

10 Development of Small and Medium-Sized Seed Companies in Africa: The AGRA Experience

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Key Messages

- 1** The supply and uptake of seed of improved crop varieties is now firmly established as key to increased productivity and food security in African agriculture.
- 2** Private seed companies and private agrodealers have emerged as a viable channel for supply of seed to farmers, who have shown their willingness to purchase new seed.
- 3** The African small and medium-sized seed company has proven its viability in a range of different working environments.
- 4** Whereas the progress in parts of Africa has been promising, many countries have not had the opportunity to benefit from the regular supply of improved seed; that should now represent a priority for governments and development agencies.

Introduction

Perhaps one of the most significant developments in African agriculture of the past decade has been the emergence of improved seed supply for smallholder farmers as a major priority of governments, the private sector, and development agencies seeking to help Africa's farmers increase their productivity, income, and nutritional status. Previously viewed as a relatively minor factor in the lives and livelihoods of Africa's smallholder farmers or as "one among many" factors that influence farmer productivity, today the supply of quality seed of high-yielding resilient crop varieties is viewed as virtually a sine qua non of increasing yields on a broad scale in Africa.

The evidence for improved seed being a major catalyst in increasing farmer productivity in Afri-

ca is strong. Firstly, there is the strong precedent for the role of seed in modernizing agriculture. Throughout history and around the world, sustained increases in agricultural productivity and rural economic growth have been catalyzed by the introduction and broad adoption of seed of improved, locally-adapted crop varieties which make more efficient use of sunlight, water, and soil nutrients, resist pests and diseases, and mature more quickly (Pingali, 2012). Secondly, there is the intense interest being expressed by Africa's farmers in new, higher-yielding, earlier-maturing varieties—and being willing to pay for the seed. Increasing farmer demand for improved seed has contributed to the emergence of a growing number of private seed companies, which have increased the supply of certified seed in several countries (Access to Seeds Foundation, 2019).

Numerous countries in Africa have now undergone a transformation of their seed supply

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system which has allowed farmers to adopt and cultivate high-yielding varieties (Das et al., 2019; Kamoga, 2019). The uptake of hybrid maize technology in Uganda, where supply of seed of new, disease-resistant, drought-tolerant, hybrid varieties closely paralleled the increase in yields, is shown in Figures 10.1 and 8.2. Similar scenarios are currently playing out in other countries, including Ethiopia, Rwanda, Tanzania, Zambia, and Ghana (Sanchez, 2015; *The Economist*, 2016).

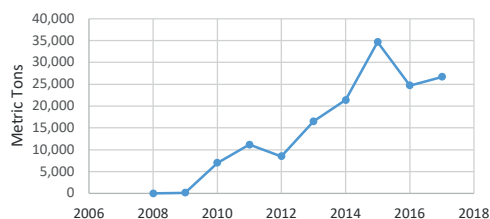


Figure 10.1. Supply of improved seed by private, national seed companies in Uganda, 2006–2018

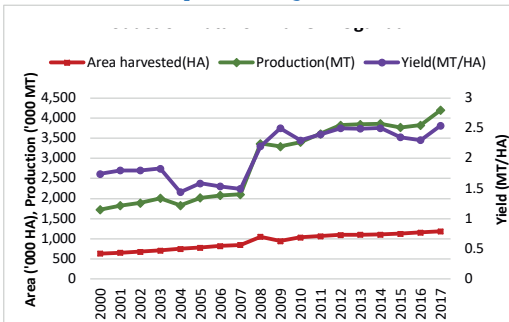


Figure 10.2. Maize cultivation data for Uganda, 2001–2017

It is probably no coincidence that the countries which have consistently registered increases in average crop yields have been the focus of ample investment by governments and donor institutions in the development of their seed value chains, from the education of crop breeders and seed professionals to seed production, and commercial seed supply networks. The comparison of cereal crop yield levels between African countries which have received significant international support for the development of public–private seed supply systems and those which have received little or no support is likewise quite striking, as shown in Figure 10.3.

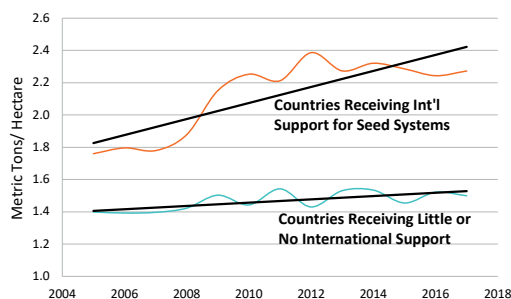


Figure 10.3. Maize and rice crop yield trends in various African countries, 2005–2017

Note: Trendlines for PASS countries including Burkina Faso, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Tanzania, Uganda, and Zambia. Proposed countries include Angola, Benin, Botswana, Burundi, Chad, Cote d'Ivoire, Democratic Rep. of Congo, Eritrea, Guinea, Madagascar, and Togo.

Source: FAOSTAT.

Emerging models for production, distribution, and uptake of improved seed in Africa

Arriving at this juncture has come as a result of considerable effort, trial, and error. Developing professional seed supply systems for the African continent—with its wide range of food crops, diverse array of agro-ecologies, and large number of countries, each with its own set of policies and institutions which influence seed supply among farmers—was never going to be a simple matter. It has required a massive push on crop breeding by national agricultural research institutes, the CGIAR, and several major seed companies to develop and release the catalogue of improved crop varieties that are now available for commercialization. This effort has been matched by private sector investment in the production, packaging, distribution, and sale of seed of the new varieties through decentralized, demand-driven supply systems. Keys to success in the development of sustainable seed supply systems include:

- Degree-based training of a critical number of plant breeders and seed scientists to the level of MSc and PhD.
- Active support to public crop breeding teams to identify and release a series of improved crop varieties that are well suited to local crop environments.
- The establishment of a critical number of private independent seed companies which produce, process, package, and market improved, adapted seed of staple food crops.
- The broad popularization of seed of the new varieties among local farmers through private sector-led extension activities.
- The building of a network of private, village-based agrodealers to supply seed at village level.
- Active review and reform of national seed policies which constrain public and private entities engaged in supply of improved seed.

But perhaps the most critical factor of all these keys to success is that they must all be conducted together, at the same time, in a true value chain fashion. Implementing only one or two of these activities in isolation, as was often the case in the past, will produce very limited and short-lived results. The sustainability of a seed system relies on all the areas of work being set in motion in one package.

Viewed from this perspective, the progress registered over the past 15 years or so has been very encouraging. Farmers in many countries are now aware of the benefits of planting quality seed of improved, adapted varieties, and are increasingly buying them at private agrodealer shops selling a range of seed, fertilizers, and other production technologies. Equally important, farmers are increasingly using the new

seed within a package of improved production practices to achieve double and triple the harvests they were previously producing on their farms.

Nevertheless, high rates of population growth, climate change, and the sheer vastness of the African agricultural landscape mean that the task is far from complete. Tens of millions of African farmers still do not have dependable access to seed of improved crop varieties, and most of these farmers live in the most vulnerable countries with respect to food security and climate change. Some African countries still do not have a single private seed company operating within their borders. In others, seed companies operate under the burden of policies put in place when the State was the sole supplier of improved seed. And despite the good progress being made by crop breeders, a full range of improved varieties adapted to African conditions have still not been developed for several of the continent's critical food crops.

Looking back on the developments of the past several decades in the field of seed systems development, several important innovations stand out as key to the progress made. This chapter will attempt to identify some of these key innovations as a means of documenting progress, and also as a means of identifying weaknesses and gaps in the current set of investments, actors, and institutions which drive seed supply among Africa's farmers. The views expressed here are based on the author's experience with seed supply systems across approximately 17 African countries through his work with the seed initiative of the Alliance for a Green Revolution in Africa (AGRA), known as the Program for Africa's Seed Systems (PASS).

Breakthroughs in crop breeding; innovations in seed supply

The PASS initiative was implemented over a 10-year period between 2007 and 2017, and was funded by several major donors, including The Rockefeller Foundation, the Bill and Melinda Gates Foundation, the United States Agency for International Development (USAID), the Dutch Government, and the Howard G. Buffett Foundation. In all, PASS invested approximately US\$285 million dollars in 4 major areas: the education of plant breeders, crop breeding and variety release, seed production and seed company development, and agrodealer training and development.

A key under-reported area of innovation in the development of African seed systems has been the collective advancement made by many crop breeders employed within the CGIAR system, the national agricultural research systems (NARS), and the private sector in breeding high-yielding, stress-tolerant, earlier-maturing, and nutritionally-enhanced varieties of critical African food crops. Their breakthroughs in introgressing unique genes for traits of importance to African smallholder farmer production systems into modernized genetic backgrounds that are adapted to African conditions has undoubtedly been a major step forward for African agriculture.

Examples of how crop breeding has improved the resilience and productivity of African crop species are now too numerous to mention. Several that represent major breakthroughs include:

- Resistance to maize streak virus, *Turicum* leaf blight, and other foliar diseases of maize.
- Tolerance of drought in maize.

- Resistance to angular leaf spot, anthracnose, and other foliar diseases in beans.
- Development of high beta-carotene levels in sweet potato.
- Resistance to the parasitic weed *Striga* in sorghum and cowpea.
- Hybridization of maize, sorghum, and millet adapted to African agro-ecologies.
- Resistance to rust in soybean.
- Resistance to *Cercospora* leaf spot and rosette virus in groundnut.
- Resistance to the viral pathogens which cause mosaic and brown streak disease in cassava.
- Resistance to black Sigatoka disease in East African highland banana.
- Earlier maturity in maize, sorghum, rice, millet, bean, cassava, and cowpea varieties adapted to African agro-ecologies.

Africa's crop breeders have achieved these results by using new farmer-participatory methods of breeding which treat farmers as genuine partners in the enterprise of crop genetic improvement, and by screening new candidate varieties in more stress-prone environments. Moreover, their willingness to venture outside the realm of research and work hand-in-hand with private seed companies has meant that this time around, the varieties have not remained trapped on the shelves of research institutions. Involving farmers in breeding activities and interacting regularly with the private sector has required breeders to take a different approach to their vocation than was previously the norm, and is likewise still a work-in-progress. But more and more, African farmers are gaining access to seed varieties with truly unique and valuable traits that help them reap greater economic value from their labor.

First and foremost, among the innovations that have driven seed supply forward in Africa in recent years is the advent of the private small or medium-sized African seed company as a viable actor in the seed supply chain. Coming in a wide range of origins, ownership structure, and product ranges, the private for-profit seed company has been of inarguable importance in establishing greater volumes of seed supplied to African farmers on a regular, dependable basis, as well as a means of updating the pool of genetic products available on the market—of “getting seed off the shelves” of researchers in many countries. Their continual need for better products in order to survive in an increasingly competitive market has driven these newly-formed and newly-expanded seed companies to work closely with public crop breeders. This in turn has driven the introduction of many new varieties into testing and release processes which otherwise would never have been introduced. Juxtaposed against a long history of monopoly control by public seed agencies, centrally-planned seed schemes, and sporadic seed supply initiatives from non-governmental organizations (NGOs), the private seed company has served as a classic example of positive disruption within agricultural systems across much of the continent.

If today the private seed sector in Africa is widely considered to be an important factor in farmers’ hopes for increasing their productivity, it is important to recall that this is still a very recent innovation, and that the sector is still in a phase of rapid evolution. Tracing the current status of private investment in seed supply back to its roots is perhaps a useful exercise in considering what the next steps should be, and how similar processes might be promoted in other countries.

In April 2006, as AGRA was opening its doors at its headquarters in Nairobi, Kenya, it faced a major dilemma. Central to its theory of change

for achieving an African Green Revolution was the assumption that thousands, and eventually millions, of smallholder farmers within its 13-country program area would gain access to quality seed of higher-yielding, resilient crop varieties, allowing them to increase their crop yields and lead to widespread intensification of cropping systems. Proof of concept for this approach was readily available from the history of agricultural development in other developing regions of the world, including North America, Latin America, and Asia (Vietmeyer, 2011). Moreover, several new, higher-yielding crop varieties had recently been released, with more on the way (The Rockefeller Foundation, 2006). Yet regular, dependable supply of seed of improved varieties was still a major challenge in most countries.

Whereas seed markets had been established for some time in Kenya, Zambia, and Malawi, supply was mostly limited to maize seed of varieties developed for the high-potential agro-ecologies of those countries. This left out millions of farmers in marginal production zones, some of whom depended on crops other than maize as their primary source of energy, and required on a range of more drought-tolerant crops. The situation in the other countries was even less promising. Supply of certified seed to smallholder farmers depended on sporadic funding from governments and donors working through public agencies, NGOs, and farmer groups. Farmers were unsure from year to year whether seed would be available, and had no control over which variety would be supplied, or even which crop species would be targeted (Joughin, 2014). Seed supplied through centralized distribution schemes often arrived too late to be planted, and was of undetermined origin, variety, and purity. In many cases farmers did not even plant it, and instead consumed it as food. In some countries, these seed supply schemes are still in operation.

The rise of African small and medium-sized seed companies as a viable option

AGRA took its signal for how to resolve the seed supply dilemma from a small group of private seed entities operating in several countries. In the beginning, these were mostly weakly-organized, ad hoc businesses or groups which initially lacked full documentation and legal status to be recognized as seed companies, but which likewise were not cooperatives or associations of farmers. What they had in common was: 1) a central decision-maker and manager; 2) a rudimentary knowledge of how to produce and handle seed; and 3) a belief that they could respond to farmer demand for better seed as a profit-making business. Surprisingly, these groups were beginning to emerge in all countries and regions of Africa where AGRA operated, from Mozambique and Uganda and in Mali, Burkina Faso, and Ghana. From these original “grassroots” entrepreneurs, AGRA took its signal to invest strongly in the business opportunity of small and medium-sized seed companies across its full program area. To ensure the ability of the emerging companies to market seed at farmer level, it likewise set out to develop networks of agrodealers in every country.

AGRA's approach was thus firmly oriented toward development of the private, agribusiness sector as the main supplier of improved seed. Given the unconvincing history of seed supply in most countries, AGRA decided to avoid most of the prior approaches, and instead invest in a new system, one which would be based on local entrepreneurship combined with a belief in smallholder farmers' ability to choose—and willingness to purchase—better seed, provided they are aware of the benefits of the new varieties. Most of the emerging local seed companies were small but had the advantage of being able to operate profitably on very small volumes of seed sold. Equally important, they had a very

good understanding of the farmers who bought their seed, and were using innovative ways of marketing seed, including rural radio advertisements, sponsoring radio quiz shows where the prizes were packages of seed, building and deploying mobile seed kiosks, using sales agents on motorcycles to circulate among shoppers during village market days, and deploying vans with loudspeakers to drive through rural towns.

In summary, the advantages of small and medium-sized seed companies, observed across 17 African countries over the course of 10 years, include:

- Their legitimacy and their voice, contributing to policy reform: The voices of the owners of these private, tax-paying companies, led by local citizens, has been heard in their respective countries, resulting in policy changes that would have taken many more years to achieve by project leaders and international advocacy specialists.
- Their built-in dissatisfaction with old varieties: Young, emerging seed companies seeking to distinguish themselves from the old seed supply system are not motivated by producing and selling seed of outdated, standard crop varieties. Their individual and collective clamoring for newer, better varieties which allow them to compete more strongly for farmer demand has helped to refresh the crop genetic base in the countries where they operate.
- Their longevity: The average lifetime of a small and medium-sized seed company stands in sharp contrast with the lifespan of most donor-funded projects. Even the relatively long-lived PASS initiative, which received funding over a period of 10 years, has now faded into history while over 80% of the seed companies it helped bring to life are still operating, planting seed, and looking forward to the next sales season.
- Their knowledge of smallholders' needs: Small and medium-sized seed companies

operate in close proximity to smallholder farmers, and hence are able to anticipate emerging crop production trends and respond by supplying the seed of the trending crops. Recent examples of seed supply by small and medium-sized companies which could not have been supplied by larger entities or public agencies include sesame, pigeon pea, groundnut, and indigenous vegetables.

- Their efficiency: Small and medium-sized seed companies have lower cost structure, and are able to offer quality seed to farmers at a lower cost than other seed producers. They are well-positioned to understand how much farmers will pay for seed, and how much seed they want to buy. This has sparked a flurry of innovation in seed package size, price, availability, and positioning. In short, local seed companies create “buzz” of the type local farmers respond to.

Establishing a small and medium-sized incubator for seed supply

The scenario on the ground in these countries was, nevertheless, challenging. As AGRA continued to search for private sector partners capable of future growth it was often observed that, “The people who have money don’t understand the market for seed among smallholder farmers, and the people who do understand it don’t have the money to act on it.”

AGRA took out advertisements in national newspapers, inviting applications from private groups to compete for “start-up grants” of up to US\$150,000 over a period of 2 years. From hundreds of applications received in each country, it sifted out those which were most promising, based on reputation, understanding of farmers’ seed needs, and a common vision for how the future of seed supply should look.

Seed company investment funds were aimed at allowing organized seed production companies to travel to research stations to learn about new crop varieties, to plant larger seed production farms, rent warehouse space, develop their seed brand, process, treat, and package their seed, and finally to engage in marketing activities, including supplying seed for sale by village-based agrodealers. Grant funds were not allowed to cover capital expenditure.

Meanwhile, each emerging seed company was enrolled in a series of intensive training modules given at two central locations—the University of Nairobi for seed companies from English-speaking countries and the University of Thies, Senegal, for those from French-speaking countries. Over a period of approximately 10 years over 1,000 trainees from private seed companies in 22 countries earned certificates in seed business management. In addition, each company received regular visits from international seed industry experts, plus AGRA’s own seed program officers, to provide them with real-time advice and coaching. And, as the network of agrodealers was grown through a separate series of investments, seed companies were given information about their location, interests, management, etc. Finally, AGRA sponsored periodic national meetings of its grantees in crop breeding, seed production, and agrodealer development together with the seed regulatory body and farmers to discuss progress made toward meeting farmer demand in each country. These gatherings allowed seed company staff to interact freely with key upstream (breeders, heads of research, and regulators) and downstream (agrodealers and farmers) actors to discuss issues relevant to their prospects for growth and profitability. Such gatherings also helped public sector actors gain an appreciation for the risks and difficulties faced by private seed companies, and helped reduce the tensions between the two groups.

As companies began to outgrow the limitations of hand-sorting and hand-packaging of seed, AGRA commissioned a study aimed at identifying the world's lowest-cost seed processing equipment manufacturers. A Chinese firm, Shijiazhuang Sanli, was the clear winner on a cost basis, offering a full set of seed cleaning, sorting, treating, and packaging machines capable of processing up to 6,000 MT of seed per year at a cost of approximately US\$50,000, delivered. The machinery from Sanli carried the added advantage of being able to run on a modest-sized generator when electricity supply failed. Many emerging companies which were given the contacts of Sanli eventually purchased the machinery, and continued to use it during their early growth stages.

In essence, AGRA's intervention was aimed at establishing a series of vertically-integrated seed companies capable of planning, producing certified seed (and, eventually, foundation seed as well), processing, storing, and packaging the seed, and delivering it for sale to farmers via agrodealers. This effectively replaced the previous, public supply system with one which was more driven by farmer demand, and which could grow to meet increasing demand. Interestingly, many of the newly-minted seed companies were owned by people who had previously served as government-contracted seed growers but who had seen the limitations of the previous system, and believed they could do it better. As such, AGRA did not introduce new concepts as much as simply enable and bring to fruition ones that had already taken root in the minds of local individuals.

To ensure it respected its US IRS requirements for operation as a public charity, AGRA insisted that each company which received its support would preferentially target poor, smallholder farmers living in areas where seed supply was lacking, that it would sell its seed at a 10% discount off prevailing seed prices, and that it

would re-invest the proceeds from the sale of seed in the growth of the company. Program officers charged with sponsoring the seed company grants were also charged with ensuring compliance to these requirements. In practice, however, these measures were strongly in the interest of the companies' growth plans, and the companies saw the wisdom in presenting a sympathetic human face to the needs of poor farmers. One chief executive officer of an emerging seed company in Mali was quoted as saying, "No farmer who enters my shop will leave without some seed, even if they can't afford to buy any." This kind of solidarity was seen in practice across many of the new, private seed operations, and helped earn the respect of smallholder farmers who were often encountering packaged seed of field crops for sale in shops for the first time.

Over the course of 10 years, PASS directed funds provided by its donors into the establishment and growth of a total of 114 seed companies in 17 countries. A survey of these companies conducted in 2018 revealed that 82% of those which had received some level of start-up funding were still in operation at least 3 years after the end of the grant support. In 2018 these companies produced, in aggregate, approximately 142,000 MT of certified seed. Based on AGRA's estimate of average seed demand per smallholder farmer of 8 kg, these companies can now supply the seed needs of approximately 18 million farmers.

A common complaint among seed companies as their grant funding ended was the lack of access to loan capital for growth. Very few banks were willing to provide loans to local seed companies, and even when they were, the interest rates charged on such loans were too high for small seed companies to pay. In response, AGRA funded private fund managers operating in Uganda and Ghana to make commercial or semi-commercial loans and equity investments

in private emerging seed companies in East and West African countries respectively. From these negotiations, AGRA eventually placed a total of US\$17 million with the regional fund managers Pearl Capital, Ltd, of Uganda and Injaro Agricultural Holdings of Ghana. These funds were subsequently disbursed as loans to 19 private seed companies. Loan sizes ranged from US\$350,000 to US\$2 million. More recently, AGRA contributed US\$3 million toward the creation of a third small and medium-sized seed company investment fund, the Seeds for Impact fund managed by the African Enterprise Challenge Fund, which makes concessional loans and grants valued at US\$350,000 to US\$1.5 million to seed companies with less than US\$10 million in annual turnover operating in 12 countries in Africa.

Nevertheless, the size to which the seed companies grew was sometimes sobering. A rapid analysis of the levels of production and supply of 44 of the companies which had received AGRA's assistance conducted in 2018 revealed that 63% of them were still marketing less than 1,000 MT of certified seed annually, and only 10 (23%) were producing over 2,000 MT every year. Four companies, however, managed to grow to over 10,000 MT of seed sold per year, including two private, independent companies operating in Nigeria and Uganda and two companies owned by regional governments in Ethiopia.

Anecdotal evidence of how seed systems are progressing in these countries include several unplanned outcomes, including:

- The emergence of non-AGRA-supported seed companies based on the observed success of the AGRA grantees.
- The entry of regional and multi-national seed companies into African seed markets where they were not present or had been previously and were abandoned.
- Increased cross-border seed trade.

Taking stock of progress in seed supply in Africa

In the face of such great need, real world results seem to always fall into a category of, “could do better”. Sub-Saharan Africa's annual seed requirements easily top 2 million MT, and it is unlikely that even 500,000 MT are currently being produced and sold each year. Yet the progress made by Africa's small and medium-sized seed companies, likewise, cannot be ignored. In fact, viewed against the history of previous attempts at getting seed supply moving in Africa, the results are startlingly good.

As such, it is worthwhile to take stock of what worked, what went well, and what, in retrospect, could have been done better.

In the category of what worked, the results broadly accrued to three areas of investment: 1) financing; 2) training; and 3) policy changes. These are considered separately.

1) One-time cash transfers to start-up private seed companies. The proposal to grant funding to private companies of any kind, including start-up seed companies in Africa, proved controversial in some circles at the time it was introduced. Among field staff, however, the resistance was minimal. They were keenly aware of the challenges these companies were up against. These included the long history of public seed supply, which meant that farmers were unaccustomed to buying their own seed, unaccustomed to having to make choices among several seed products, and, in the beginning, found the prices charged by private seed companies to be more than what they were thought to be worth.

The novelty of private seed supply likewise meant that many hidden barriers also existed within the seed policies and procedures, such as the restrictions on the production and sale of early generation

seed, and the high fees and highly formalized systems for certifying seed. This also meant that nearly all the expertise in seed production, and nearly all the existing infrastructure and equipment for seed production and processing were held by public sector. The lack of experience and expertise among the first generation of private seed operations meant they were destined to make many errors of both a technical nature and of business judgment. A frequent trend among the first entrepreneurs was to focus preferentially on seed production and processing, while devoting a minimum of attention to seed marketing. Many of the first companies likewise over-emphasized producing their own seed on owned or rented land instead of setting up production contracts through out-growers. Few companies or producers owned irrigation systems, warehouses, or processing machines. Many were producing seed of recently released crop varieties which were poorly known or unknown by farmers. Even the retail points of sale needed to market the seed produced by private companies was in most countries nonexistent, and had to be developed through separate investments in agrodealers.

2) **Training seed company professionals.**

All seed company chief executive officers were vetted carefully by AGRA through routine grant-making procedures. Nevertheless, many lacked long-term experience in seed production or marketing, and most of their staff likewise lacked strong experience in the sector. AGRA's investment in training came in two main categories: on-site visits from internationally-qualified specialists in seed production and seed business, and more formal training sessions in Kenya (for English-speaking trainees) and Senegal (for French-speaking trainees). Week-long module courses were organized and given

to cohorts of approximately 25 students in the areas of production, processing, seed business management, seed marketing, and quality control. The composition of each cohort included seed company staff from up to 10 or more countries, who were often eager to share their experience and learning with fellow students. Students often learned as much from each other as they did from the lecturers.

- 3) **Changes in seed policy.** It was not surprising that seed policies put in place when seed supply was mostly carried out by state institutions were not conducive to growth of the private sector. What came as something of a surprise was the rapidity with which many governments amended their policies and practices when AGRA and its partners presented them with evidence for the need for reforms. In fact, although much remains to be done in the area of seed policies in Africa, governments deserve credit for the many ways they have listened, and taken action.

Perhaps no single policy was more debilitating for private seed companies than the insistence that all early generation seed be produced by public sources. As seed markets grew and additional seed companies entered the market, foundation seed supply became a serious bottleneck in all countries. Ethiopia's fast-growing seed sector was the first to experience this issue, and among the first to permit private seed companies to produce foundation seed for their own needs and even sell foundation seed of public crop varieties to other seed companies. Mali likewise did not hesitate to liberalize the production of foundation seed when supplies began to run short. Ghana's revised seed law, which went into effect in 2011, likewise freed up foundation seed production for private seed companies and also relaxed the condition which

previously required that all certified seed be packaged in bags produced and sold by the seed regulatory body.

What went well

Perhaps the most important outcome is the way farmers came forward and purchased the new seed, thus dispelling once and for all the myth that Africa's smallholder farmers are too poor to buy certified seed. Seed company managers have many stories to tell about the intense demand for their seed among farmers. This anecdotal evidence was backed up by a large survey carried out in 2015 in six African countries which showed that even in areas affected by long-term stress farmers were paying cash for their seed from local sources (McGuire & Sperling, 2016). In many cases, the key to convincing the poorest farmers has been to reduce the package size, from standardized packages of 15 kg or more to 2 kg, or even 1 kg packages. Wide distribution to farmers of 50 g sample packs which they could plant on a small area on their farm at little risk helped convince farmers to return the following season and purchase larger quantities.

Hybrid maize seed has been the most prominent seed product sold by such companies. Less well known, but equally important has been the uptake of improved seed of beans, millet, cowpea, sorghum, pigeon pea, groundnut, and other so-called orphan crops. In a survey of 46 small and medium-sized seed companies from 13 countries conducted in 2018, a total of 32 companies reported selling seed of 4 or more crop species (Agri-Experience, 2019). These companies sold 48% of their seed through agrodealers or via direct sales to farmers. Moreover, the bulk of their seed was from varieties that were less than eight years old. While meeting the full demand among farmers has proven difficult for small and medium-sized companies, the fact that farmers have shown high levels of demand for seed of these crops has exploded the myth that

private sector will never focus on seed of orphan crops, and greatly increases the likelihood that measures will be taken to alleviate the shortages.

Lessons learned

Without a doubt, the greatest oversight by the AGRA program was underestimating the need for increasing farmer awareness of the advantages of the new seed. While the program contributed funds to seed companies, breeders, and agrodealers to carry out on-farm trials and demonstrations, the level at which these groups were able to carry out extension activities was always limited, and far less than what was needed to ensure that all farmers learned about the benefits of the new varieties. Raising farmer awareness around improved seed is a critical, stand-alone activity. Moreover, new methods for promoting improved seed, such as the distribution of tiny, 50 gram packages for free to farmers attending field days or market promotion events, together with SMS messaging, recruitment of village-based advisors, and radio programs are deserving of their own source of support. African agriculture has many hundreds of new crop varieties and seed products that urgently need to be brought to the attention of smallholder farmers using these new, private sector-friendly methods.

A second error made was in under-estimating the effort required to broker transactions between public breeding programs and private seed companies. Although the opportunities for mutual benefit from collaboration between the groups were self-evident, historical divisions between the public and the private sector constrained the delivery of new varieties to farmers. As the number of newly-released varieties began to climb into the hundreds, AGRA employed two full-time officers as "product managers", whose role was to focus on this gap between breeder and seed company. The officers often had to go to great lengths to ensure transactions were made, and the new varieties

were put into production at-scale, in some cases, even helping to draft licensing agreements to negotiate the terms of royalty agreements.

Lingering threats to Africa's small and medium-sized seed companies

Seed subsidies

Given the proven willingness of farmers to buy their own seed, the persistence of public seed subsidy programs, implemented at high cost to taxpayers and donors, is puzzling. Subsidy programs which supply seed via public outlets undercut agrodealers on which seed companies depend on for their sales networks, often leading to the demise of many agrodealers. Subsidy programs which buy and distribute seed from unscrupulous “briefcase” seed companies directly undermine the business of small and medium-sized seed companies (O'Connor, 2017). When seed subsidy programs source their seed from these seed companies they often drag down the quality of seed being offered by otherwise competitive players. While large subsidy programs may succeed in providing access to better seed among very poor farmers more quickly than those farmers would be converted to customers of seed companies, they also tend to supply lower-quality seed of older, lower-yielding, and less-resilient varieties. This fact seriously reduces the net public value of the initiative. Therefore, on balance, while the impetus for governments to intervene in supplying farmers with better seed may be laudable, the net impact of such programs is nearly always negative.

Climate change

There is no doubt that climate change is occurring rapidly in most African countries, increasing the urgency of supplying all the continent's farmers with more resilient,

higher-yielding seed. As farmers try to adjust their cropping patterns as a means of adapting to climate change, they often need a wider range of varieties of their principal crops. They also need access to seed of a wider range of crop species. Small and medium-sized seed companies are ideally placed to supply this need, but are themselves at risk of being wiped out by climate change. They and their larger out-growers need to install irrigation systems, but can rarely afford to do this on a large scale. Given the value of these seed companies cited, this scenario should not be dealt with through a “survival-of-the-fittest” approach, but by creative initiatives aimed at permitting small and medium-sized companies to acquire irrigation facilities to secure their—and their countries’—supply of a wide range of seed.

Lack of adequate financing

Like all growing young private enterprises, small and medium-sized seed companies require capital for growth. Sadly, the African banking system has proven unwilling in most cases to extend loans to these companies. In other cases, the banks require loan guarantees which are unacceptable to seed company operators. Meanwhile, impact investment funds tend to set lower limits to deal-size well above what young seed companies can absorb, and often impose terms which seed companies consider exorbitant. Hence, the lack of access to capital for growth is probably the single biggest constraint to expansion of many well-managed small and medium-sized seed companies.

This has broader implications at a national and even continental level. As seed companies starved for capital struggle to respond to farmer demand for sufficient certified seed, governments and NGOs step up free seed distribution schemes, often funded by international donors. This has a dampening effect

on effective demand for seed by farmers, who, instead of purchasing seed available from seed companies, wait for the free “handout” seed, which is rarely of the same quality. This trend, currently spreading across much of West Africa through funding from several international donors, threatens to undo much of the progress made over the past decade, and could even lead to a reversion to previous eras of monopoly control by governments.

Lack of funding for breeding African crops

While several donor agencies have shown remarkable generosity and fortitude in supporting crop breeding in Africa, the availability and reliability of funding remains a major concern for both national and international crop breeding initiatives. Africa’s seed companies are not yet capable of funding their own breeding research, and rely almost entirely on public breeding initiatives for new varieties. Therefore support for crop breeding is critical at both international and national levels. International crop breeding teams of the CGIAR system are needed for developing and deploying novel traits which contribute to the resilience of crop varieties needed to confront an increasingly erratic climate. National crop breeding teams are needed to address local adaptation and farmer preferences in high-yielding varieties. Many of them have developed and released original, high-performing varieties of their own creation (AGRA, 2018). But if funds are unavailable at the national level, very good varieties often fail to reach the farmers. African governments must be urged through policy and advocacy campaigns to support their national crop breeding activities as a priority intervention for achieving food security and economic development.

Concluding remarks

Given that it is critical to maintain a steady supply of quality seed of improved crop varieties, it is important to ask what governments and development partners can do to encourage the survival of professional seed suppliers outside of the public realm. In considering this challenge, several elements emerge which come at little or no cost, but which could go far in ensuring the continued viability of private seed enterprise, both within the context of input supply programs and within the broader, demand-driven seed market:

- 1) Governments must avoid competing with the private seed sector. Many governments continue to maintain public seed agencies, parastatals, and seed supply units within universities, research stations, and other public facilities which make use of public funding and access to public germplasm to compete with the private sector.
- 2) In a more general sense, governments must do everything possible to make seed markets as friendly as possible to the private sector, notwithstanding the role of ensuring seed quality, including stamping out the supply of fake seed.
- 3) Farmer awareness of the value of improved seed must be increased through the distribution of small packs, planting large numbers of small on-farm demonstration plots, holding of farmer field days, and several other interventions which have proven effective in informing farmers and allowing them to make smart choices. As public extension systems continue to face serious challenges with these tasks, governments should encourage the private sector and NGOs to take up this set of tasks alongside public efforts.

- 4) Early generation seed supply must be ensured by liberalizing the policies that govern who can produce and sell breeder seed and foundation seed. As certified seed markets have grown, the scarcity of early generation seed on-hand to produce certified seed has grown more acute. Private foundation seed companies should be encouraged, along with increased public funding for the production and supply of breeder seed.

The way forward

Clearly, much remains to be done to consolidate the progress made over the past couple of decades in seed supply for Africa's farmers, but in practical terms four major tracks hold great promise for impact. Firstly, additional resilient, higher-yielding varieties must be developed, especially those targeting the needs of women farmers (often the cultivation of legumes and traditional vegetables, and farmers living in marginal agro-ecologies). Secondly, more seed companies are needed to join the fold of those already in action in the countries where modernized seed systems have been initiated and are under development. Thirdly, with a base of vibrant, competitive seed companies established in many countries more funding is needed to inform farmers of their benefits and open large numbers of agrodealers at village level. Fourthly, more private sector-friendly seed policies are also still required, especially in the critical areas of variety release and seed certification.

Final note: Addressing the imbalance in access to improved seed

Finally, no description of the challenges and opportunities for seed systems development in Africa would be complete without recognizing that the geography of improved seed supply in Africa remains very exclusive, with some countries benefiting from significant levels of assistance to develop their seed systems, while others are receiving almost none at all.

Counting only those countries with a population of 5 million people or more, there remain 15 countries with a total population of over 320 million people and home to 40 million farmers where access to improved seed is minimal or non-existent. Farmers in these countries continue to plant seed of crop varieties developed over 40 years ago, and are achieving very low yields. Extending the benefits of improved seed supply into those countries—which have so far been left behind in the movement toward better-performing seed supply systems—represents an achievable goal.

With a proven model for seed delivery now in place and many high-yielding, climate-resilient crop varieties now available, getting seed systems development going in these countries is a genuine priority for the continent. Moreover, the leaders of these countries are asking for assistance in this area.

All farmers who cultivate the land to bring home harvests which feed their families and growing populations deserve good seed. Yet, in far too many African countries, farmers still have no better choice with respect to the seed they plant than did their forefathers and foremothers. The advances made in getting seed to farmers in some African countries provide ample evidence that these advances can be achieved in every country of the continent.

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