

Kisima Farms: a large farm supporting local communities

located in Kenya on the slopes of Mt. Kenya

Contributed by Dr. Berga Lemaga

of the International Potato Center.

1. Collaboration between local operators/partnerships/financing

In each Sub-Saharan African (SSA) country, there is a potato research and development that involves many actors (partners) ranging from input suppliers to consumers. There is, however, a disconnect between these partners, leading to duplication of efforts and hence waste of meagre resources which hinders the potato value chain from becoming strong and sustainable. Research is mainly conducted at the National Agricultural Research Institutes (NARIs) that include research centers, domestic and foreign universities and sometimes private partners in collaboration with international partners such as the International Potato Center (CIP) and research organizations. There is little involvement of local partners such as farmers, extension experts and consumers in research, for example, in varietal selection and agronomic package development, except at highly advanced stages just before the release of varieties. At this advanced stage, germplasm that may perform well in some environments and may be preferred by farmers is dropped throughout the selection process and lost forever. Even though extension is not part of the research in the technology generation process, it becomes a major player for dissemination of technologies. This slows down both dissemination and rate of adoption of technologies by end users.

Limited budget negatively affects rates of generating technologies, multiplication of released technologies, dissemination as well as adoption rates of technologies. Our experience shows that technologies are not adequately demonstrated in various agro-ecologies in a participatory manner, mainly due to limited funds and human resources. As a result, technology uptake rates are slow after their release. Moreover, due to little involvement of the private sector, the pace of technology multiplication does not match the demand for technologies. Good examples are critical shortage of clean seed of productive and adapted CIP-bred varieties that have been released in many sub-Sahara African countries and high costs of seed potato because of its limited availability. In



Seed potato harvest at Kisima farms

most of these countries, the private sector is not interested in potato production (seed and ware) because of the high production cost of seed, and the perishability and bulkiness nature of the crop. There are a few exceptions to this, for example, Kisima Farm Ltd (see below under quality planting material) produces seed potato on about 100 ha/season (200 ha/year) from clean in vitro plantlets it buys from Genetic Technologies International Limited (GTIL) and Stokmen Rozen, both are private companies that produce in-vitro plantlets by order. Clean mother plants for in-vitro plantlets are mostly supplied by CIP to these private multipliers. In Ethiopia, there is Solagrow (a Dutch company) that produces seed potato. This company is also mechanized and has its own TC laboratory, enabling it to produce clean early generation seed, but it met a major setback when some of its farms were destroyed during public unrest that erupted in 2016 in some parts of the country, where most of Solagrow farms are located.

There is a great need to have more of such successful commercial farms that produce seed and ware potatoes to have a viable potato industry. However, government policies in most SSA countries do not encourage potato production, which negatively affects availability of supplies such as quality seed, fertilizers and pesticides. This trend, we believe will change going forward because the dwindling arable land due to growing population will force governments and farmers to resort to crops that give more food per area, time and other inputs, of which potato is one.

An effective partnership in the input supply to consumption continuum would result in improvement of cash availability, research results, dissemination and adoption of technologies leading to higher productivity. Increased productivity coupled with improved market access will result in improved food and nutrition security. Effective partnership also enhances capacity building of actors at several levels, enabling the establishment of an effective potato value chain.



Community Potato Storage shared by local farmers receiving seed potatoes from Kisima farms

Kisima Farm is a privately owned mixed farm located in Meru County, Buuri Sub-county, Eastern part of Kenya. It has a long history for producing cereals such as wheat and barley, flowers, oil crops and pulses. Income from such activities served as a source of cash for the recently started seed potato production, for which it is now a number one leader. Kisima produces seed potato on about 200 ha annually in two seasons (100 ha/season). It started producing seed potatoes in 2008/2009 in collaboration with CIP-led and initially USAID- funded, but later also GIZ-funded 3G project on

only 8 ha. Kisima employs the CIP-promoted 3G techniques to rapidly multiply clean seed using aeroponics.

The company also collaborates with the Kenya Plant Health Inspectorate Services (KEPHIS) of the National Agricultural and Livestock Research Organization (KARLO) to get its seed potato certified, which is then sold to other seed producers in the different regions. Kisima has partnered with Syngenta Foundation for Sustainable Agriculture (SFSA) to supply certified potato seed to small scale seed producers in Meru since 2011. The effort later benefited from the Africa Enterprise Challenge Fund as well. In addition to supplying quality seed potatoes that increase yields of smallholder farmers by 60% and creating employment, the Kisima foundation benefits the community in its area of operation in several ways, including promotion of education, healthcare, water development, agricultural extension, and environmental sustainability.

2. Quality & healthy planting material

Critical shortage of quality seed of productive and adaptive varieties is probably the major constraint to potato production in SSA countries. The yield and quality of potato produced is dependent on the quality of seed potato planted. Most smallholder farmers in SSA recycle seed potatoes for several seasons, resulting in low yields of inferior quality due to seed degeneration, which is caused by seed-borne diseases. It is also known that many smallholder farmers save from their harvests small tubers which they cannot sell as seed increasing the probability of virus infection, including very important yield reducing viruses: potato leaf roll virus (PLRV) and potato virus Y (PVY). Still worse is that there are farmers who use for seed ware potato they buy from unknown sources increasing the chances of not only spreading viruses, but also bacterial wilt (BW) dissemination caused by *Ralstonia solanacearum*, among several other seed-borne diseases that are known to reduce yield.

Being aware of this very dangerous trend, CIP, public research organizations, commercial farmers, NGOs and the private sector have supported the production of better quality seed through formal, intermediate (also called alternative) and informal seed systems. The formal seed system, which follows strict production and seed certification procedures, is a most sure way to produce quality seed. The strictest seed potato certification is practiced in Kenya by the Kenya Plant Health Inspectorate Service (KEPHIS) with a significant support by CIP. However, the formal seed covers only less than 5% of potato seed requirements in most successful countries like Kenya and remains less than 3% in most SSA countries. This system produces expensive seed that farmers cannot easily afford, and production is limited to only a few locations increasing transportation costs to reach the farmers. This coupled with small quantity it produces does not make it an effective problem solver but a foundation for subsequent systems. The alternative or intermediate system has both the formal and informal components and is produced closer to farmers. This system mostly follows a quality declared seed (QDS) production system (promoted by CIP and respective governments) following certain criteria, which may vary among countries. In Ethiopia, while it is less strict than the formal with regards to virus infection and purity, it has zero tolerance to BW, as it is the most devastating disease of the potato in the country. Kenya also has zero tolerance to BW. This kind of seed is produced by trained commercial farmers, cooperatives and some advanced smallholder farmers. These producers get basic seed from research centers (formal system), whose clean seed producing capacity has been greatly strengthened by CIP and further bulk the seed to get quantities under QDS regulations. The seed they produce is inspected by government inspectors, for example,

in Ethiopia both in the field and in the store (diffused light store, DLS). This seed can be infected with BW in the process of QDS production if the soil is infested with the bacterium. Unfortunately, this cannot be easily detected by inspectors because they conduct only visual inspection.

To put a strong quality seed production system in place to improve the performance of the three systems discussed above, availability of clean early generation seed potato is a prerequisite. Supported by CIP, most countries in SSA, among others, Burundi, Ethiopia, Kenya, Malawi, Rwanda, Tanzania and Uganda have basic infrastructure, including tissue culture laboratories, aeroponics and screen houses where clean minitubers are being produced from in-vitro plantlets. In some of these countries, aeroponics units have not been efficiently utilized due to power outage and scarcity of nutrients. Moreover, it is important to note that there is a possibility of disseminating BW with early generation seed because testing for BW at every stage of early generation seed production starting from minitubers is not strictly implemented. Some studies have shown that BW has been disseminated to non-traditional highland areas with seed movement probably from research centers.

Despite all this, some trends in relation to quality seed production are encouraging, for example, Kisima farm produces about 200 ha of seed potato per year that is officially certified as clean. In Ethiopia, many cooperatives and some commercial farmers also produce QDS that has acceptable quality, which is a step in the right direction. Any support accorded to the production of quality seed to sell to potato producers in SSA will contribute to the transformation of the potato industry, enabling it to significantly contribute to household food security and income and to the macro-economy of respective countries.

Kisima Farm is the largest certified seed potato producer in Kenya supplying about 75% of the total certified seed potato that is available in the country. It produces seed potato for farmers preferred varieties that are mainly KALRO/CIP bred and some HZPC varieties based on demand. Annually, it produces over 4000 MT of potatoes of which 75% is qualified as seed with a tuber size of 28-45 mm (size 1), and, 45-60mm (size 2). To ensure that the seed potato it produces is clean, it starts from in-vitro plantlets that it procures from GTIL and Stokmen Rozen and grows in aeroponics to produce minitubers that are later bulked to quantity in clean soil.



Dr Dinah Borus shows the aeroponically grown plants and tubers grown by Kisima farms.

Many small-scale seed multipliers either individually or organized in groups have started growing quality seed from the certified seed they buy from Kisima farm, which they sell to other potato farmers. These farmers have made a lot of money as their yields increased by about 60%, which resulted in a corresponding increase in household income. Farmers do not always have to travel long distances to Kisima to get quality seed because such small-scale seed producers make it available close to them.

3. Farm management & crop techniques

The genetic potential of high yielding varieties can be achieved only if quality seed is used together with good agricultural practices (GAP). Research in collaboration with CIP in several SSA countries has developed agronomic packages that go along with improved varieties. These, usually referred to as GAPs, however, are not adopted for a number of reasons such as: (1) lack of motivation and in many cases lack of awareness by smallholder farmers about the importance of implementing GAPs, and/or (2) the recommendations are not user, particularly female farmers friendly, and/or (3) the practices are resource intensive such as time which farmers do not have during growing seasons, and/or (4) they are expensive for smallholder farmers.

For these and other reasons, farm management differs from farm to farm, including in big farms depending on labor requirement and expected returns. In most countries in SSA, potatoes are traded on a weight or a bag/sac basis and better-quality potatoes do not necessarily fetch premium prices, so producers have no compelling reasons to deploy GAPs that increase production costs. On the other hand, failure to follow standard farm management practices leads to the production of potatoes with variable quality, making the produce unsuitable for processing or for sale to major supermarkets and high-end hotels and restaurants.

Farm management can be improved, and appropriate crop techniques can be applied progressively through enhanced capacity building for creation of a viable potato value chain. Good crop techniques include soil and water conservation practices, optimized use of mineral and organic

fertilizers, green manuring, mulching, intercropping, irrigation, integrated pest management (IPM), including crop rotation to help reduce utilization of pesticides to control insects and diseases that occur in intensive potato cultivation. These and other conservation agriculture (CA) techniques enhance natural biological processes enabling a sustainable potato production, while maintaining the natural resource base.

Kisima farm produces wheat and barley as its primary crops, but also produces oil crops pulses and others. It therefore uses crop rotation to ensure that the soil is not infested by continuous production of potato. It employs soil and water conservation practices such as no tillage and direct drilling techniques. It has also adopted the satellite guidance systems for precision agriculture.

Seed potato production in Kisima is fully mechanized (97% mechanized) from planting through to packaging. With this, application of recommended fertilizers, crop protection and other production practices are done more or less precisely. Since it provides optimum farm management practices and crop techniques, it produces high yields of quality seed potato.

4. Sustainable production and storage of potatoes

For a successful potato industry that will bring about impact at household and national levels, a continuous production and storage of potatoes is indispensable. This will enable availability of potatoes for fresh consumption and processing throughout the year, improving food security and income of the growing population. To have a sustainable potato processing, a constant supply of good quality raw material all-year round is a pre-requisite. This will require



Modern potato grading system at Kisima farms.

producing potatoes two to three times a year and having good cold storage facilities. The SSA region has suitable agro-ecologies with bimodal rainfall, making multiple productions per year possible, particularly if there is access to irrigation.

Forced by the growing population that needs to be fed on same or less arable land, governments in SSA are planning to reduce dependence on rain-fed agriculture by increasing production area under irrigation. For example, Ethiopia is planning to expand irrigated agriculture from the current 2.7 million ha to 4.1 million ha before the end of its second (current) Growth and Transformation Plan (GTP II, from 2015/16 to 2019/20). Potato being a suitable crop for irrigation coupled with its high potential to produce more dietary energy than any other major food crop for every cubic meter of water applied, it will be prioritized for production under irrigation in GTP II. The country has mapped

its ground water that can be used for irrigation together with other water resources such as rivers, rain water, etc. Although progress is found at different stages, most countries in SSA have plans to produce increasingly more under irrigated agriculture, where potato stands a very good chance of being one of the crops that will be considered.

Kisima Farm produces seed potato twice a year on about 100 ha per season. Since it has ultra-modern cold storage with a capacity of about 1000 tons, it can make available large quantities of certified seed potato almost throughout the year. The cold storage ensures that postharvest losses, disease infections and insect damage are kept to the minimum. High seed quality is probably the main reason why further seed multipliers that procure seed from Kisima are reporting high productivity rates. Farmers access to quality seed from smallholder seed producers who grow certified seed from Kisima improves availability of potato for fresh consumption and processing.

5. Creating added value (packaging, processing...)

Potato production in SSA is increasing rapidly just like in other developing regions. Most of the potato produced is consumed fresh, while globally more processed potato is consumed as opposed to fresh. However, even in SSA, consumption of processed potatoes is steadily increasing due to an increasing demand for processed potatoes in urban areas. There is a vivid change in eating habits in urban areas and seeing people eat potato French fries on streets is no more a rare occurrence. This calls for developing potatoes with good processing traits by researchers and producing good quality raw material by producers to produce high quality processed products that in future could also be exported to developed countries. I think countries in SSA have to get their good share of processed potatoes. Currently, however, the biggest obstacle to the processing industry is unavailability of good quality raw material on a sustainable basis and the high cost of raw material. Increasing productivity will lead to reduced raw material costs hence efforts should be directed towards increasing productivity.



Preparing seed potatoes and placement into pallet boxes for short term storage and transportation.

In many SSA countries, potato is sold with mud on tubers so even washing and proper packaging of unprocessed potato fetches more money than unwashed potato that is not packaged well. This needs to be demonstrated. There are big super markets in big cities of all SSA countries so systematically labeled and well packaged potatoes by indicating their areas of production for traceability purposes and variety is a good value add that will increase profitability. A participatory market chain approach work that was implemented by CIP in Uganda for the first time on the African

continent and later in Kenya and other countries, showed that improving designs on the packaging material significantly increased sale of various agricultural products even when the quality of the produce remained the same. The concept of value addition should not therefore be misunderstood by attaching it to big investments only. Value addition can be as simple as just washing the produce and packaging it better and as big as processing that involves big investments. Only when this is clear, small holder farmers in SSA can benefit from value adding.

Kisima Farm sells only certified seed potatoes that meet stringent KEPHIS requirements both in terms of health and seed size. This is a very big value addition to the grower who is willing to pay more. The appropriate seed sizes enable the grower to cover the optimum land area compared to other seed types that cover less area if the tubers are big or cover more area if tubers are small with virus and BW risks. Moreover, the seed potato from Kisima is stored in a cold store and packaged in a professional way (mechanized) in bags containing all the necessary information that help, among others, for traceability purposes.

6. Marketing

It is established that good market access is a driver of sustainable potato production. To have a permanent market for a continuous potato supply, linking farmers to traders, big supermarkets, hotels, and processors is imperative. We witnessed that effective market linkage of the Kabale (Uganda) Nyabyumba United Farmers Group (initiated and implemented by CIP, when it was successful others such as Africare joined) that produces potato for a fast-food restaurant in Kampala, Nandos, that specialized in French fries resulted in a sustainable potato production and farmers as well as the restaurant greatly benefited. Similarly, CIP's effort of connecting farmers in Bomet (Kenya) to a processor called Tropical Heat (also called DEEPA Industries) that exports processed potatoes to UK in 2010 helped farmers to get a permanent market for their potato, encouraging them to produce high quality ware potatoes and increase their income. The company also benefited by reducing losses and improving the quality of their products (crisps) and hence profit. Prompted by the success of this company, several others started engaging farmers in contract farming to produce potatoes for them with technical advice by CIP. Such contractual agreements assist farmers to have the much-needed cash for purchasing fertilizers and other inputs to increase potato productivity. However, the one big challenge faced in contractual agreements was failure in honoring the agreements by farmers and processors alike. Farmers were tempted to sell their potato to others when they got higher prices than stated in the agreement. Processors, sometimes rejected potatoes supplied by the farmers on pretext of the produce not meeting the quality standard. To overcome such problems, regular discussions between farmers and processors and revising the contractual agreement every three months to update the price was found useful. The processor was paying 5% more than the prevailing price at the time of signing the agreements.

The export market, particularly for processed potatoes is increasing at a fast rate. Currently, more potatoes are processed in response to increasing demands from the fast food and convenience food industries that ensued from the growing urban populations, diversification of diets and lifestyles that do not leave sufficient time to prepare fresh food for consumption. This trend increased the demand for processed products, particularly frozen and dehydrated potato products, from which developing countries have not had their fair share, especially in the export market. Exporting fresh and processed potato products to developed countries from SSA is extremely difficult because of

enacted high unfair standards and tariff. There is, however, room for substituting huge imports of potato processed products by developing countries and a chance for exporting to neighboring countries within Africa and the Middle East. Exports of both fresh and processed potatoes between neighboring countries in Africa is not very well documented as the borders are porous and exchanges happen unofficially. To determine real contributions of potato to a country's economy, exports between neighboring countries have to be streamlined. This will also reduce uncontrolled movements of potatoes that carries a high risk of disease transmission.

For a successful marketing, constant supply of quality produce, having a collection center, organizing farmers in groups to both produce and market together, effective capacity building and creating trust among the members are vital and CIP invested heavily in these. Although small farmers have fragmented and small land holdings, land can be consolidated, as it has been successfully executed in Rwanda. Consolidated production allows mechanization and efficient control of pests and diseases, improves access to credit and enables effective marketing. Ethiopia is implementing a similar action with its Agricultural Commercialization Clusters (ACC) approach, which also consolidates production and promotes collective marketing. This is a one sure way to transform smallholder farming to commercial farming.

Kisima Farm produces about 4000 MT of potatoes of which 75% is in acceptable seed-size category. Most of its seed is sold to smallholder farmers within a radius of 30 kilometers from the farm. However, since farmers know about the importance of quality seed in increasing productivity, farmers from distant areas organize themselves into groups and buy certified seed in bulk to reduce per unit costs. According to an old success story (no date) that referred to a SFSA and CIP study, "the farm sold certified seed at 47 US Cents per kilogram compared to 24 US Cents/kg and 22US Cents/kg for seed potato from neighbors and open market sources, respectively." The 400 smallholders who bought seed from Kisima and an estimated another 12,000 farmers who got seed from the 400, earned 480 million Kenyan shillings at the end of 2013. Because the advantages of certified seed, farmers go for it, despite the high seed cost and hence the demand for certified seed grows by the day