCS when they visited. The inspectors validated the decisions taken by the internal LSB quality control officers. The pilot also focused on testing inspection of QDS fields by the NSCS inspectors from MAAIF and standardizing the issuance of the tamper-proof green labels as the certification mark for QDS. The pilot performed well and provided clear evidence of LSB's capacity to produce and market quality seed. The introduction of the green QDS label was an important step in the recognition of QDS as a seed class. A major step in the recognition of this label was the official launch of the tamper-proof labels for certified seed and QDS by the president of the Republic of Uganda during the agricultural show in 2016.

Once the first pilot was successfully completed and QDS recognized as quality seed, the next step in institutionalizing QDS was a pilot on decentralization of inspection services to the District Agricultural Office. The inspection of QDS fields by NSCS inspectors from MAAIF was not economically feasible in terms of distance and logistics required by the inspectors. In addition, once QDS would be rolled out nationwide, the number of inspectors would not be sufficient. Therefore, we recognized the need to decentralize inspection of QDS fields to the district local government by the District Agricultural Officers (DAOs). In this pilot that started in 2014, we supported MAAIF to train DAOs on field inspections. The trained DAOs were then authorized to inspect the QDS fields, a process required in the certification process. Seed sampling for purposes of laboratory testing remained the responsibility of the NSCS seed samplers from the central seed testing laboratory. DAO's involvement in the inspection of QDS fields improved access to inspection services by LSBs due to their proximity and lower costs. Each LSB producing QDS pays a fee of UGX 50,000 (about USD 15) as a cost for each inspection. These fees were later revised to UGX 6000 (USD 1.7) per acre in the new Seed and Plant (QDS) Regulation (2020) [34]. This pilot provided evidence that QDS inspection can be decentralized to the district local government by involving and accrediting DAOs to conduct inspections.

These pilots presented evidence-based inputs towards the drafting of the new QDS Regulations which was initiated by MAAIF in 2016. The development of the separate QDS regulation got traction after the approval of the National Seed Policy (2018). With regards to the QDS system, the policy statement in the national seed policy is that the "Government will put in place appropriate seed quality standards and mechanisms for regulation, production and sale of Quality Declared Seed to reduce use of home saved seed and bridge the gap between formal and informal seed systems" [36] (p12). The new QDS regulations eased the rigors of full certification without compromising on the minimum standards for variety purity, germination, and moisture content. The QDS system is designed as an alternative quality seed assurance system to complement the regular certification processes, thus relieving pressure on the limited resources of the NSCS.

5. Achieved level of Institutionalization of the QDS system

As shown in this paper, Uganda has achieved much in terms of institutionalizing QDS as a seed class that facilitates smallholder farmers access to quality seed of the preferred varieties at affordable prices. The QDS system is anchored in the national seed policy, strategy, and implementation plan of the Government of Uganda. The Ugandan experience demonstrates that adoption and implementation of a quality declared seed system does increase access to and availability of quality seed for smallholder farmers. The complementarity of local seed businesses to national seed companies has been demonstrated, and the feasibility of their development is shown. Using an evidence-based approach, stakeholders better recognized that the effectiveness of the seed sector is determined by the use of good quality seed, which can come from different sources.

To assess the level of institutionalization achieved, we used the S-curve of market transformation developed by Molenaar and others [37]. The steps to transit from inception to institutionalization involve that progressively more and different stakeholders get involved, the level of professionalizing increases, implementation shifts from project-based to regulation and market mechanisms, and mainstreaming sustainability until it is standardized [37].

Uganda has reached stage 3, critical mass, in the transition of the QDS system towards sustainability. Driving commitment to QDS is no longer pushed by only civil society or frontrunners. Producers are professionalizing, and the number of farmer groups producing and marketing QDS is increasing. Interventions have shifted away from the project, with MAAIF extension workers picking up to support groups becoming QDS producers. However, MAAIF has not yet fully decentralized the system and has not yet formally accredited the DAOs. QDS is getting known in areas where they are produced, but not yet countrywide as not all districts have LBS. MAAIF is investing efforts in coordination and creating a space for alignment and collaboration.

LSBs are proving successful in producing substantial amounts of seed for sale to farmers. To sustainably institutionalize QDS into the Ugandan seed sector we highlight four areas of attention. Two seed sector-wide challenges are faced by both certified seed producers and QDS producers. The first is the short supply of early generation seed that serves as starting material to produce certified seed and quality declared seed classes. The second is the limited awareness of smallholder farmers about yield potentials of quality seed, where to access the seed, and the value-for-money of this seed. The two other challenges are more specific to the QDS system. These are the limited number of farmer groups that are producing and marketing QDS and strengthening the decentralized quality assurance system.

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