

Development Policy Review

Policy and performance in Uganda's seed sector: Opportunities and challenges

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Summary

Motivation: Efforts to increase smallholder access to improved varieties and quality seed is often central to agricultural development, economic growth and poverty reduction in low-income countries. Yet many governments and development partners grow impatient with slow progress in their seed sectors. Uganda stands out for its recent policy innovations, regulatory reforms, and market experiments for seed, and for the extensive analysis of its experience.

Purpose: This paper reviews the changing landscape of Uganda's seed system and assesses recent policy, regulatory, and institutional changes.

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Methods and approach: We draw on a wide range of documents, studies, and statistics.

Findings: The low uptake of improved varieties and quality seed in Uganda has encouraged innovation to overcome failures in the country's seed market. These innovations include regulatory changes to allow the production of quality-declared seed (QDS) by smallholder seed producers; labelling to allow text message verification of seed; and crowd-sourcing information on seed quality by farmers. All have promise, but it remains to be seen just how effective they will be. In the meantime, vested interests may resist moves to a more innovative seed sector, instead preferring to maintain the incumbent approach designed to use seed to secure political support from smallholders. This is at variance with the spirit of the 2018 legislation and subsequent regulatory reforms.

Policy implications: Uganda has a policy framework that could make a real difference to farmer access to better varieties and seed. Market innovations can help the vision to become reality. But the seed sector needs sufficient public investment to generate new varieties and foundation seed, and capacity to manage the seed market to the benefit of producers, dealers and farmers.

Having come so far, it would be counter-productive for political economy factors to displace the efforts of private provision which is far more sustainable in the medium and long run.

Keywords: genetic resources policy, market development, seed policy, seed regulation, seed systems, Uganda

1 INTRODUCTION

Building on decades of empirical evidence, development policy in many low-income countries often prioritizes agricultural productivity growth as a primary vehicle to achieve broader economic growth and poverty reduction, at least in the early stages of development (Byerlee et al., 2009; Dorward et al., 2004). Specific policy emphasis is often placed on boosting the productivity of smallholder farmers who, in regions such as Africa, represent the largest share of agricultural producers and account for significant shares of output (Scoones and Thompson, 2011; Wiggins., 2010). This emphasis on smallholder productivity remains central to development policy even despite increasing recognition of the more nuanced role that agricultural policy plays in development (for example, Dorosh and Thurlow, 2018; Jayne et al., 2016; Collier and Dercon, 2014).

Among the many policy thrusts aimed at increasing smallholder productivity are interventions to increase the use of improved varieties and quality seed—interventions that have been shown to be an effective means of addressing low yields and output across a range of countries and conditions, especially when combined with inorganic fertilizer use.¹ Ample evidence shows that adoption of improved varieties and quality seed has contributed significantly to agricultural productivity growth in many low- and middle-income countries (Walker and Alwang, 2015; Evenson and Gollin, 2003). Although neither should be viewed as a panacea to all problems in agriculture and food security, many global and national development programs rely heavily on

¹ Throughout this paper, we refer to both improved varieties and quality seed. The former denotes varieties in which the embodied genetic characteristics have been changed or improved via breeding, whereas the latter refers to propagation material that is characterized by higher rates of physical purity, genetic purity, and germination, and lower rates of pest/disease presence and moisture when compared to other types and sources of seed.

improved varieties and quality seed as an entry point for their efforts to enhance productivity and improve rural livelihoods.

Uganda is no exception. The country's development strategies and policies place considerable emphasis on the role of agricultural productivity growth through intensification and the increased use of improved varieties and quality seed. This is due partly to the fact that agriculture is the main source of livelihood and employment for more than 70 percent of the population and a key driver of industrial and service sector growth as well as export earnings (MAAIF, 2018; UBOS, 2016). Yet Uganda's agriculture is overwhelmingly characterized by low-input, rainfed production systems managed by small-scale, resource-poor farmers with limited support from extension and advisory services. Its production systems rely primarily on the use of farmer-saved or locally exchanged seeds, with numerous studies highlighting the low uptake of improved varieties and quality seed. Estimates from various sources suggest that, depending on the crop, 70 to 95 percent of farmers use own-saved seed and informal seed exchanges in Uganda (Mugisha et al., 2020; Joughin, 2014; Mubangizi et al., 2012; AGRA, 2011; Ferris and Laker-Ojok, 2006). While this is not itself an issue for some crops where own-saved seed and informal seed exchanges are conventional practice and sufficient substitutes for seed obtained through formal commercial markets, it can be limiting for other crops, especially where both seed replacement and varietal turnover are important to sustaining yields and returns.²

The low uptake of better varieties and seeds is a well-recognized challenge to Uganda's efforts to improve agricultural production and productivity (Chauvin et al., 2017). As such, Uganda's national strategies for agricultural development have explicitly and repeatedly identified increases in the rates of improved varieties and quality seed use in their targets (see, for example, MAAIF, 2018). To achieve these targets—and in recognition of the many institutional and market constraints that limit farmers' access to better varieties and seeds—Uganda has undertaken several notable reforms in the seed sector in recent years. It may even be argued that Uganda stands out among other sub-Saharan African countries both for its wide range of policy innovations, regulatory reforms, and market experiments undertaken in the seed sector during the past decade, and for the extensive documentation of its experience to date.

This paper reviews the changing landscape of Uganda's seed sector and analyses the performance of recent policy, regulatory, and institutional changes. Focus is placed not only on the commercial maize seed market—typically the first market of interest in most studies on the topic—but also on other seed-provisioning strategies (public, private, and community-based) and other archetypes of crops and crop reproductive biology (hybrid, self-/open-pollinated, and vegetatively propagated), as well as the policies and regulations that shape varietal release procedures, seed quality assurance systems, and seed distribution and marketing channels.

The paper relies on several prior studies to frame its analysis. Drawing on the seminal studies of seed policy by Tripp and Louwaars (1997) and Tripp and Rohrbach (2001), the paper examines

² Although certified seed is expected to be superior to farmer-saved seed in terms of genetic and physical purity, this may not always be the case, for example, if: the early generation seed used to produce certified seed is poorly maintained and produced; inspections are poorly conducted; the market is populated with counterfeit or fraudulent seed providers; or certification standards are otherwise not met. In such cases, it is possible that farmer-saved seed performs as well as or is more cost effective than certified seed. See Maredia et al. (2019) and Gray (2021) for further discussion.

the role of key seed policies and policy reforms in Uganda. Drawing on Louwaars and de Boef (2012) and Louwaars et al. (2013), the paper tackles seed sector development from an integrated perspective—one that eschews reference to formal and informal seed systems and instead views a seed system as a continuum of closely related actors, relationships, species, and products. From Spielman and Kennedy (2016), the paper identifies indicators that are useful in measuring seed sector development in the Ugandan context. And by drawing on Scoones and Thompson (2011), the paper explores the deeper political economy dimensions of seed sector policy in Uganda.

This analysis makes three contributions to the literature on seed sector development and, more generally, agriculture and rural development. First, the paper offers a novel review of the evolution and evidence to date on seed policy reforms in Uganda, synthesizing multiple but fragmented studies into a coherent storyline built around the country's policy change process. Second, the paper weighs in on the debate over seed quality issues, supply chain bottlenecks, and alleged counterfeiting in the seed sector with a more nuanced discussion of the challenge. Third, the paper highlights several technological and institutional innovations in Uganda's seed sector that may be models for replication and adaptation in other countries and contexts.

The paper proceeds as follows. Section 2 provides a nuanced diagnosis of the evidence on improved variety and quality seed use in Uganda, drawing on national statistics and prior studies. Section 3 characterizes the policy landscapes of Uganda's seed sector over time, highlighting major innovations that have been pursued in recent years. Section 4 discusses the continued policy challenges and priorities for Uganda going forward, followed by concluding remarks in Section 5.

2 IMPROVED VARIETY ADOPTION AND QUALITY SEED USE IN UGANDA

In its Annual Agricultural Survey, the Uganda Bureau of Statistics (UBOS) estimates that, on average, only 23 percent of households used improved seeds in Uganda in 2018 (UBOS, 2018). Unfortunately, the term "improved seeds" as used in these surveys does not distinguish between (a) seed of a new variety that is purchased or otherwise obtained by the respondent, (b) new seed purchased or otherwise obtained of a variety already grown by the respondent, or (c) seed of an unknown variety that is purchased or otherwise obtained for its potentially superior (or possibly inferior) quality relative to farmer-saved seed. Instead, all of these possible responses are grouped into a misleading binary response to a somewhat subjective question of whether the respondent used "improved seed" (see Spielman and Kennedy, 2016).

Instead, we turn to data from the agriculture module of the Uganda National Panel Survey (UNPS) from 2013/14 to 2019/20 which, though it presents the same problem in terms of response options on "improved seed," provides richer data on household seed acquisition

Table 1. Trends in adoption rates of improved maize, Uganda 2013 - 2019

Type of seed	2013/14				2015/16				2018/19				2019/20			
	N	%	Acreage	%	N	%	Acreage	%	N	%	Acreage	%	N	%	Acreage	%
Purchased	674	28.0	736.2	28.8	566	22.6	583.6	25.1	520	23.7	792.3	30.7	552	25.5	665.6	30.0
Unpurchased	1,730	72.0	1818.1	71.2	1,933	77.4	1739.6	74.9	1,672	76.3	1785.1	69.3	1,612	74.5	1549.8	70.0
Unimproved	2,107	87.6	2182.1	85.4	2,198	88.0	1975.5	85.0	1,991	90.8	2210.2	85.8	1,921	88.8	1900.6	85.8
<i>Purchased</i>	453	18.8	451.8	17.7	345	13.8	309.6	13.3	355	16.2	544.8	21.1	348	16.1	389.1	17.6
At high price	119	5.0	121.3	4.7	69	2.8	54.1	2.3	110	5.0	162.7	6.3	109	5.0	104.0	4.7
<i>Unpurchased</i>	1654	68.8	1730.3	67.7	1853	74.1	1665.9	71.7	1,636	74.6	1665.3	64.6	1,573	72.7	1511.5	68.2
Improved	297	12.4	372.2	14.6	301	12.0	347.7	15.0	234	10.7	468.6	18.2	213	9.8	314.9	14.2
<i>Purchased</i>	221	9.2	284.4	11.1	221	8.8	273.9	11.8	197	9.0	347.9	13.5	174	8.0	276.5	12.5
hybrid	91	3.8	132.3	5.2	106	4.2	140.6	6.1	110	5.0	196.6	7.6	114	5.3	160.4	7.2
OPV	92	3.8	110.1	4.3	87	3.5	100.1	4.3	71	3.2	121.1	4.7	49	2.3	90.8	4.1
undefined	38	1.6	42.0	1.6	28	1.1	33.2	1.4	27	1.2	57.1	2.2	16	0.7	44.4	2.0
<i>Unpurchased</i>	76	3.2	87.7	3.4	80	3.2	73.8	3.2	37	1.7	120.7	4.7	39	1.8	38.4	1.7
total	2,404	100.0	2,554	100.0	2,499	100.0	2,323	100.0	2,192	100.0	2,577	100.0	2,164	100.0	2,215	100.0

Source: Authors, based on data from UBOS: Uganda National Panel Survey (UNPS) 2013/14; 2015/206; 2018/2019; 2019/2020 (Agriculture Questionnaire)

Notes: 2013/14 (wave 4 agricultural module data collected in 2013 season 1 and 2); 2015/16 (Wave 5 agricultural module data collected in 2014 season 2 and 2015 season 1); 2018/19 (Wave 7 agricultural module data collected in 2017 season 2 and 2018 season 1); 2018/19 (Wave 8 agricultural module data collected in 2018 season 2 and 2019 season 1).

practices over time.³ Figures from these surveys indicate that the share of households using improved seed, as well as the share of cultivated area under improved seeds, is far lower and considerably varied between crops (UBOS, 2014, 2016, 2019, 2020). Tables 1–3 detail the trends in improved variety and quality seed use in Uganda, covering three crops of importance to the country: maize, beans, and potato.⁴

For example, the UNPS data clearly show that use rates for improved maize seed are higher than our other crops of interest (and most other crops covered by the survey). This reflects a well-understood fact about maize: all else equal, farmers are more likely to realize high maize yields when they purchase fresh seed each season, particularly if it is certified hybrid maize seed that embodies the yield advantage conferred by heterosis, and if it has been properly multiplied, tested, and certified for quality.⁵ Despite the importance of seasonal seed replacement for maize, recent studies suggest that just a fraction of farmers use improved maize seed, with an even smaller share using certified maize seed (Table 1; Van Campenhout, Spielman, and Lecoutere, 2021; Bold et al., 2017; Sheahan and Barrett, 2017). This implies that the remaining share of farmers rely on saved seed from a prior season, seed exchanged with neighbours, or seed of unknown provenance, all of which may contribute to lower yields.

For other crops such as legumes, the use of improved varieties and quality seed is possibly less sensitive to seasonal purchases of fresh seed. In many contexts, farmers can readily save seed for several seasons, exchange seed with neighbours, or purchase seed in local markets without necessarily experiencing yield losses (David and Sperling, 1999). The same may apply to field crops such as rice, where seed replacement is primarily a vehicle for varietal turnover (see Kijima et al. (2011) on rice in Uganda). Potatoes and other vegetatively propagated crops, on the other hand, may require more frequent use of fresh seed to manage the accumulation of seed- and soil-borne pests and diseases, and to secure access to new varieties as they are released to the market (see, for example, Gildemacher et al., 2009).

Evidence suggests that increased access to improved varieties and quality seed could go a long way in increasing the social and economic returns to agriculture in Uganda. For example, Joughin (2014) shows that the average yields of Ugandan farmers are just 10 percent of what is potentially attainable for maize and 40 percent for bananas, based on research station trials, although we note that measurement of the gap in yields between research trials conducted under controlled scientific conditions and farmer conditions is only one among many indicators—and often a problematic indicator (Sumberg, 2012)—used to characterize the potential impact of seed sector development.

³ These data points in the UNPS are the result of UBOS's collaboration with the Living Standards Measurement Survey—Integrated Survey of Agriculture (LSMS-ISA) initiative, which UBOS first introduced in the 2013/14 UNPS round. UBOS only introduced the survey modules from LSMS-ISA to generate similar data points in its 2018 round.

⁴ For an in-depth analysis of UNPS data and similar data from the LSMS-ISA in five other countries, see Sheahan and Barrett (2017).

⁵ Key quality indicators for certified seed are acceptable rates of genetic purity, germination, physical purity, and moisture content.

Table 2. Trends in adoption rates of improved beans, Uganda 2013 - 2019

Type of seed	2013/14			2015/16				2018/19				2019/20				
	N	%	Acreage	%	N	%	Acreage	%	N	%	Acreage	%	N	%	Acreage	%
Purchased seed	931	34.5	755.2	32.6	756	28.8	565.2	28.7	656	30.0	552.1	27.9	627	28.4	558.1	28.0
Unpurchased seed	1,767	65.5	1558.6	67.4	1,870	71.2	1401.7	71.3	1,530	70.0	1427.4	72.1	1,580	71.6	1432.1	72.0
Improved	60	2.2	72.1	3.1	26	1.0	27.1	1.4	32	1.5	34.7	1.8	24	1.1	29.6	1.5
<i>Certified</i>	20	0.7	25.7	1.1	13	0.5	15.1	0.8	14	0.6	13.4	0.7	6	0.3	6.6	0.3
<i>Quality declared</i>	32	1.2	32.9	1.4	12	0.5	7.8	0.4	9	0.4	14.7	0.7	18	0.8	22.9	1.2
<i>Unaware</i>	8	0.3	13.5	0.6	13	0.5	8.7	0.4	9	0.4	6.6	0.3	0.0	0.0	0.0	0.0
Unimproved	2,638	97.8	2241.7	96.9	2,537	96.6	1939.8	98.6	2,153	98.5	1944.3	98.2	2,183	98.9	1960.6	98.5
Total	2,698	100	2,314	100	2,626	100	1,967	100	2,186	100.0	1,980	100.0	2,207	100.0	1,990	100.0

Source: Authors, based on data from the UBOS: Uganda National Panel Survey (UNPS) 2013/14; 2015/206; 2018/2019; 2019/2020 (Agriculture Questionnaire).

Notes: 2013/14 (wave 4 agricultural module data collected in 2013 season 1 and 2); 2015/16 (Wave 5 agricultural module data collected in 2014 season 2 and 2015 season 1); 2018/19 (Wave 7 agricultural module data collected in 2017 season 2 and 2018 season 1); 2018/19 (Wave 8 agricultural module data collected in 2018 season 2 and 2019 season 1).

Table 3. Trends in potato seed adoption rates, Uganda 2013 - 2019

Type of seed	2013/14				2015/16				2018/19				2019/20			
	N	%	Acreage	%	N	%	Acreage	%	N	%	Acreage	%	N	%	Acreage	%
Purchased seed	108	38.8	39.5	35.8	106	30.1	53	33.7	86	37.4	49.8	40.2	88	37.4	41.1	32.5
Unpurchased seed	170	61.2	70.9	64.2	246	69.9	104.4	66.3	144	62.6	74.2	59.8	147	62.6	85.2	67.5
Improved	2	0.7	1.3	1.2	7	2.0	3	1.9	6	2.6	5.4	4.4	2	0.9	0.8	0.6
<i>Certified</i>	1	0.4	1	0.9	6	1.7	2.9	1.8	6	2.6	5.4	4.4	2	0.9	0.8	0.6
<i>Unaware</i>	1	0.4	0.3	0.3	1	0.3	0.1	0.1	0	0.0	0	0.0	0	0.0	0	0.0
Unimproved	276	99.3	109.1	98.8	345	98.0	154.4	98.1	224	97.4	118.5	95.6	233	99.1	125.6	99.4
Total	278	100.0	110.4	100.0	352	100.0	157.4	100.0	230	100.0	124	100.0	235	100.0	126.3	100.0

Source: Authors, based on data from UBOS: Uganda National Panel Survey (UNPS) 2013/14; 2015/206; 2018/2019; 2019/2020 (Agriculture Questionnaire).

Notes: 2013/14 (wave 4 agricultural module data collected in 2013 season 1 and 2); 2015/16 (Wave 5 agricultural module data collected in 2014 season 2 and 2015 season 1); 2018/19 (Wave 7 agricultural module data collected in 2017 season 2 and 2018 season 1); 2018/19 (Wave 8 agricultural module data collected in 2018 season 2 and 2019 season 1).

Bold et al. (2017) demonstrate that the revenues from maize cultivation are as much as 78 percent lower due to substandard quality of both seed and fertilizer found in Uganda's input markets, and that farmers' (low) expectations about the quality of inputs constrain adoption of both inputs. Many other studies on Uganda investigate the constraints and returns to adoption of improved varieties and quality seed using a range of methods, including analyses of cross-sectional survey data (Shiferaw et al. (2015) and Kassie et al. (2011) on groundnuts), panel survey data (Sheahan and Barrett (2017) on modern inputs), and data from randomized controlled trials and field experiments (Omotilewa et al. (2018) on improved storage technologies for maize; Vandavelde et al. (2021) on positive seed selection for potato). While many of these studies highlight the important role that farmer awareness and access to information plays in encouraging adoption, others point out that even in the presence of information, market performance—the credible supply of improved varieties and quality seed to farmers—remains a significant constraint.

3 THE EVOLUTION OF UGANDA'S SEED POLICY LANDSCAPE

Alongside this body of evidence on seed systems and markets in Uganda, an interesting policy reform story has emerged. Since the late 1980s—when these issues were still nascent in the literature—Uganda has pursued multiple development strategies and policies, each with the goal of stimulating rapid economic growth, eradicating poverty, and leveraging agriculture as a key driver of change. The latest edition of these—the Second National Development Plan (NDP II)—identifies agriculture as first among the five priorities that will drive industrialization and economic transformation in the country (MAAIF, 2018). Although Uganda's agriculture sector faces a long list of challenges, ranging from highly fragmented landholdings to climate change vulnerability to low levels of commercialization, it is the weak supply of, and demand for, improved varieties and quality seed that is often identified as the agriculture sector's most basic binding constraint.

Uganda's seed sector grew out of a state-run system that operated from the 1970s, fully controlling variety development, seed multiplication, and seed dissemination with support from donor-funded projects. Following liberalization of Uganda's economy in the late 1980s, a number of companies of varying sizes entered the seed market, taking on some of the multiplication and distribution functions that had previously been the responsibility of government. As a result, seed sector participants and commercial seed volumes increased somewhat (Lwakuba, 2012).

But it was not until later that the seed sector received systemic policy attention, first with the introduction of the Agricultural Plant and Seeds Statute in 1994, and then by the Seeds and Plant Act in 2006. As in many other countries, the 1994 Statute and 2006 Act established many of the organizational entities that manage the seed sector today, but also introduced new restrictions that hampered private investment in the sector (Joughin, 2014). Additional restrictions on private sector participation were introduced in a draft of the Seeds and Plant Act Regulations in 2011, although that draft was ultimately rejected by the Cabinet. Still, the seed sector remained highly restrictive as a consequence of multiple factors, including: complicated and time-consuming variety release requirements; restrictions on multiplying and bulking seed by private companies; lengthy, expensive, and time-consuming inspections for certification; and ineffective capacity to regulate seed quality.

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Responsibility for implementation of the 1994 Statute and 2006 Act was distributed across several governmental entities, both existing and new. The Ministry of Agriculture Animal Resources and Fisheries (MAAIF) and its various directorates and departments were responsible for overall implementation. Crop breeding, varietal release, and early generation seed (EGS) production were the mandate of the National Agricultural Research Organisation (NARO). Regulatory oversight was provided for in the 1994 Statute with the creation of the National Seed Certification Service (NSCS), and guidance to the ministry was provided for in the 2006 Act with a National Seed Board (NSB) that ultimately never convened. Other entities provide additional support on issues related to agricultural extension and advisory services, intellectual property rights, environmental health, biosafety, and performance monitoring (Joughin, 2014).⁶ Closely tied to this policy framework and implementation structure are several stakeholder organizations representing private seed producers, agro-input dealer associations, farmer organizations, and other interests.

During this same period, Uganda signed on to a regional initiative aimed at harmonizing seed regulations among and between participating countries to encourage cross-border trade in seeds, increase the overall supply of seed to farmers, and stimulate productivity growth in the region's agriculture sectors. The initiative covered a host of policy and regulatory topics, including varietal evaluation, registration, and release procedures, seed certification standards and processes, phytosanitary measures, plant variety protections, and import/export documentation (Waithaka et al., 2011).

As of 2015, Uganda had 32 registered seed companies producing an estimated 18,000 metric tons of seed, contributing to about 10–15 percent of planted seed in the country (MAAIF, 2018; Bonny, 2015). Maize seed accounted for an estimated 70 percent of this volume, and within this volume, hybrid maize comprised about 31 percent. The seed offerings from these companies also cover sunflower, rice, groundnut, and beans, as well as vegetables, much of which is imported (MAAIF, 2018). But in reality, most farmers continued to depend on own-saved seed, local seed exchanges, and positive selection practices, and participated in the commercial seed market only to a limited extent (UBOS, 2018; Lwakuba, 2012).

Subsequent efforts to strengthen Uganda's seed sector led to the National Agricultural Seed Policy of 2018, viewed by many as the most significant policy change in Uganda's seed sector to date. The 2018 Policy is unique in several ways. First, its principles highlight not only the importance of a private sector-led, market-oriented seed sector in the country, but also one that is (a) pluralistic in terms of the types of seed systems involved in the sector (both formal and informal) and the types of actors involved (public, private, and other nonstate actors), and (b) inclusive in terms of gender and equity. While it may be easy to dismiss these principles as mere pleasantries written to satisfy key interest groups, the language is quite distinct from that found in other models of legislation in the region, particularly in neighboring Kenya (Ayieko et al., 2021; Spielman et al., 2021) and Ethiopia (Hassena et al., 2016).

⁶ Semi-autonomous government bodies such as the Uganda Coffee Development Authority (UCDA) and the Cotton Development Organisation (CDO) operate parallel seed systems for these more commercial and export-oriented crops, while other agencies provide additional support.

As a result, multiple channels now exist to supply seed to farmers. The primary channel still runs through NARO which, as the main supplier of EGS, is the linchpin of the formal seed system. With its limited technical, financial, and physical resources,⁷ NARO supplies EGS of registered varieties to seed producers who, in turn, produce certified seed (“blue labeled” seed) or other seed classes that are then distributed to agro-dealers. Imported seed—primarily for vegetables and other niche market crops—bypasses the seed certification channel and is supplied directly to agro-dealers and farmers, while exported seed produced in Uganda goes through the certification process before being sold to neighboring countries.

Multiple regulatory mechanisms also exist to ensure that farmers receive quality seed, at least in principle. Agro-dealers—those that sell certified seed and thus must be registered with the Uganda National Agro-Input Dealers Association—are not allowed to repackage seed to prevent adulteration. On top of this, NSCS is mandated to conduct routine monitoring of seed stocks in agro-dealer shops to validate seed quality. Similar inspection and monitoring mechanisms exist for quality declared seed (see below), albeit at a lower level of intensity. However, the extent to which these regulatory mechanisms work is a topic of further discussion below.

Second, the 2018 Policy explicitly recognizes the important contribution of informal seed systems on which most farmers still depend in Uganda. Specifically, the policy establishes a new seed class—quality declared seed (QDS)—that enables the production and sale of quality seed for self-pollinated and vegetatively propagated crops by farmers and farmer organizations.

QDS production and marketing operate as follows. First, seed producers—agricultural entrepreneurs, farmer-based organizations, or other small-scale entities interested in multiplying seed of registered varieties—register with MAAIF through their respective District Agricultural Officers (DAOs). These producers are then trained by NCSC in QDS production. The regulatory process to follow is less rigorous than the standard seed certification process, typically requiring only one or two field inspections by DAOs, who themselves are trained and delegated by NSCS to conduct relatively simple seed field inspections. NSCS routinely conducts simple “audit inspections” of the DAOs’ inspection roles. QDS producers are permitted to sell QDS (“green labeled” seed) within the area in which it was produced, a geographical boundary described by NSCS at registration, but cannot sell beyond it. Unlike other community-based seed systems, proponents of the QDS approach view it as one that focuses more on developing viable seed businesses within a community and less on distributing free or low-cost seed to community members in response to shocks (Mastenbroek, 2015b).

Though similar seed classes exist in Ethiopia and Rwanda, neither have advanced QDS production at the same scale as Uganda in recent years, while Kenya does not recognize the class in any form.

The QDS approach has potential to create seed market opportunities when considered against a regulatory status quo that favors stricter quality certification standards. Strict certification regimes were originally established to ensure that seed for critical food

⁷ See Beintema et al. (2018) for detailed patterns and trends in public investment in agricultural research and development in Uganda.

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security crops met minimum quality standards and protected farmers—and national food security—from harm (FAO, 2006). The costs of complying with these standards also tended to favor incumbent actors, especially public seed enterprises. With the growth in private seed companies in hybrid maize and imported vegetable seed, strict certification standards similarly protected their markets from low-quality entrants. However, this has tended to result in insufficient policy attention given to seed for many types of open-pollinated and vegetatively propagated crops in Uganda. QDS offers small-scale seed producers access to quality assurance standards that are less demanding and more affordable than strict, formal certification standards. Crops covered by the QDS regulations include several important cereals (millet, barley, and wheat); legumes (beans, cowpeas, and groundnut), and oilseed crops (soybean and sesame).

Proponents of the QDS system highlight attributes such as its low startup and entry costs, decentralized inspection, and a suite of appropriate technologies that make QDS production potentially profitable for farmer entrepreneurs and farmer-based organizations serving their communities (Mastenbroek et al., 2021). Necessarily, opponents take issue with the potential harm to farmers and crop production that could result from lower-quality seed entering the market.

4 CONTINUED CHALLENGES

Despite these encouraging policy innovations, concerns persist over several overarching challenges. The first and most obvious challenge is the capacity to implement the 2018 Policy. Awareness and information about the 2018 Policy and the regulations that follow from it are still limited among many seed sector actors. Closely related to this—as both a cause and consequence—is the weak supply of and demand for better varieties and seeds in Uganda. This issue warrants further unpacking.

Earlier studies have identified a wide range of problems in Uganda's seed market, many of which are common to the region (AGRA, 2017; Mastenbroek, 2015a; Waithaka et al., 2011; Langyintuo et. al., 2010). Several studies point to insufficient public investment in the requirements of a modern seed industry such as well-funded public crop breeding programs, effective seed inspection services, laboratories accredited by the International Seed Testing Association (ISTA), and plant breeders' rights (Lwakuba, 2012). Other studies highlight the limited technical, scientific, and financial capacity for implementation of the regulatory system (Kiiza and Lwasa, 2008; Kabeere and Wulff, 2008), financial services in support of seed sector growth (Okot, 2011), and a range of other system- and market-level issues (Mubangizi, 2012; Lwakuba, 2012; Stenhouse and Muhuuku, 2006; Larson and Mbowe, 2004). Still other studies focus on the political economy dimensions of seed sector development, in which incumbent political and economic elites and interests leverage their considerable power to thwart substantive policy reforms that would otherwise reduce the benefits they enjoy from the status quo of an imperfect market and imperfect policy regime (Joughin, 2014; Kjær et al., 2012). It remains to be seen how the 2018 Policy will resolve any of these problems, particularly the problem of seed quality loss in the supply chain.

This seed supply chain problem has commanded considerable attention from policymakers, donors, and researchers alike. Over a decade ago, a compelling

narrative emerged around bottlenecks at both upstream and downstream points along the supply chain (Barriga and Fiala, 2020; Bold et al., 2017; Bonny, 2015; Lwakuba, 2012). At upstream points, concerns were raised about the government's capacity to produce and distribute EGS to seed producers of different types and at requisite quality levels.⁸ Highlighted issues included poor practices in maintenance breeding and EGS production at NARO. Especially for crops that rely on vegetative propagation like potatoes, timely access to sufficient and high-quality EGS is an important bottleneck (Vandevelde et al., 2021; McEwan et al., 2021; Spielman et al. 2021). At downstream points where seed producers distribute and market seed to farmers, concerns focused on poor practices in seed production, storage, and handling or, more nefariously, seed counterfeiting at downstream points.

The theoretical consequences of these problems are straightforward and seem to fit with ground realities in Uganda. Higher-quality seed producers have been pushed out by lower-quality producers crowding into an imperfect market, as illustrated by the classic "lemons" problem described by Akerlof (1970). As a result, few legitimate seed companies are investing significantly in the infrastructure, equipment, and other components needed to produce quality seed. Nor are they achieving much success in lobbying for additional public investment in EGS production at NARO or other necessary complements to their business models such as more effective extension and advisory services (Joughin, 2014; Lwakuba, 2012).

Industry structure and market power may also be significant issues at play in Uganda. Smaller farmer-based seed enterprises—including those competing in non-maize seed markets—struggle against larger companies to comply with costly regulations. Those same regulations also tend to limit where they can actually sell their seed, including not just to farmers beyond their locality but also to institutional buyers such as governmental agencies and non-governmental organizations.

Another recent problem, where industry structure and political economy issues intersect, was the shift in the public extension system from National Agricultural Advisory Services (NAADS) to Operation Wealth Creation (OWC), which led to an increased and narrow focus on input distribution (Rwamigisa et al., 2018). The government, through the armed forces that were assigned by direct presidential order to solve logistical problems in the agriculture sector, procured massive quantities of seed from a few selected seed producers. The latter struggled to meet quality standards and required quantities, further crowding out the market for quality seed.

At the same time, and partly as a result of the above, farmers may have chosen not to participate in the market and to instead depend on substitutes such as own-saved seed or exchanges with neighbours. For hybrid maize where fresh (F1) seed is critically important each season, this is a suboptimal strategy. For other crops, informal seed channels may be less problematic and may even provide farmers with perfect substitutes in the short run. But in the long run, farmer non-participation in seed markets can also limit their access to improved traits released in new varieties by both NARO and private companies. From a policy perspective, these concerns draw attention to both the design and implementation of quality assurance regulations within the public sector organizations, along the supply chain, and in the market itself. Not

⁸ For insights into the challenges of distinguishing low-quality seed from counterfeit seed, see Gharib et al. (2021)

surprisingly, opponents of QDS view the introduction of farmer-based seed systems as a distraction from the larger challenge of implementing a strong seed inspection and certification regime, especially for hybrid maize.

These concerns have opened the door to several innovative industry-led solutions. Among the most significant is an e-verification system introduced by Tetra Tech under a project funded by the U.S. Agency for International Development. In the e-verification system, packages of seed and other inputs are labelled with scratch-off labels that provide the buyer with a unique code that can be sent by SMS for instant confirmation of the product's identity and authenticity. An evaluation conducted by Gilligan et al. (2019) found that the e-verification program resulted in a statistically significant 5.4 percentage point increase in the use of hybrid maize seed—a considerable effect size given that only 10.5 percent of households in the control group were using hybrid maize at endline. Similar scratch-off SMS-based verification systems exist for other seed products in Uganda beyond those investigated by Gilligan et al. (2019). However, the impacts of these other systems have not been evaluated with similar levels of rigor.

Other industry-led solutions include agro-processor-led vertical integration. Under these arrangements, processors (or other market agents) supply farmers with seed of a specific variety that meets their processing needs, and condition the seed provision on the purchase of farmers' output at some agreed-upon price point. Elsewhere in sub-Saharan Africa, these arrangements are observed most frequently in the cultivation of barley for breweries, potatoes for chip/crisp makers, and several other crops. However, it remains to be seen how effective such institutional innovations can be in more informal value chains where competition provides ample opportunities for farmers to side-sell (Macchiavello and Morjaria, 2020).

As a more decentralized solution to quality control, a recent experiment uses crowd-sourcing to reduce the asymmetric information that lies at the basis of the "lemons" problem alluded to above. In Van Campenhout et al. (2021), farmers are asked to assess the seed that they bought from agro-input dealers. This information is aggregated and fed back to agro-input dealer and farmers. The idea is that making information about the quality of seed visible downstream will crowd-in quality seed upstream. First results are expected toward the second half of 2022.

The long-term success of solutions such as these are partly determined by broader political economy factors at play in Uganda. Considerable evidence exists of a strong coalition of political elites, their associated business holdings, and patronage systems channelling public resources to support their commercial interests, block policy reforms that threaten their interests, or otherwise protect their economic and political advantages (Kjær and Joughin, 2012; Kjær et al., 2012). However, as Joughin (2014) points out by drawing on a series of studies synthesized in Kjær et al. (2012), this coalition tends to intervene when structural conditions allow benefits to be readily captured, as was the case in Uganda's dairy sector but not the fisheries sector. There is little documentary evidence to suggest that this coalition has intervened in or captured the seed sector per se. Rather, the seed sector itself may be a vehicle for the coalition to secure continued support from its base—smallholder farmers—through the supply of seed and other inputs via OWC, which, as a program implemented by the army, is itself closely tied to the coalition. This possibility may, in turn, disincentivize the

government from introducing many of the substantive policy reforms required to accelerate seed sector growth (Joughin, 2014). For example, reforms designed to improve quality assurance systems could result in higher seed production costs, a share of which could be passed on to smallholder farmers. At the same time, it may be that some actors in the seed sector themselves are content with the status quo, including the opportunities created by large-scale public procurement contracts and low levels of credible regulatory oversight.

In spite of these political economy factors, it is still possible for continued experimentation in Uganda's seed sector to change the seed policy landscape toward greater private sector engagement, pluralism, and innovation. The coalition of seed companies, governmental organizations, and bilateral donors has, in effect, made this possible by advancing many of the innovations described above. In the absence of attention from the ruling elite, these innovations may have significant policy influence. Alternatively, they may simply persist as innovations on the margin, and the policy landscape may change slowly or not at all as a result. This suggests the need for continued attention to seed sector development in Uganda, including the policy and regulatory dimensions of the development process.

5 CONCLUSIONS AND POLICY RECOMMENDATIONS

So where are the gaps in Uganda's seed policy landscape, and where are the opportunities for change? Clearly, a major challenge remains on the policy implementation front. While the 2018 Policy envisions creation of a vibrant and pluralistic seed sector, much still needs to be done: creating clear procedures and guidelines for seed enterprises, developing producer and regulatory capacity, improving EGS access, and strengthening farmer engagement in the sector itself, as both producers and consumers of seed. This needs to be accompanied by improvements in agricultural extension and advisory services, which currently seem to prioritize quantitative targets for seed distribution over the development of farmers' technical capabilities.

Challenges also remain to advancing a vision of an integrated seed sector in which the boundary between stylized "formal" and "informal" systems is blurred and a broad range of seed sector actors operate across these imaginary boundaries to provide farmers with both improved varieties and quality seed. Introduction of the QDS class is a step in that direction insofar as it supports small-scale, farmer-led seed businesses. But the associated regulations seem to place a rather tight boundary around who can participate in QDS production, which crops are permissible, and where QDS can be sold. Easing these restrictions or expanding this boundary could go a long way in improving access to affordable seed for many farmers, provided that sufficient public and private investment is allocated to support these seed businesses.

All of these efforts will ultimately hinge on efforts to address the political economy aspects of seed systems and markets in Uganda. Industry structure, market power, and elite capture may all stand in the way of a reasonably competitive seed market, even despite the experiments and innovations observed to date. And without competition, seed companies are unlikely to make long-term investments in delivering improved genetics and quality seed to farmers in a timely manner.

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DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

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