Potato Seed Sector Development:

10 key lessons learned

Emily ter Steeg (SeedNL),
Karst Weening (NAO) and
Judith Jacobs (NFP)

Introduction

The Dutch potato sector has a strong global presence and reputation. Moreover, the Dutch government is funding many projects focused on potato seed sector development in Low- and Middle-Income Countries (LMICs). Stakeholders in the potato sector want to move towards a more integrated and targeted approach to increase the impact of these projects. For this reason, the NAO (Dutch Potato Organization) joined SeedNL in 2022 aiming to align efforts of the private sector, public sector, development organizations and research institutes. This document was prepared by Emily ter Steeg (SeedNL), Karst Weening (NAO) and Judith Jacobs (Netherlands Food Partnership) to provide insights and guidelines for funding parties and implementing partners of future potato projects in LMICs. The content is based on the vision document prepared by the NAO, NFP and stakeholders in the Dutch potato sector.

Potential of potatoes

Potato may be the staple crop of the future. It is the fourth largest crop in the world after maize, rice, and wheat. The use of potato seed tubers, which are *living organisms*, marks a crucial difference with the other major staples. It ensures the potato is a highly productive crop. In terms of water use and land efficiency, potato easily beats the other major staples: it is the most efficient crop in terms of 'crop per drop' (kg/litre) and food product per hectare (kg/ha). Simultaneously, the potato is a 'high-investment, high-risk' crop, which is prone to accumulating diseases. Potatoes have a high nutritional value in comparison to crops like maize or cassava and are classified as vegetables in various regions. Average potato yields in Sub-Saharan Africa are around 7–12 tons per hectare, which is far below the potential levels of 30–40 tons per hectare. This hampers potato's potential impact on nutrition security in LMICs.

Potato seed sector: status quo

In many LMICs, farmers express the lack of healthy potato seed tubers and improved varieties as their major constraint. The great majority of potato farmers in LMICs saves their own seed tubers; during harvest, farmers save small potatoes, which they use as 'seed' during the next season. Alternatively, they exchange with or buy seed tubers from other farmers. In traditional potato areas, most seed tubers and soils are contaminated with diseases and pests. The quantity and quality of potato yields decrease every season. Furthermore, seed tubers pose logistical challenges in many LMICs. Storage facilities and roads are of variable quality while climates can be hot and humid. High losses and quality reduction of seed tubers are the result. Combined, these challenges result in an insufficient and unreliable supply of seed at the start of each growing season.

Preparation of tissue culture in lab of RAB in Rwanda, photo by: Emily ter Steeg (SeedNL)

Models for production of high-quality potato seed

There are various models to produce high-quality potato starting material. In all models, the first step is to produce clean early generation potato seed tubers using seed tubers, in-vitro plantlets, cuttings, or (hybrid) true seed. Subsequently, early generation seed tubers are multiplied vegetatively with quality gradually deteriorating each generation due to accumulation of pests and diseases. Therefore, each model needs disease-free soil as an environment for field multiplication. Seed sector development projects can focus on one or multiple models. Below the three main models for the production of early generation potato seed are described outlining associated challenges and opportunities.

1. Rapid Multiplication

Tissue culture plantlets are grown in a laboratory starting from clean stock material. Subsequently, mini-tubers (pre-basic seed) are produced in a protected greenhouse. This process is followed by 2–3 cycles of multiplication growing basic and certified seed in an open field. This system requires competent laboratory facilities. Also, it takes about 5 seasons to produce adequate volumes of potato seed.

Aeroponic facility of RAB in Rwanda, photo by: Emily ter Steeg (SeedNL)

Two subsystems can be distinguished:

Private 'commercial' varieties
Commercial varieties are developed by private companies and multiplied locally often on basis of licensing agreements. The varieties have a strong performance in terms of yield, processing and/or consumer quality and have various resistances against diseases or pests. This model is being implemented and has political support. Multiplication of Dutch varieties is happening in countries such as China and South Africa. A major challenge is the requirement of a well-functioning Plant Variety Protection (PVP) system to guarantee royalty payment. In absence of an effective PVP system, potato breeding companies are likely to work exclusively with international processors. Few companies can bear the long-term investment and risks of judicial disputes over PVP and royalties.

Public varieties
Public varieties are developed by the International Potato Centre (CIP) or local government institutes. Often, these varieties meet the needs of subsistence farmers as they are robust with high heat tolerance and late blight resistance. They have a short dormancy not requiring a long storage period of the seed. Multiplication of tissue culture and mini tubers is mostly done through the public system, usually with support of (donor) subsidies. The system is generally promoted by local policy makers. However, it is often not commercially viable and depends on external financial support. In the absence of a stronger commercial incentive, the seed production chain of public varieties is usually inefficiently managed, and supply fails to meet demand. The final stages of field multiplication tend to lack coordination and quality management. Individual seed growers often lack working capital, which may lead to seed tubers being sold as ware potatoes.

2. Local Field Multiplication of Imported Seed Tubers

Seed tubers can be shipped from the Netherlands to target markets. Imported seed potatoes (basic seed) are multiplied locally (certified A-class up to E-class). This model can result in faster availability of large volumes of certified seed in 1–2 years, compared to 4–5 years for 'Rapid Multiplication'. Also, it allows for stricter quality management as only 1–2 rounds of multiplication are done locally. In comparison to 'Rapid Multiplication', fixed investment costs are lower making this system feasible for smaller companies. However, many countries restrict the import of field-grown seed tubers, often, for phytosanitary reasons. This poses a major challenge. Local Field Multiplication of imported seed tubers is currently done in countries such as Kenia, Turkey, and Tanzania.


Manual sowing of Dutch seed potatoes for multiplication in Rwanda, photo by: Hollanda FairFoods


Large-scale multiplication of Dutch seed potatoes in Kenya, photo by: Agrico


Mechanized harvest of Dutch seed potatoes in Kenya, photo by: Agrico

Planting of hybrid true potato seed in trays in Rwanda, photo by: Emily ter Steeg (SeedNL)

3. True Potato Seed

The first commercial varieties of (hybrid) true potato seed (TPS) are currently entering the market. TPS has potential for certain tropical regions, but it has yet to be commercialized and the regulatory framework has yet to be developed. The TPS system is still under development and implementation at scale is limited.

The TPS system is promising as many challenges related to field-grown seed tubers are avoided. There are no phytosanitary risks, logistical challenges related to transport and storage, or large working capital requirements. Still, its introduction will require either integration of TPS in existing potato seed systems or transformation of these systems, which may prove challenging.

Planting of seedlings in Rwanda, photo by: Emily ter Steeg (SeedNL)

Enabling environment

A country's seed regulatory framework organizes Plant Variety Protection (PVP), variety release procedures, seed imports, quarantine rules and quality assurance. Discrepancies may exist between rules and actual implementation by local authorities. The enabling environment is a decisive factor for potato seed sector development. Seed sector development is feasible only if the regulatory context is favourable.

Distinctness Uniformity Stability

Varieties must pass testing for Distinctness Uniformity Stability (DUS) to be recognized and registered as a new variety. DUS registration generates a passport for the variety listing its unique characteristics. It is also necessary to obtain PVP protection. Many countries accept European DUS reports of high quality, which are often prepared by organisations together with Naktuinbouw. Others require local DUS testing or additional trials to verify the reports. Countries should be encouraged to accept existing DUS reports thus increasing efficiency.

Value for Cultivation and Use (VCU)

Many countries require potato varieties to be locally tested, conducting Value for Cultivation and Use (VCU) trials. Admission to the mandatory National Variety List requires a strong VCU performance. The VCU-process is often lengthy, costly, and cumbersome. The combination of a variety testing procedure of 4–5 seasons with the Rapid Multiplication system results in a commercial introduction time of 5–10 years for new varieties. Ideally, VCU-requirements would be cancelled or at least simplified. In the EU, VCU was annulled, and a single food safety standard (maximum glyco-alkoid level) is imposed. Simplification would increase diversity of varieties available to local growers. In Egypt, a limited number of seed tubers of varieties being tested can be imported. This could be an alternative measure.

Import bans and self-reliance

In addition to variety release procedures and import rules, political barriers may also exist. Some countries have imposed a ban on the import of seed potatoes pursuing self-reliance (e.g. Indonesia and Rwanda). In this case, the model based on Local Field Multiplication is not feasible. Instead, it might be possible to work with imported tissue culture or TPS. Countries could be encouraged to still allow imports of small volumes of (pre) basic seed to facilitate the Local Field Multiplication of seed tubers.

Variety trials in Rwanda, photo by Emily ter Steeg (SeedNL)

10 key lessons learned for potato seed sector development projects

Stakeholders working in the potato sector seek to seize the potato's full potential and overcome challenges as described above. This requires joint efforts to maximize impact of potato projects. Below 10 key lessons learned that can contribute to successful design and implementation of future projects focused on potato seed sector transformation are described.

1. Integrated seed sector

Projects should aim for Integrated Seed Sector Development (ISSD). This approach creates a level playing field for all seed systems: formal and informal and public and private. As a result, growers can choose potato seed, which best matches their livelihood. Smallholders may use robust CIP varieties, while more advanced farmers may use high-yielding commercial varieties.

2. A conducive 'enabling' environment

The enabling environment is the starting point of and a prerequisite for seed sector transformation. Issues related to variety registration, imports and local quality assurance system persist hampering project implementation and sector development. Public and private sector actors should collaborate to remove bottlenecks as individual efforts are usually ineffective.

3. Capacity building is key

The introduction of improved seed potatoes (and other inputs) is most effective when combined with capacity building. Extension, training, and education are needed to raise awareness about good agricultural practices amongst large numbers of growers. There are low hanging fruits: simple and cost-effective techniques can result in major improvement.

4. Affordability for growers

Seed potatoes produced via the formal multiplication systems is (more) expensive and costs are difficult to cover for most farmers. Without (financial) support for farmers or cooperatives, it is unclear how quality seed of commercial varieties can become accessible for smallholders. As potato is a 'high input, high output' crop, availability of (short-)term credit schemes can enable growers to buy necessary inputs.

5. Promotion of other inputs

Diseases and pests, especially late blight, can be devastating in potato production. Farmers need effective crop protection for risk mitigation. Also, fertilizer is important: application is rarely based on actual crop (and soil) requirements. Promotion of diagnostic services for soil fertility and disease monitoring can further improve performance.

6. Post-harvest management

In many countries, post-harvest losses and price fluctuation are high. Farmers refrain from investing in quality seed potatoes and inputs if these issues are not addressed. Improved storage facilities can reduce losses and mitigate seasonal fluctuations.

7. Private sector involvement

The contribution of the (international) private sector is important for financial sustainability. Companies do not only develop varieties and sell seed; they also provide access to technology and support knowledge transfers. Development projects tend to last 2–4 years after which activities comes to an end. Private companies aim for long-term business development committing themselves to a market for an indefinite period.

8. Realistic timeframes

Potato seed sector development is always a slow process due to the slow multiplication process of seed potatoes. In several countries with currently strong performing potato sectors, such as Poland or South Africa, the transformation took around 20 years. This timeframe is a reality to bear in mind when designing and implementing projects with a shorter timeline.

9. Multi-stakeholder process

Comprehensive and objective assessment of the project context is a prerequisite for success. Allocation of time and resources for the inception phase has been limited for many projects. Consequently, projects may fail to take an integrated approach and make a sustainable impact: an intervention is based on the vision of a small selection of stakeholders rather than a multi-stakeholder process.

10. Inception phase

Potato seed multiplication requires substantial investment, making it costly to change a chosen strategy later, even when new insights or developments would desire a re-orientation of the project. This underlines the importance of an inclusive and extensive inception phase to ensure a carefully designed strategy.