



Seed Systems in Uganda: Review of Present Status and Future Needs

EDEMA, R.^{1,2}, MBABAZI, S.T.¹, ADEBO, A.O.^{1,3} and DRAMADRI, I. ONZIGA^{1,2}.

¹Makerere University Regional Center for Crop Improvement, P.O. Box 7062, Kampala, Uganda

²College of Agriculture and Environmental Sciences, Makerere University, P.O. Box 7062, Kampala, Uganda

³College of Natural Science, Makerere University, P.O. Box 7062, Kampala, Uganda

Corresponding Author: redema14@gmail.com

ABSTRACT

Seed systems provide a foundation for agricultural development. Agriculture is the dominant occupation in the continent, employing 70% of the population in Africa and 68% in Uganda. If governments are to transform rural areas and their people, investment has to target agriculture and the seed sector must be a high priority. Globally, tremendous gains have been achieved by using quality seed because crop performance as well as response of other inputs in crop production largely depends on the seed material planted. It is estimated that good quality seeds of improved varieties can contribute about 20-25% increase in yield in general, and much more in specific cases where new varieties overcome major disease problems. The seed industry in Uganda and other developing countries is however still evolving and faces numerous challenges. The Ugandan seed laws recognize the existence of only two seed systems, formal and informal seed systems, with almost exclusive emphasis on the formal systems. However, actual seed systems are very diverse when all crops and types of producers are considered. In this paper, the seed industry in Uganda is described in terms of five distinct Seed Systems in regard to seed production and supply: Formal Seed System, Cash Crop Seed System, Informal Seed System, Community-based Seed System and Individual Private Seed Producers and Seed Sellers. The current laws do not legitimize and strengthen the role of the various types of non-formal seed production and distribution in relation to variety release policy, production capacity for foundation seed, and quality control-- yet 95% of the planting material does not go through, and will not in the foreseeable future, go through the formal seed certification channels. In addition, farmers are not empowered enough to create a sustainable demand for seed at a scale that provides much incentive to registered seed companies/producers. Although the government revolutionized extension services through establishment of a semi-autonomous organization, the National Agricultural Advisory Services (NAADS), support to farmers as well as to seed companies from the public extension services has been inadequate and erratic. There is no clear policy on how the decentralized extension services to district local governments could be empowered to complement the few seed quality control agents at the national level and to aid the operation and quality control of non-formal seed systems.

In light of these various challenges, the focus of this paper is to describe: 1) Seed-related policies and the current organization of the seed production and supply systems in Uganda, 2) Challenges along the seed value chain for various types of crops, 3) Characteristics of a diversified seed system that can effectively serve all farmers, regardless of crop and scale of production, and 4) Steps toward creation of a vibrant farmer-centered seed system.

Keywords: Agricultural development, seed systems, Uganda

RÉSUMÉ

Les systèmes de semences constituent la base du développement agricole. L'agriculture est la principale occupation sur le continent, employant 70 % de la population en Afrique et 68 % en Ouganda. Si les gouvernements veulent transformer les zones rurales et leurs habitants, l'investissement doit cibler l'agriculture et le secteur des semences doit être une priorité élevée. À l'échelle mondiale, d'énormes progrès ont été réalisés en utilisant des semences de qualité car les performances des cultures ainsi que la réponse aux autres intrants de la production agricole dépendent largement du matériel de semence planté. On estime que des semences de bonne qualité de variétés améliorées peuvent contribuer à une augmentation d'environ 20 à 25 % du rendement en général, et bien plus dans des cas spécifiques où de nouvelles variétés surmontent des problèmes majeurs de maladies. Cependant, l'industrie des semences en Ouganda et dans d'autres pays en développement est encore en évolution et fait face à de nombreux défis. La législation sur les semences ougandaises reconnaît l'existence de seulement deux systèmes de semences, formels et informels, avec une des systèmes formels. Cependant, les systèmes de semences sont très divers lorsque l'on prend en compte toutes les cultures et tous les types de producteurs. Dans cet article, l'industrie des semences en Ouganda est décrite en termes de cinq systèmes distincts de semences en ce qui concerne la production et la fourniture de semences : Système de Semences Formel, Système de Semences de Cultures Commerciales, Système de Semences Informel, Système de Semences Basé sur la Communauté et Producteurs de Semences Privées Individuelles et Vendeurs de Semences. Les lois actuelles ne légitiment pas et ne renforcent pas le rôle des différents types de production et de distribution de semences non formelles en ce qui concerne la politique de libération de variétés, la capacité de production de semences de base et le contrôle de la qualité, alors que 95 % du matériel de plantation ne passe pas par, et ne passera pas dans un avenir prévisible, par les canaux officiels de certification des semences. De plus, les agriculteurs ne sont pas suffisamment habilités à créer une demande durable de semences à une échelle qui incite fortement les entreprises/producteurs de semences enregistrés. Bien que le gouvernement ait révolutionné les services de vulgarisation en créant une organisation semi-autonome, le Service de Conseil Agricole National (NAADS), le soutien aux agriculteurs ainsi qu'aux entreprises de semences de la part des services de vulgarisation publics a été insuffisant et inconsistant. Il n'y a pas de politique claire sur la manière dont les services de vulgarisation décentralisés des gouvernements locaux de district pourraient être habilités à compléter les quelques agents de contrôle de la qualité des semences au niveau national et à aider le fonctionnement et le contrôle

de qualité des systèmes de semences non formels. À la lumière de ces différents défis, l'objectif de cet article est de décrire : 1) Les politiques liées aux semences et l'organisation actuelle des systèmes de production et de fourniture de semences en Ouganda, 2) Les défis le long de la chaîne de valeur des semences pour différents types de cultures, 3) Les caractéristiques d'un système de semences diversifié capable de servir efficacement tous les agriculteurs, quelle que soit la culture et l'échelle de production, et 4) Les étapes vers la création d'un système de semences et dynamique centré sur les agriculteurs.

Mots-clés: Développement agricole, systèmes de semences, développement de l'Ouganda

Introduction

Seed is a critical input in agricultural production and the use of good quality seed is a prerequisite for satisfactory production of a good quality crop for food and income.

Scientifically, the definition of a true seed is a mature ovule, consisting of an embryonic plant, a store of food (cotyledon and endosperm) and a protective seed coat. In a broad sense and in the context of this paper, seed is any plant material which is used for planting a crop or propagation of plants. In this paper, seed refers not only to the structurally true seed, but includes any other propagating materials such as seedlings, tuber, bulbs, rhizome, roots, cuttings, setts, slips and grafts used for production purposes.

Venkatachalam Venkatesan (1994) stressed the need for the countries in sub-Saharan Africa to put in place a seed system which would meet the seed needs of a wide range of farmers, classified according to their risk tolerance capacity and resource endowments. The author recommended a mix of strategies emphasizing the relationship between the seed system and other services to farmers such as research, extension, rural infrastructure and marketing. In Uganda, only about 5% of the planting material used by farmers passes through any formal system of quality control. Given the current extreme inadequacy of seed production and quality control systems in Uganda, establishment of a comprehensive seed system that addresses all crops and all types of farmers

needs to be an extremely urgent national priority.

Seed systems provide a foundation for agricultural development. Agriculture is the dominant preoccupation in the continent, employing 70% of the population in Africa and 68% in Uganda. If governments are to develop and transform rural areas and their people, investment has to target agriculture with the seed sector as a first priority. It is through seed that agriculture can be transformed as evidenced by the Green Revolutions in other parts of the world: as examples-- Latin America through wheat, Asia through wheat and rice and America through hybrid maize. Seed is often the first major new technology adopted, with other production-enhancing investments built around seed: e.g. fertilizers, good crop management practices and eventually market for produce.

Tremendous gains have been achieved by using quality seed because crop performance as well as response of other inputs in crop production largely depends on the seed material planted. It is estimated that good quality seeds of improved varieties can contribute about 20-25% increase in yield in general, and much more in specific cases where new varieties overcome major disease problems. Attaining quality seed however requires prudence among those involved in the seed value chain. Quality seed must be genetically pure: breeder/nucleus 100 %, foundation seeds 99.5%, certified

varieties seeds 98%, certified hybrid seeds 95%. It should have physical purity of 98% for all crops; and free from other crop seeds, objectionable weed seeds and designated diseases. It should have high germination and vigor (physical quality); and optimum moisture content: cereals 10-12 %, pulses 7-9%, oilseeds 6-7% and vegetables 5-6%.

The importance of quality seed has been recognized since time immemorial (records indicate before 2000 BC) and seed quality has been treated as an important factor in the improvement of agriculture and livelihood of farming communities. By the 5th century seed technologies such as seed treatment was already in place. For instance, seed was dressed with milk, cow dung, honey, vidanga, etc. to protect it during germination and ensure good germination (<http://agriquest.info/>). Although the need for organized seed production in developing countries was identified only at the beginning of 20th century, the notion that good quality seed increases the yield potential of the crop and is one of; the most economical and an efficient input to increase crop production and productivity is widely spread. The Food and Agriculture Organization (FAO) recognizes the pivotal role of seeds in agricultural development and many governments have embraced the need to establish sustainable seed production systems for increased agricultural production. They have put in place seed policies to ensure that farmers are protected from poor quality seed particularly from unscrupulous traders.

Country profiles show that at least 25% of sub-Saharan African countries Uganda inclusive have passed a Seed Act stipulating specific seed regulations that must be satisfied to protect the farmer from poor quality seed. Uganda together with countries such as Nigeria, Malawi, Mali, Zambia, South Africa and Burkina Faso is one of the few African countries where a large number of farmers do purchase seeds of improved varieties. However, the seed industry

in Uganda and other countries is very diverse, still evolving and faces numerous challenges. Probably the greatest challenge is to address the needs of the farmers for quality seeds when the vast majority of planting material used by them is not and cannot be addressed through the formal certification channels (Louwaars and Boef, 2012; Louwaars *et al.*, 2013).

The focus of this paper is to describe:

- a) Seed-related policies and the current organization of the seed production and supply systems in Uganda.
- b) Challenges along the seed value chain for various types of crops.
- c) Characteristics of a diversified seed system that can effectively serve all farmers, regardless of crop and scale of production.
- d) Steps toward creation of such a seed system.

Seed systems in Uganda today – Seed related policy and sector organization

Seed production and distribution in Uganda is guided by a national agricultural seed policy (2011) which has been on review. The goal of the national seed policy is to ‘significantly contribute to increased agricultural production and productivity for improved standards of living and food security through the use of high-quality seed’. The seed policy recognizes the existence of two systems: formal and informal seed systems. It puts an emphasis on public-private partnerships towards the development of a vibrant formal system seed industry, with the public sector being responsible for providing an enabling environment for private investment. It aims to transform the informal seed system into a viable and commercial sector through capacity building, linking the sector to research, creating sustainable formal markets locally, regionally and internationally through harmonization with regional and international conventions and protocols, and establishing quality control mechanisms. The Seed and Plant Act (2006) provides for the promotion, regulation and control of plant breeding and

variety release, seed multiplication and marketing, seed import and export, and quality assurance of seeds and planting materials while the Seed and Plant Regulations (2009) provide guidelines for enforcement of the Act. The Plant Variety Protection Bill (2010) is aimed at granting plant breeders' rights over their innovations and attracting investment in the seed industry. Besides national legal framework, Uganda is party to the Convention on Biological Diversity (CBD), which aims to regulate the trans-border movement of germplasm. It is also a signatory to the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), and to the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization.

In Uganda the seed policy recognizes existence of only two seed systems, formal and informal seed systems, with almost exclusive emphasis on the formal systems. However, actual seed systems are very diverse when all crops and types of producers are considered. For example, the seed systems of Zambia have been characterized in Louwaars et al. (2013).

In this paper, for purposes of discussion, the seed industry in Uganda is described in similar, but not identical terms, considering five distinct Seed Systems in regard to seed production and supply: Formal Seed System, Closed Value Chain, Informal Seed System, Community-based Seed System and individual private seed producers and seed sellers. In Table 1, Individual Private Seed producers and sellers are included in the community-based associations, but these have differing motives and types of operations compared to the community-based associations, it seems useful to categorize them separately.

The Formal Seed System is a system in which seed of tested quality and of released varieties

Table 1. Seed Systems in Zambia, as Identified in the ISSD-Africa project

Seed system	Farm-saved seed (FS)	Community-based associations (CB)	Community-based NGOs and public (CN)	National companies (NC)	International companies (IC)	Closed value chain (CV)
Type of crop(s)	local food crops	food and crops	food crops (roots and tubers)	food and cash crops	High-input cereals	closed value chain crops
Major crops	cereals and pulses	cereals and pulses	cassava and sweet potato	maize, beans, soy bean, and groundnut	maize and wheat	cotton, tobacco, malting barley
Type of varieties	local	local and improved	improved	improved	improved	improved
Type of system	farm-saved, informal	informal, quality declared and certified	quality planting material and informal	certified	certified	certified
Dissemination system	farm-saved and exchange, informal markets	exchange, local marketing	NGO distribution and local marketing	marketing, agro-dealers, and government dissemination (maize)	export, marketing, agro-dealer networks, and government dissemination (maize)	input package

Source: based on Nakaponda 2011; Self Help Africa 2011.

is produced following stipulated regulations. Under the formal seed system seed production is characterized by a structured and well-defined procedure involving research/plant breeding to produce a variety, seed multiplication, processing, marketing and distribution and, quality control and certification. Regulations are available for varietal purity, physical and physiological quality aspects following crop and seed inspection, testing and labeling. The seed is sold as certified seed and the production is organized on a commercial basis. Under this seed system, farmers do not own the seed but rather part with money to have it. Key players in the Formal seed system include the public domain involved especially in research and quality assurance while private domain handle the production and marketing of the seed.

Closed Value Chain applies to crops whereby the input package and the marketing functions of the produce are handled by an entity dedicated to that specific crop. These entities can be parastatal; in which the government directly or indirectly controls the activity; or fully private, in which the government may have some regulatory role, but not have a controlling financial interest.

The Informal Seed System is as old as agriculture itself in Africa where farmers save seed from the previous harvest, exchange with neighbors, receive donations from relatives and friends or buy grain from some source like local markets. It is sometimes referred to as Traditional or Local Seed System and with this system it is mostly the local land races that are passed on over generations. In general, such varieties have low yield potential and in some instances the seed is a mixture of several varieties. Seed production and supply is not regulated at all, thus the seed produced/saved is not certified. It is operated by the private domain mainly by individual farmers.

Community-based Seed System is where

farmers organize themselves either in groups or communities to produce seed of selected crops and varieties, initially for the members and subsequently for sale either directly to other farmers, or through an established seed company. Unlike in the informal seed system, attention is normally placed on improved varieties as well as improved seed quality. Community-based seed system is an improvement of the informal seed system and is a step towards formal seed production. It is operated by the private domain with support from NGOs and public extension services.

Private individual seed producers and sellers as described in this paper differ from seed companies in that they operate informally, without being registered as a business. They differ from the informal system in that they have a profit motive and devote considerable time to their seed-related activities. They differ from the community-based system in that they are individual and private. These private small operators are almost completely neglected, but critical component, of a viable seed system for crops and markets with little profit potential for larger seed businesses.

Crops may be categorized according to seed distribution patterns into six groups which have considerable overlap with the seed systems that supply them: i) “Closed Value Chain” – planting material provided by single-crop commercial ventures (sugarcane, coffee, cotton), ii) Distinctly profitable for seed companies (maize, sunflower, etc.)-potential seed sales represent a large portion of the acreage, company-managed distribution to small - scale producers, iii) Marginally profitable for seed companies (beans, sorghum, millet, etc.) – potential seed sales represent a small portion of the acreage—company-managed distribution to larger buyers (Govt., NGO’s, community-based seed producers, private sellers), iv) Only profitable for specialty producers (especially tissue culture, bananas,

cassava, sweet potato, etc.) – primarily relevant to large-scale producers/distributors, v) Primarily local distribution following delivery of substantial quantities to the region/district/local area by larger-scale seed distributors (self-pollinated crops), vi) Primarily local distribution almost entirely through the non-formal system.

Governments should recognize and encourage the potentially beneficial role of all of the different types of seed producers and sellers, and the different seed supply channels involved. There must be an enabling environment and infrastructural support provided by the government to all these participants in seed supply and delivery.

In Uganda there are many government agencies with activities relating to seed systems. These include the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) and her semi-autonomous organizations with specialized mandates including National Agricultural Research Organization (NARO) (responsible for research, conservation and sustainable use of plant genetic resources), Cotton Development Organization (CDO), Uganda Coffee Development Authority (UCDA) and National Agricultural Advisory Services (NAADS). Others include Public universities; the National Tree Seed Centre (NTSC) under the National Forestry Authority (NFA) of the Ministry of Land, Water and Environment; and Local Governments at the district level responsible for provision of agricultural extension services. MAAIF discharges its role through statutory agencies, the National Seed Board (NSB), Variety Release Committee (VRC), and National Seed Certification Services (NSCS) operating under her Crop Protection Department; and previously through former Uganda Seed Project which ended following IMF/World Bank Structural Adjustment. The public domain only thrives as long as government puts in money and is

characterized by inefficiency due to bureaucracies and lack of business model.

On the other hand the private domain effectively includes all non-government agencies. Most focus has been on registered seed companies with almost total neglect of private individual seed sellers. Laws pertaining to and facilitation of registered seed companies have received and continue to receive much attention. These seed companies provide an important service in seed production and delivery. The larger companies use either local or foreign-bred varieties and sometimes have breeding programs for their most profitable crops. The registered seed companies include local home grown seed companies e.g. FICA, Naseco, Victoria, Pearl, Equator, Masindi, Otis Garden; regional companies e.g. Kenya Seed Company, Seed Co, Pannar; and multinationals e.g. Monsanto, Pioneer and Syngenta. There are also emerging companies for vegetative propagated crop seeds such as Agro-genetic Technologies (AGT) and Bio-Crops limited which produce mainly tissue culture plants of crops like banana, pineapple and Irish potato for planting. The regional companies tend to focus mainly on maize, and often depend on production that is outside the country of sale. The supply may not be regular as home country policies may ban seed export. The multinational companies, because of their company policies never or rarely take up varieties from national programs, yet these varieties are more adapted and take care of farmers' desired traits. They only do business if the market is large and therefore profitable to a large company. Therefore, their main focus is on one crop (maize) yet farmers grow a wide array of crops. The local companies are more appropriate, produce a wide range of crops and have wide spread network in rural areas.

There has been a shift from public seed companies to private local, regional and multinational seed companies. The number of

private seed companies increased from 2007 to 2013 for instance in: Burkina Faso from 1 to 9, Ghana 1 to 15, Ethiopia 2 to 33, Tanzania 5 to 48, Nigeria 1 to 74, Uganda 5 to 23 and Kenya 25 to 109 (Bigirwa, 2014). The amount of seed (MT) produced by government before liberalization versus what local companies produced in 2013 contrast sharply. For instance in Nigeria before liberalization Government produced 5,000 MT while in 2013 local companies produced 22,685 MT, in Uganda before liberalization government produced 3,500 MT but after liberation local seed companies produced 15,833 MT and in Tanzania it was 4,800 MT and 8,284 MT, respectively.

Investment in plant breeding must be continuous and adequate to ensure that breeders have resources to run effective breeding program with adequate supply of foundation seed to seed companies. There is need to strengthen local foundation seed supply, develop public-private sector partnerships in foundation seed supply, have policy to support liberalization of foundation seed supply, Increase the capacity of public sector supply for breeder seed. Foundation seed of newly bred varieties need to be made accessible to the informal sector and well-trained and equipped extension services need to be deployed to advise on seed production, processing, treatment and storage. There is need empower larger seed companies to produce foundation seed for sale to smaller companies, develop the capacity of small and medium-sized seed companies to produce their own foundation seed and to liberalize laws regulating foundation seed production. While the seed companies play a very important role in the seed system, the reality is that about 95% of seed in Uganda is provided by the non-formal system. Previously, most of that has been by the completely informal system. Recently, there has been increased activity in the semi-formal system (community-based seed system

and private individual seed producers and sellers). The semi-formal system has been getting support because of the recognition of the limitations of the formal system to deal with crops that do not produce much profit to formal seed businesses (Louwaars and de Boef, 2012; Louwaars et al., 2013).

The over-riding issue for agricultural development, food security, and income generation in the country is the supply of quality seed to the farmer. While regulations are necessary and important, seed systems will only deliver quality seed if all seed providers are sufficiently motivated to do so. The motivation for providing quality seed differs for the different types of suppliers. Some of the motivating factors include:

- a) The legal provisions and enforcement of the seed law and the certification system
- b) The reputation of registered seed companies as it affects their competitiveness and market share
- c) The altruistic motives and the reputation of NGO's
- d) Community sense of responsibility and pride in the case of community-based seed production
- e) The personal reputation and long-term profitability of private individual seed producers and sellers, including market sellers.

The following diagram, taken from Figure 2 of Louwaars and de Boef (2012), shows the interaction of the formal and non-formal systems. Note that in the informal system, most movement of seed occurs within the local community, where people know each other, and the motivations of personal reputation, continued sales potential, and community benefit encourage a quality supply of seed. In such cases, the main limitation on seed quality is not legal or regulatory in nature, but rather technical knowledge and access to improved genotypes and high-quality foundation seed.

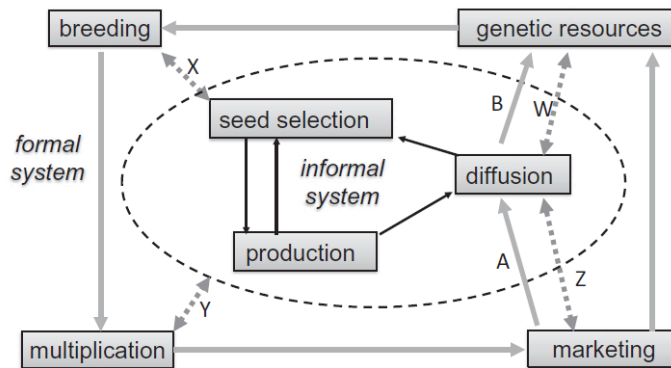


Figure 1. Interaction of formal and informal seed systems

→ Flow within the informal system
 → Flow within the formal system with two interactions with the informal system
 ↔ Reciprocal flow within between the formal and informal system

Source: From Figure 2, Louwaars and de Boef, (2012)

As previously stated, government policy needs to value all the various types of seed producers and sellers, and create an enabling environment and infrastructural support for all of these types to survive and thrive. Only then will quality seed of improved varieties of the majority of important crops be provided to the farmers. The needed components of quality include:

- Genetic purity including assurance that the seed is of the stated variety
- Physical purity - absence of weed seed, dirt, etc.
- Physical quality/germinability
- Freedom from diseases.

There is need to promote and ensure internal quality control and appropriate-level accreditation by all seed producers; train seed companies and private individual seed producers in seed inspection and other aspects of quality control; allow strengthened seed companies to self-regulate; strengthen and professionalize associations of different types of seed producers; strengthen seed trade associations to effectively hold their association members accountable and to be respected and trusted allies of government; strengthen Seed Regulatory Agencies to play oversight roles.

and strengthen public private partnerships in quality assurance and certifications (e.g. training, inspection etc.). In addition, there is need to enact and enforce legislation that ensures legal actions/punishment against seed companies for violations of truthful labeling and against all the activities of counterfeit seed traders. Seed inspection training courses need to be widespread. The capacity of non-formal seed system participants to deliver quality seed needs to be greatly enhanced. It is essential to be aware of and strengthen the non-formal system, and to appreciate and provide for the legitimate role and activities of the non-formal system. This is a major paradigm shift, but essential for agricultural and national development.

One of the main issues in farmers obtaining good quality seed is that of poor-quality seed being readily available. That will only change when there is a regular and adequate supply of high-quality seed, so that farmers can identify and choose seed from reliable suppliers. The non-formal sector is a key to that supply, and must be encouraged by government policy and support.

Challenges along the seed value chain

Policy issues and production capacity.

Although the above seed-related policy and legal framework appear appropriate to deal with the commercial seed sector, there are many challenges in the seed value chain (seed sector) in Uganda limiting sustainable seed production and supply especially to smallholder farmers. The current seed law in Uganda does not adequately address the overall needs of farmers, especially small farmers. Currently the UPOV-based Ugandan variety release policy has stricter DUS, testing and performance requirements than necessary for varieties not entering international trade, therefore limiting access of farmers to useful genotypes (Louwaars *et al*, 2013). There is need for a 2nd tier system that provides quality assurance for genotypes that have value to farmers but which do not meet the full certification requirements of the current system. Sometimes new potential varieties developed by the breeders would be beneficial to farmers within the country or local area, but do not quite meet the UPOV standards or the release requirement of a substantial demonstrated superiority over all currently registered varieties. This may be especially true when the “improvement” is simply a matter of farmer or consumer preference, something which is not given sufficient importance in the current law. In addition, local varieties/land races meet certain needs for particular qualities, and provide seed to farmers in the absence of availability of “improved” seeds. These purposely bred varieties and useful local land-race varieties that do not meet the demanding release requirements need some form of legal status in order to provide enforceability of quality standards. While the main quality assurance on these types of varieties will come from personal and community motivations of the local producers/sellers, without some form of legal status, sellers of fake or poor-quality seed feel free to operate without even any threat of legal action. There is a provision in current seed law in Uganda for “Quality Declared

Seed,” but the actual operation of this provision is not clear and does not seem to have received much attention.

Besides the need for more flexible legal release/registration mechanisms, there is a critical need for more reliable availability of foundation seed (the seed from which certified or commercial seed is produced). Usually, the mandate for the production and distribution of foundation seed of publicly-bred varieties fall under the public breeders. Government financial support of foundation seed production is inadequate and inconsistent, and many donors do not see this activity as an area of priority investment. In addition, foundation seed production makes demands on breeders’ time, yet usually does not contribute to the breeders’ promotion or income. Although NARO has credible scientists and some of her institutions are centers of excellence for some crops in the region, the number of well-trained breeders is still far from adequate, and these scientists are completely overwhelmed by the multiple demands on their time. These few well-trained plant breeders are always tempted to leave NARO for employment in other institutions or countries where their services are better compensated and where they anticipate circumstances will allow greater opportunity to use their skills effectively. Limited financial resources and human capacity, coupled with weak incentives, severely hinder adequate production of foundation seed production. This leaves seed companies and all other seed producers with limited access to quality foundation seed. There needs to be a self-sustaining mechanism for supporting foundation seed production, and this mechanism will differ dramatically for the different types of crops.

Quality control in seed production and sale is supposed to be provided through the formal seed certification system. This has legally and functionally been the sole responsibility of

public seed regulatory agencies. These agencies are terribly understaffed and underfunded. The available seed inspectors are inadequate to meet the certification needs of maize alone. It is almost impossible to envision how the existing seed certification system can be expanded adequately to provide quality control across all crops, at all stages of seed production and sale, in all places, when the final users of seed are mostly small-scale farmers scattered throughout the country. Sustainable seed supply through constant and adequate supply of foundation seed to seed companies to increase farmer access to certified quality seed is far from adequate. Mechanisms need to be found to encourage and legally protect new approaches to supplement the existing system, especially for food security crops of little interest to registered seed companies.

The negative impact of fake and low-quality seed being sold to farmers cannot be overstated. Farmer awareness of the value of improved varieties is increasing rapidly. This has caused a greatly increased demand for seed amidst weak quality control mechanisms. Therefore, unscrupulous profit seekers in the seed market chain routinely adulterate the little seed produced as a result of inadequate foundation seed. Farmers, especially those in remote areas such as Karamoja, Kasese, Koboko, etc., hardly access certified quality seed unless through support from NGOs or government programs like NAADS and NUSAF who can buy seed directly from the big commercial seed companies. Therefore, farmers seeking to purchase improved varieties are often supplied with “seed” that is nothing more than market grain, of inferior genetic composition, and which may not even germinate.

Whereas Uganda’s economy is liberalized and all the seed related policies emphasize public-private partnership, there is still dominance of the public sector in seed production with limited private sector participation hindering

development of sustainable seed systems. The national policy is not clear on how private sector’s contribution to the development of the seed system can be recognized and enhanced. This lack of an enabling policy environment negatively affects seed companies, and even more so the non-formal sector of seed production. The seed companies have limited equipment, limited capital investment and very weak market strategies. They basically gamble and operate at high cost. As a result, most of the companies operating in the country are interested in hybrid seed and seeds of a few high-value crops mainly of grain crops so that they can recover their high costs of production. They rarely deal in cultivars or varieties of important food security crops such as cassava, banana, potato, etc. Government support through policy or otherwise to seed companies has not been adequate to ensure that farmers have access to quality certified seed including of their traditional food security crops. The scale and profit potential of registered seed companies will lead to improvements in that sector through competition at national and regional levels if an enabling policy environment is provided. The greater challenge is to develop sustainable systems for the many food-security crops that are of little interest to registered seed companies.

Farmer awareness and empowerment.

Extension services to link the farmers to reputable seed providers and research in order to access quality seed of newly released varieties is limited. Although government revolutionized extension services through establishment of a semi-autonomous organization, National Agricultural Advisory services (NAADS) instead of an understaffed and poorly facilitated bureaucratic extension department, support to farmers as well as to seed companies from the public extension services has been inadequate and erratic. There is no clear policy on how the decentralized extension services to district local governments

could be empowered to complement the few seed quality control agents at national level. There is a systematic lack of functional structures to enhance participation of the private sector in seed trade and distribution.

Farmers are not empowered enough to create a sustainable demand for seed at a scale that provides much incentive to registered seed companies/ producers.

Extension services remain fundamental for effective seed production and distribution and thus the success of agricultural development. Government needs to empower extension agents technically and with logistics for timely delivery of advice to farmers including on agronomic practices so that they can exploit the full potential of improved varieties. Governments need to provide extension agents transport facilities and other incentives to motivate them.

The shift of government programs like NAADS and NUSAF to distribution of free seed to farmers is not sustainable and will never increase demand for seed. It is rather a recipe for creation of a vulnerable community which is a vicious bottleneck in seed sector development. If this approach is continued, farmers will develop habits of waiting for seed handouts whose supply has never been timely. Therefore, the farmers will plant late and will be extremely vulnerable to the increasing unpredictability of the rains. This can weaken even farmer-based seed systems and lead to the severe reduction of agricultural output in general. Government needs to empower farmers through creation of an enabling environment to acquire their own seed.

Government also should invest in general infrastructure and services that will enhance agricultural development in general. Highest priority should be on farmer-friendly policies and on marketing infrastructure. Improved seed production, quality and supply will have a much greater impact on food-security,

improved livelihoods, and general agricultural and national development if there are strong market incentives for farmers to produce more.

What should seed systems look like in Uganda in the future?

Feistritzer (1975) outlined four key roles of improved seed: a carrier of new technologies, a basic tool for secured food supply, a principle means to secure crop yields in less favorable production areas and a medium for rapid rehabilitation of agriculture in case of natural disaster. Regardless of whatever seed systems will be adopted in the future, exploiting these seed roles especially at a time of climate change, population explosion and rapid soil degradation will be fundamental. Thus, it is urgent and imperative that Uganda's seed system is developed to meet the diversity of needs present in the country. Commercial seed production and marketing should cover a range of crops including seeds of vegetative crops. Effective seed laws and regulations are in place and linkages with actors outside seed sector well established. The use of improved seed should be widespread and effectively guided by a vibrant extension system. Other factors that influence seed productivity such as soil fertility, water for irrigation, seed treatment and storage, equipment for proper and timely tillage, etc. should be widely improved. There is need for strong strategies and investment for promoting fertilizer use and irrigation for seed production, especially in the current era of climate change. Modern plant breeding methods and biotechnological advances should be embraced in a timely manner in the seed industry.

The various laws and policies need to be adequately implemented and thus adequate logistical, financial and human resources should be provided. There is need for timely enactment and efficient implementation of seed laws. MAAIF need to build the capacity of District level Agricultural departments to support seed inspection. Seed polices should be

clear on the strengthening and involvement of extension agents.

Since farmer saved seed, and community- and private-individual based seed distribution will supply the vast majority of seed for the foreseeable future, there is need to consider the role of extension agents in helping provide widespread, locally-based quality control. Strategies for traceability of the seed should be developed and penalty on selling adulterated seed should be enforced. Universities should continue reviewing the curriculum or drafting specialized seed courses and produce relevant all round seed scientists who can facilitate both production and regulation of seed technologies, and facilitate the effective transfer of these technologies to large and small-scale farmers.

Characteristics of a sustainable seed system.

Strong seed systems are largely operated by the private sector in developed countries. Therefore, governments ought to look at private companies as partners and not predators to be shot on sight. Sustainable seed systems thrive on mutual partnership whereby the public and private sector need each other to create employment and serve farmers with improved seed. Government will need to create an enabling environment, play a suitable regulatory role, and fix friendly royalties (2-4% of sale revenue) on commercial seed sales as a primary funding mechanism of varietal improvement and foundation seed production. Vibrant seed companies are a key way that varieties from research will be widely available to the benefit of farmers. On the other hand, seed companies should recognize that the reason for their existence is to serve farmers, putting their long-term market share and reputation ahead of short-term profit based on substandard practices. Seed companies must honor their commitments such as paying royalties promptly, reliably producing and distributing adequate supplies of commercial seed, foundation seed, and where applicable, breeder's seed. Seed companies must also self-regulate quality.

Sustainability of quality seed production by registered seed companies will be obtained mainly through the effects of competition on market share. A much bigger need and challenge is the development and maintenance of sustainable seed production for seed of crops not effectively supplied by the commercial seed companies.

What needs to be done?

To ensure that the farmer gets high-quality seed there is need for many improvements in the current system and for encouragement of new initiatives to provide for the crops and circumstances that have been neglected in the current system. The changes needed include:

- a. Strengthening certification activities with more officers, more budget and adequate training.
- b. Realistically assessing the role of seed certification. There is need to assess its limitations in relation to how it can work for:
 - 1) all crops at the foundation seed level,
 - 2) a large portion of the acreage of industrial crops, crops with high-profitability to seed companies, and commercial first-level multiplication of crops by tissue-culture,
 - 3) the less profitable crops that are nonetheless handled by seed companies,
 - 4) widely-scattered community seed production schemes, and
 - 5) for crops/varieties distributed almost entirely by the completely informal system and private individual seed producers.
- c. Recognizing that the certification system, because of its dependence on government financial support and administration, cannot sustainably play a dominant role in ensuring seed availability and seed quality across the

- multitude of crops and locations of production and sale.
- d. Recognizing that sustainable systems of seed distribution and quality assurance will only be sustainable if all participants in the system obtain some profit.
 - e. Establishing a pragmatic legal framework that results in enforcement of penalties against commercial seed businesses that sell poor quality seed. Working with foundation seed providers to ensure access to adequate quantities of high-quality foundation seed.
 - f. Strengthening community-based seed producers by encouraging associations of community-based seed producers.
 - g. Working with government and NGO's to provide training in technical and financial management to community-based seed producer.
 - h. Providing the training for groups/associations of individual private seed producers as well as groups/associations of individual private seed sellers.

It is critically important to put in place a comprehensive system that is sustainable and produces a competitive seed sector to provide farmers or seed users with good quality seed in respect of varietal identity and purity, germination capability, specific purity and seed health. This will require extensive discussion among all stakeholders, envisioning and piloting innovative approaches to deal with food-security crops, and substantial financial public and private investment. Multiple types of future, go through the formal seed certification channels.

Only then will there be the needed improvements in the crop production that is based on the 95% of planting material that does not go through, and will not in the foreseeable

functional public-private partnerships need to be created. Relevant legislation needs to be efficiently implemented that addresses the needs of the formal and the non-formal sectors to ensure that seed is produced and distributed with appropriate quality controls. Plant breeder's rights in both the public and private sectors should be protected in order to provide incentives for development of new varieties. If these various needs are effectively addressed, there will be rapid improvement in Uganda's agricultural production, and the well-being of her people, both rural and urban.

Conclusion

Uganda requires a coordinated effort between the public (government, NGO's, and community-based systems) and the private sector (both commercial companies and individual seed producers/sellers) in seed development, production, and marketing for both crops of national interest and traditional food security crops. The public sector needs to invest more in plant breeding and development of new varieties and extension services and empower the private sector in seed production and marketing, particularly by putting in place a genuine enabling policy environment. There should be a clear legal framework for private seed companies to access publicly-bred varieties adequately; Seed policy should also help promote an efficient integrated seed system with vibrant seed quality assurance mechanisms. The most critical, but also the most difficult and controversial, policy interventions are those of legitimizing and strengthening the role of the various types of non-formal seed production and distribution.

Statement of no conflict of interest: The authors declare that there is no conflict of interest in this paper.

References

- Kabeere, F. 2011. African Seed and Biotechnology Programme/Integrated Seed Sector Development in Africa: National Seed Sector Assessment -Uganda. Report submitted to University of Wageningen, the Netherlands (on behalf of the African Union). 113 pp..
- Kabeere, F. 2012. Baseline Survey Report on the Project: Quality Assurance to Promote Production and Use of Certified Seeds in Uganda. Report submitted to AGRA.
- Louwaars Neils P., Walter S. de Boef and Edeme, J. 2013 Integrated Seed Sector Development in Africa: A Basis for Seed Policy and Law. *Journal of Crop Improvement*, 27 (2): 186-214, DOI: 10.1080/15427528.2012.751472
- Minot .N, 2008. Promoting a Strong Seed Sector in Sub-Saharan Africa. IFPRI Policy Brief 6. September 2008. <http://www.ifpri.org/sites/default/files/publications/bp006.pdf>
- Minot, N., Smale, M., Eicher, C., Jayne, T. Kling, J., Horna, D. and Meyers, R. 2007 Seed Development Programs in Sub-Saharan Africa: A Review of Experiences. Paper prepared for the Rockefeller Foundation, Washington, DC: IFPRI
- Mubangizi, E., Nandagire Ntamu, D., Mwesigwa Thembo, W. and Marja Thijssen, 2012. Uganda Seed Sector Assessment, ISSD Briefing Note – September 2012. <http://agriquest.info/index.php/quality-seed-and-its-importance-in-agriculture> downloaded 14/10/2014.
- Niels P. Louwaars and Walter Simon de Boef. 2012. Integrated Seed Sector Development in Africa: A Conceptual Framework for Creating Coherence Between Practices, Programs, and Policies, *Journal of Crop Improvement* 26 (1): 39-59. DOI:10.1080/15427528.2011.611277
- Report of the Fourth African Green Revolution Forum held in Addis Ababa, Ethiopia, from September 1-4, 2014
- Venkatachalam Venkatesan. 1994. Seed Systems in Sub-Saharan Africa: Issues and options: Pages: 126. SBN: 978-0-8213-3086-9; <http://dx.doi.org/10.1596/0-8213-3086-1>
- <http://www.agriquest.info/index.php/quality-seed-and-its-importance-in-agriculture/61-quality-seed-and-its-importance-in-agriculture>