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**Research Paper**

# Sweetpotato seed business model: the case of the South Agricultural Research Institute, Ethiopia

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***Abstract.*** Sweetpotato is one of the important food security crops in Ethiopia. The production of this crop is mainly challenged by shortage of clean planting materials. Farmers use their own saved seeds for next planting season. However, due to sweetpotato viruses (SPVD) and recurrent drought, the farmers are unable to maintain their seeds and hence being forced to stop sweetpotato production. SPVD is one of the major challenges that affect the quality of the planting materials and seriously reduces the root yield. Therefore, the South Agricultural Research Institute (SARI) has been trying to clean the planting materials in tissue culture and supply virus free seeds of preferred varieties through pre-basic and basic seed production. There are some sweetpotato seed multipliers in the country that purchase initial seeds from SARI and produce clean vines of sweetpotato. However, these multipliers are running the seed business without any business plan and sometimes they fail to cover their production costs and hence are leaving the seed business. Therefore, the objective of this study was to develop the sweetpotato seed business model at SARI and support the seed multipliers to prepare their own business plans in order to sustain the sweetpotato seed business. According to the study, the breakeven cost for production of a 3 to 4 node basic sweetpotato vine cutting at SARI is 0.12 ETB or USD 0.006 with the exchange rate of USD 1 = 21 ETB at the time of the study (2016). SARI sells the same cutting for 0.30 ETB or USD 0.015. Using these figures and factoring in contingencies, it has been established that the net cash flow is positive and the business will remain profitable and able to sustain itself. This sweetpotato seed business model is the first of its kind in public institutions in Ethiopia and can be used as a reference for seed business of other crops.

**Keywords:** Business plan, cash flow, quality seeds, SPVD, sweetpotato, tissue culture.

## INTRODUCTION

Sweetpotato is widely grown in Ethiopia as a food security and nutrition crop. According to Central Statistical Agency (CSA) of Ethiopia, sweetpotato is the second among root and tuber crops next to potato in terms of area cultivated and first in production (CSA, 2011, 2015). In the most recent cropping season (2017/2018), nearly 60,000 ha were planted with sweetpotato producing over 2.7 million tonnes (CSA, 2018). The trend showing sweetpotato production and number of smallholders over the last 12 years is presented in Figure 1. The trend shows that number of smallholders, production and productivity, are increasing and area covered by sweetpotato is also increasing but at lower rate. Nearly 20 million Ethiopians consume sweetpotato daily as staple food during the growing seasons (Tofu, 2007). The largest sweetpotato

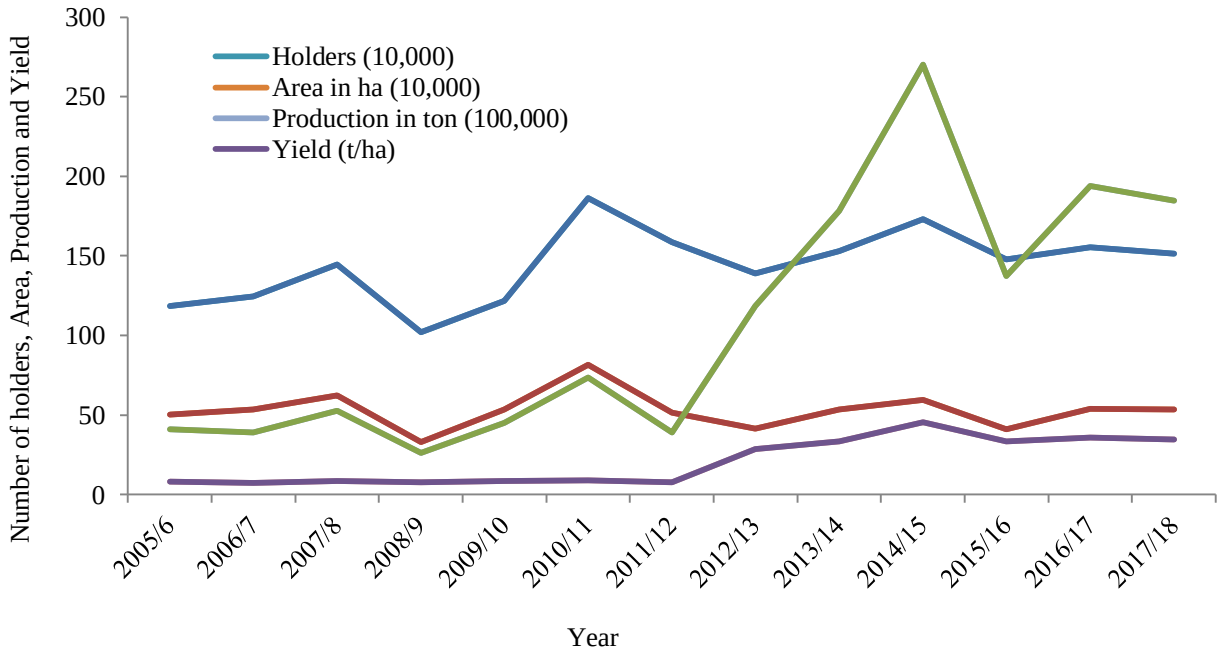


**Figure 1.** Trends of sweetpotato production over the last 14 years in Ethiopia.

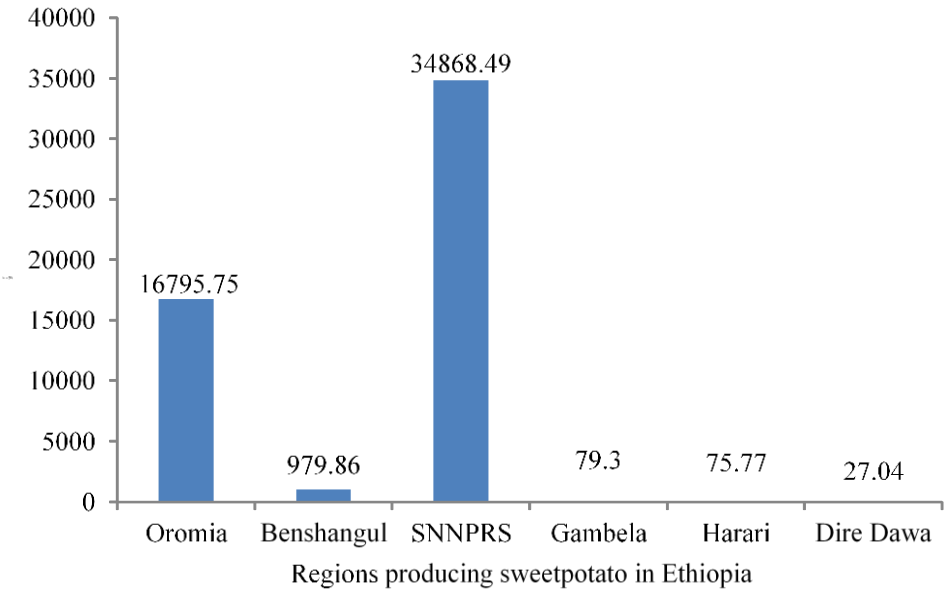


**Figure 2.** Major Sweetpotato producing regions in Ethiopia, 2017/18.

production and consumption is found in the eastern, south and south-western parts of the country (CSA, 2014; 2015). Recently, the crop is being introduced to the northern part of the country, Tigray and Amhara regions, due to its drought tolerant nature and contribution to food security and improved nutrition.

Southern Nation, Nationalities and Peoples' Regional State (SNNPRS) and Oromia Region are the major sweetpotato growing regions in Ethiopia accounting for nearly 90% of national production (Figure 2). Within the two regions, three zones from each region are the top producers, namely Sidama, Wolayta and Gamogofa in the SNNPRS; and East Hararge, West Hararge and West Welega in Oromia.

Although the production trend of the crop is increasing over years, however, there are a number of constraints

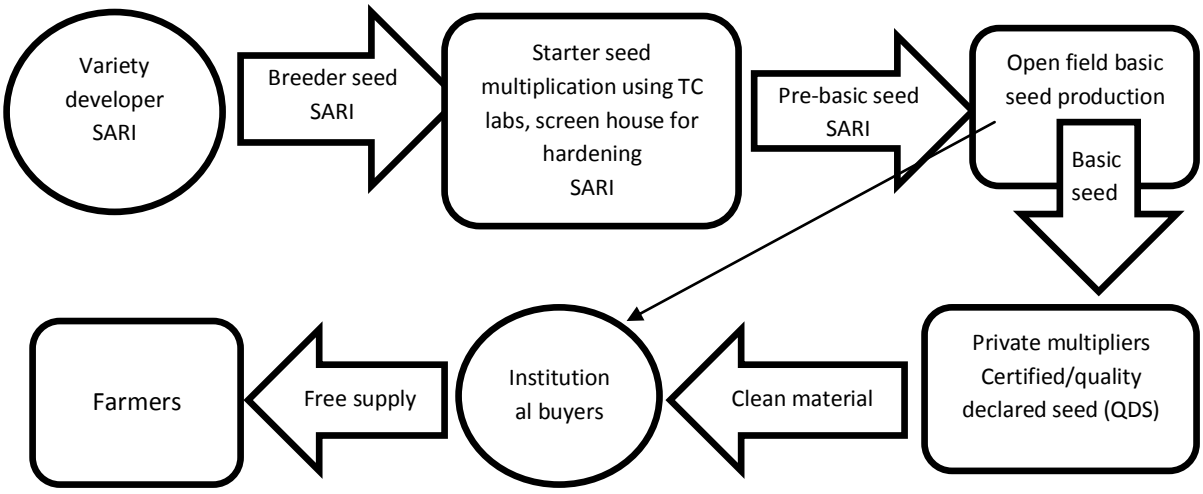


**Figure 3.** Steps followed in sweetpotato formal seed system in Ethiopia.

limiting the production and productivity of sweetpotato in Ethiopia (Gurmu *et al*., 2015a). One of the major constraints is chronic shortage of planting materials to be used for the next planting seasons (Gurmu *et al*., 2015a). Quality planting materials are very essential to boost productivity of sweetpotato (Putri *et al*., 2017). However, in Ethiopia, most farmers used to maintain the planting materials in their home gardens until the rainy seasons come for planting. Nowadays, however, due to recurrent drought the farmers are losing their materials and are being forced to stop sweetpotato production. It is not only the availability of the seeds; also the quality of the seeds is of a paramount importance due to prevalence of sweetpotato virus diseases. Sweetpotato virus disease (SPVD) is the most devastating disease of sweetpotato in Africa (Geddes, 1990; Lenné, 1991). In East Africa, it causes over 90% yield reductions (Gibson *et al*., 1998; Mukasa *et al*., 2007; Ndunguru *et al*., 2007; Mekonen *et al.*, 2014, 2016). Since SPVD is mainly transmitted through use of infected planting materials, use of clean planting materials is a key approach to reduced yield losses associated with SPVD. Therefore, for access to clean and sufficient planting materials at the right time, cleaning the planting materials in tissue culture, acclimatizing, multiplication in insect proof net tunnels and isolated open fields is very essential.

The South Agricultural Research Institute (SARI) has already been engaged in production of pre-basic and basic seeds of sweetpotato. SARI is the sole source of early generation seeds (EGS) for the commercial vine multipliers that purchase basic seeds from SARI and multiply certified or quality declared seeds (QDS). However, these actors are running the seed value chain of sweetpotato without any business plan and sometimes they fail to cover their production costs and hence are leaving the seed business. Therefore, it was important to develop SARI's sweetpotato seed business plan as a model to support other sweetpotato seed multipliers to prepare their own business plans. In general, preparing a business plan helps SARI to identify which operating costs need monitoring, current profitability, future potential expansion, investment and profitability of the sweetpotato basic seed business. At the same time this seed business model will help the multipliers to understand their profit margins and sustainably run the seed business. It is the first of its kind in public institutions in Ethiopia and can also be used as a reference for seed business of other crops.

## Description of the business

The sweetpotato seed value chain starts with cleaning of sweetpotato varieties in a tissue culture (TC) at SARI (Areka Research Center). The major activities in the TC laboratory are *in vitro* cleaning of different varieties of sweetpotato, micro-propagation of sweetpotato explants, acclimatization in insect proof screen-house and virus indexing of *in vitro* propagated materials. The virus indexed clean planting materials are taken to Hawassa research centre for production of pre-basic seeds in insect proof net tunnels. The pre-basic vines are then transferred to isolated open field for further multiplication of basic seeds (Figure 3). The core product for SARI is basic seed as the pre-basic seed is not sold but used as initial material for basic seed production. SARI is selling annually on average over one million vines to the commercial multipliers. The commercial vine multipliers purchase the basic seeds from SARI, multiply and sell certified or QDS to different government (GOs) and non-government organizations (NGOs) for distribution to root producing farmers.

Nowadays farmers' willingness to buy clean planting material is increasing in some parts of the country. But

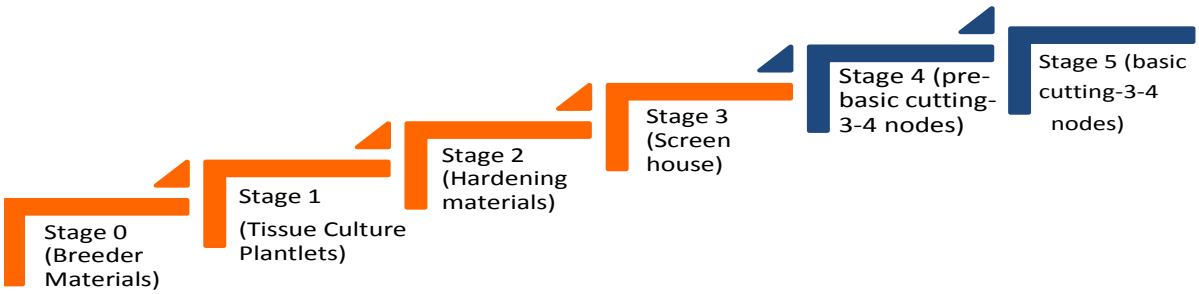


**Figure 4.** Technical stages in producing virus free planting material.

**Stage 0** involves sourcing the farmer/processor preferred varieties, virus indexing and clean up. This process can take about 5 months from sourcing to cleaning if there are any plants that have tested positive for a virus.
**Stage 1** involves initiation of the tissue culture materials and multiplication. This process takes three months.
**Stage 2** involves acclimatization (hardening) of the TC materials for six weeks.
**Stage 3** involves screen-house multiplication, in pots, of the acclimatized plants to be used as sources of cuttings for pre-basic seed production. At this stage, virus testing is done once in 2 months.
**Stage 4:** involves multiplication of pre-basic seeds in net-tunnels to be used as sources for basic seed production. At this stage, 3-4 nodes cuttings are produced over six months.
**Stage 5:** involves open field basic seed multiplication over 6 months.

the institutional buyers (GOs and NGOs) are still the largest buyers of sweetpotato vines. They buy the vines from commercial multipliers and distribute to farmers on a free basis.

SARI has a functioning tissue culture laboratory for production of starter clean planting materials, net tunnels for production of pre-basic seeds (Figure 4), lands for production of basic seeds, irrigation facility and power supply for irrigation and tissue culture laboratories.

There are technical, administration and finance staffs in SARI that are either directly or indirectly supporting sweetpotato seed production. SARI has been in the basic seed production for a long time and the market demand for its products is increasing from time to time due to the increasing demand from the commercial vine multipliers and emerging farmer cooperatives. In order to produce basic seeds, the initial seeds for the pre-basic seed production are obtained from TC lab at Areka and the pre-basic seeds are multiplied under insect proof mobile net tunnels. SARI is engaged in basic seed production because the volume of pre-basic seed is currently not enough to meet the demand of commercial multipliers due to limited capacity in human resource, finance and capital for this stage of seed production. The direct target markets for SARI are currently commercial vine multipliers and farmer cooperatives who are involved in sweetpotato vine production. GOs and NGOs are indirect markets for SARI through the vine multipliers since they purchase the vines from the multipliers.

## Analysis of the business environment

### *The regulatory system*

There is the Southern Nation, Nationalities and People's Regional State (SNNPRS) Agricultural Inputs Quality Control and Quarantine Authority (AIQCQA). This authority is responsible for approving the quality of basic seeds produced by SARI before the vines are sold to multipliers. The same authority controls the quality of vines produced by each multiplier before they sell to the institutional buyers. Therefore, any individual or organization that wants to purchase sweetpotato vines/seeds should first consult with this authority ahead of time. The multipliers should also invite the AIQCQA to evaluate and certify their farms before they start selling the vines. The multipliers cannot sell their seeds unless they obtain quality certificate from the AIQCQA.

### *Seed acquisition process*

The commercial vine multipliers can access initial sweetpotato planting materials from SARI. The general trend is that any vine multiplier should first be legally registered as a multiplier. Then they request the regional office of agriculture input department with a letter to direct them to sources of initial planting materials. The input department writes a letter to SARI to authorise to sell initial planning materials to the multipliers. The multiplier is not allowed to sell ratoon (second and third generations) for more than two generations after which he/she should return to SARI to replenish the initial seed. This increases the demand for the basic seeds of SARI and positively affects the business. The AIQCQ controls the quality while the BoA Input department controls the process.

## Strengths and opportunities

Currently, in SNNPRS, sweetpotato vine production has become a business where more than ten legally registered

commercial vine multipliers are undertaking the multiplication and selling to various GOs and NGOs. Some of the private multipliers are Jara Agro-industry, Ezera PLC, MulunehBoru Farm PLC, Mulualem Farm, Ayzman PLC, Wamole Seed Enterprise and Hulume Seed Enterprise. SARI will discuss with the vine multipliers regarding their financial records and identify whether their business is profitable or not in order to help them maximize their profit.

**Risks and threats**

The major threats for the business are: dependency of farmers on institutional buyers who distribute the vines on free basis, diseases especially SPVD, reduced financial support from the government for root crops research, shortage of land for multiplication of basic seeds, shortage of skilled staff, staff turnover, delay in purchase of different inputs and lack of new varieties. These threats have their own implications on the sweetpotato seed business. For instance, dependency of farmers on free seed from institutional buyers as part of emergency programs creates an uncertain market and risk of over production of seed. Diseases affect the ability to maintain varieties, the limited finance from the government impedes the growth of the business and shortage of land limits supply of seeds. In order to mitigate the above mentioned threats, it is important to design appropriate strategies such as awareness creation for producers about quality seeds in order to increase their willingness to pay for improved seeds, generating disease resistant varieties, developing disease management strategies to combat disease related problems, seek for other sources of finance to strengthen research on root crops and seed multiplication and generating varieties that meet consumers' preferences.

**Market analysis**

The basic seed business for sweetpotato is based in Hawassa, but the multipliers are found in SNNPRS, while the end users are from all over the country. There exists high demand for basic seeds and the demand is increasing due to the recurrent droughts occurring in the country. Moreover, production of sweetpotato is possible in marginal and less productive areas with limited inputs. So far, the institution is producing and selling huge amounts of seeds and generating income in addition to serving the community.

- Product: producing disease free basic seed and being a trusted source for planting material across the country means SARI has a pre-determined large market for its basic seed. So even without a promotion the business will grow and expand in the future.
- Price: the current price of basic seed is low and attractive, and from the calculation of cost of basic seed (0.12 birr or USD 0.006 per vine cutting), SARI can even reduce its price much lower if necessary to segment its market and even increase farmers' willingness to pay.
- People: currently SARI's direct buyers/customers are private multipliers, but the end users are smallholder farmers in the country via multipliers and institutional buyers (GOs and NGOs).
- Place: SARI is selling its product at farm gate and therefore does not incur any transportation cost which would increase its expense and might in turn have an effect on cash flow.
- Promotion: the already functioning promotional tools like demonstrations, field days, exhibitions, tag, posters and radio programmes are highly effective in reaching smallholders at community level and increasing demand for basic seeds which automatically increases market sales and cash inflow.
- Policies: The BoA-input department and quality control authority supports the business via control of the quality of the planting materials. The authority has put regulations for private multipliers not to sell ratoons for more than two generations. This implicitly increases the demand for basic seeds for SARI.

**Marketing and promotion plan**

Market research, and a development and promotion plan is vital for the sustainability as well as profitability of a business (Figure 5). However, since SARI is mandated to produce pre-basic and basic seeds of different crops and is the sole producer of basic seed of sweetpotato in the country, it already has an established good will and credibility for its products. SARI has its own method of promotion that stretches even to the end users/grass root level such as demonstrations, field days, posters and exhibitions. Therefore, the conventional way of promotion may not be vital for the growth of this particular business for the time being. Promotional activities for pre basic seed will be done by demonstrations at farmer training centres and farmers' plots in each district, organizing farmers' field days and agricultural exhibitions.

**Gender analysis**

SARI has both male and female researchers working on sweetpotato seed value chain. For instance, one of the researchers responsible for the TC laboratory management at Areka is a female researcher. There are four female laboratory attendants at Areka. The head of the seed multiplication unit at Hawassa is also a female researcher. The daily labourers who are engaged in

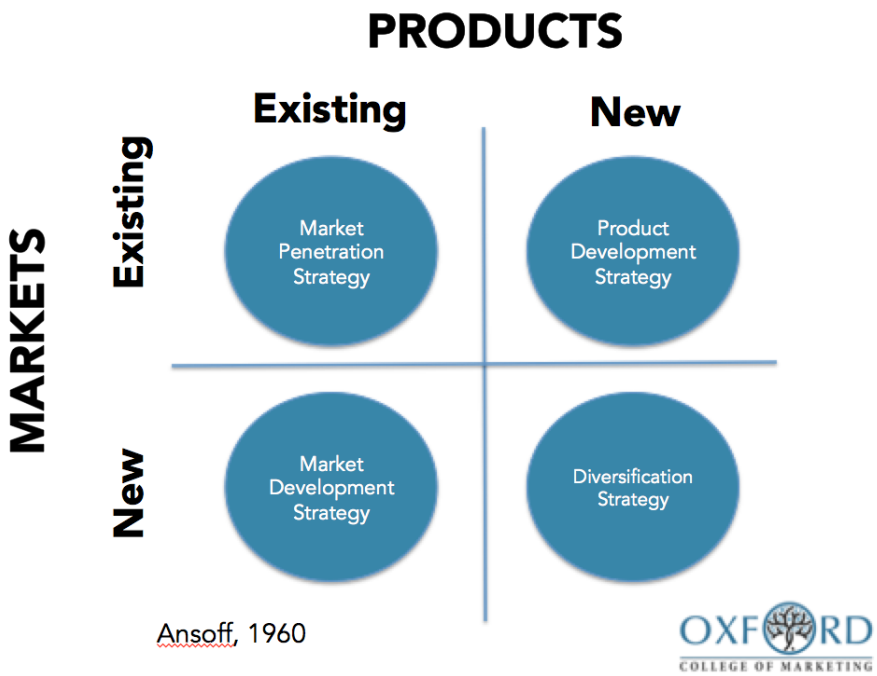


**Figure 5.** Market segments matrix, Ansoff 1960 (https://www.smartinsights.com/marketing-planning/create-a-marketing-plan/ansoff-model/

**Table 1.** Unit production cost for each stage (2016).

| Stages | Production target (cuttings) | *In vitro* cost (Birr) | Hardening costs (Birr) | Screen house costs (Birr) | Net tunnel costs (Birr) | Open field costs (Birr) | Total production costs (Birr) | Production cost per 3-4 node (Birr) |
|---|---|---|---|---|---|---|---|---|
| Stage 5 (Open field/basic cuttings) | 800,000 | 11,528.1 | 2,010.0 | 4,613.0 | 7,448.8 | 59,318.2 | 84,918.1 | 0.12 |

Exchange Rate 1 US$ = 21 Birr in year 2016

managing the net tunnels for pre-basic seed production at Hawassa are also females. This is because they are curious and responsible to take care of all the activities. The ultimate goal of the orange fleshed sweetpotato (OFSP) is to address nutrition balance of most vulnerable groups such as pregnant and lactating mothers including children under five years of age, and so marketing activities and distribution channels need to reflect the characteristics of this target group (Burri, 2011; Gurmu *et al*., 2015b).

## Financial analyses

A comprehensive Cost of Production Analysis was done for the sweetpotato business in the year 2016 (Table 1). This formed the basis of identifying a profit margin that was used to determine a suitable price for sale based on an estimated production and sales capacity. This was updated in early 2018 (Table 2). The analysis in this section reflects the costing work done during both of these exercises.

Enterprise budget analysis was used to measure cost of basic seed production by SARI. Average or approximate values were used for all costs and prices in the analysis. The international potato center (CIP) supported SARI in the development of a Financial Cost Benefit Analysis (FCBA) tool.

## Cost structure

A standardized cost structure was developed for each of the five stages in sweetpotato basic seed production.

**Table 2.** Production costs, price, mark up and margin for each stage (2018).

| Stages | Production cost including overhead & contingency per unit (US$/3-4 node) | Mark-up (%) | Profit Margin % | Price (US$) |
|---|---|---|---|---|
| Stage 5 (Open field/basic cuttings) | 0.006 | 50% | 100% | 0.014 |

US$ exchange rate: ETB 27.4 in 2018.

Cost data was collected based on either the recall or actual/real time data collection method. As record keeping improves, more real time costs are being captured.

- The total cost of the first stage unit production (i.e. cost of TC plantlet) is not an input cost for the 2nd stage (hardening plantlet).
- The total cost of 2nd stage of unit production i.e. cuttings (3-4 node or 15 cm) is not an input cost for 3rd stage i.e. pre-basic production.
- There is no difference in calculating and taking the cost of production of TC plantlets as an input in the second stage and so on to calculate the total cost of production of basic and pre-basic seed. Thus, the unit production cost of basic seed is calculated by summing up all the costs at each stage and dividing by the total number of basic seed produced.

Every stage of the production is inter-linked. The costs are variable and fixed costs.

i. For basic cuttings (stage 5) – the unit production cost was 0.12 ETB or USD 0.006 however, it is important to note that the cost of infrastructure facilities was not included in the costing as it is considered a subsidy from the government as part of the Government of Ethiopia's strategy to improve access to quality seed at an affordable price.
ii. The mark-up is a proportion of the production cost that provides a buffer (cushion) against an unforeseen increase in production costs.

## Pricing strategy

Pricing strategy and profitability analysis for basic cutting (product):

- The pricing strategy is the same for all types of buyers, with a price range of USD0.012 and USD0.014 (that is, 0.25 and 0.30 ETB)

## Sustainability of the basic seed production business

The sustainability of the sweetpotato early generation seed, in this case basic seed business is measured by looking at the performance of the Revolving Fund (RF) and Net Cash Flow in two different scenarios namely with project support and without project support by adopting a tool called "Sustainable EGS Business Analysis Tool"(SEGSBAT) to link customer seed requirements, unit production costs, and availability of funds from the revolving fund and funds or grants from other government or donor sources.

During the SASHA Phase 2 project period, SARI has used SEGSBAT to monitor the performance of the sweetpotato EGS business under the two scenarios so that they can ensure that target production and sales quantity are aligned with customer requirements and available funds to meet recurrent costs, to ensure medium-term financial sustainability for EGS production and sales.

Tables 3 and 4 show the cash flow for the institution with 2017-2018 actual sales and expenditure as the base year.

## Financially sustainable EGS business analysis tool

The interconnection of financial performance and sustainability of the sweetpotato EGS business is measured by looking at five indicators namely: i. measurement of accurate cost of EGS production ii. determining appropriate price, profit margin and mark up; iii. identifying potential market for the product; iv. increasing revenue and maintenance of a positive net cash-flow and v. ensuring adequate cash balance to meet total cost of EGS production from the revolving fund account (Figure 6).

This performance has been measured and will continue to be measured through a tool called "Sustainable EGS Business Analysis Tool" (SEGSBAT) developed by CIP scientists in the year 2017. This tool measures the financial sustainability of the EGS business by looking at the linkage between customer seed requirements, unit production costs, and availability of funds from the revolving fund. The biggest limitation of this tool is that it does not address non-financial factors of sustainability such as environmental, social and governance indicators. However, the tool is still evolving.

In order to operate SEGSBAT, the steps below must be

**Table 3.** Cash flow for SARI 2017-2019.

| | 2017 | 2018 | 2019 |
|---|---|---|---|
| | **Actual** | **Targeted** | **Targeted** |
| **Demand of cuttings (basic seed)** | 2,001,887 | 1,600,000 | 2,000,000 |
| Average sale price (ETB) | 0.30 | 0.30 | 0.30 |
| | | | |
| **Cash inflows (ETB)** | | | |
| **Cash B/F** | 176,250 | 37,757 | 241,757 |
| Sale of cuttings from screen house | 600,566 | 480,000 | 600,000 |
| Subtotal | 776,816 | 517,757 | 841,757 |
| | | | |
| **Cash Outflows (ETB)** | | | |
| Cost of production of total basic seed | 252,000 | 240,000 | 300,000 |
| Overhead expenses(15% of production cost) | | 36,000 | 45,000 |
| Capital expenditure (car customs duty) | 487,059 | | |
| Subtotal of cash outflows | 739,059 | 276,000 | 345,000 |
| Net cash | 37,757.2 | 241,757 | 496,757 |

1 US$ = ETB 27.4 in 2018

**Table 4.** Detailed cash flow.

| **Southern Agricultural Research Institute** | | | | |
|---|---|---|---|---|
| **Cash flow** | **Unit name** | **2017** | **2018** | **2019** |
| Production | | Actual | Targeted | Targeted |
| Production (QTY) – Pre-basic | | | | |
| Production (QTY) – Pre-basic | | 2,100,000 | 2,000,000 | 2,500,000 |
| | | | | |
| Cost of production | | | | |
| Per unit basic seed | Birr | 0.12 | 0.12 | 0.12 |
| | | | | |
| Average price per unit sales | | Actual | Estimated average | Estimated average |
| Average price of pre-basic per unit of sales | Cuttings | | | |
| Average price of basic per unit of sales | Birr | 0.30 | 0.3 | 0.3 |
| | | | | |
| Sales | | Actual | Estimated average | Estimated average |
| Sales of pre-basic (QTY) | Cuttings | | | |
| Sales of basic (QTY) | | 2,001,887 | 1,600,000 | 2,000,000 |
| % of sales from total pre-basic production | Percentage | | | |
| % of sales from total basic production | Percentage | | | |
| | | | | |
| **Cash Inflows** | | | | |
| Beginning cash at first reporting period | | | | |
| Revolving Fund (RF) | Birr | 176,250 | 37,757 | 241,757 |
| Cash B/F | Birr | 176,250 | 37,757 | 241,757 |
| Sale of pre-basic | Birr | | 0 | 0 |
| Sale of basic | Birr | 600,566 | 480,000 | 600,000 |
| Subtotal | | 776,816 | 517758 | 841757 |
| | | | | |
| **Cash outflows** | | | | |
| Total cost of pre-basic | Currency | 0 | 0 | 0 |
| Total cost of basic | Currency | 252,000 | 240,000 | 300,000 |

Table 4 Contd

| | | | | |
|---|---|---|---|---|
| Other expenses (Capital Expenditure) | Percentage | 487,059 | | |
| Overhead costs (15%) | Percentage | | 36,000 | 45,000 |
| Subtotal | Birr | 739,059 | 276,000 | 345,000 |
| Net cash | Birr | 37,757 | 241,757 | 496,757 |

1 US$ = ETB 27.4 in 2018

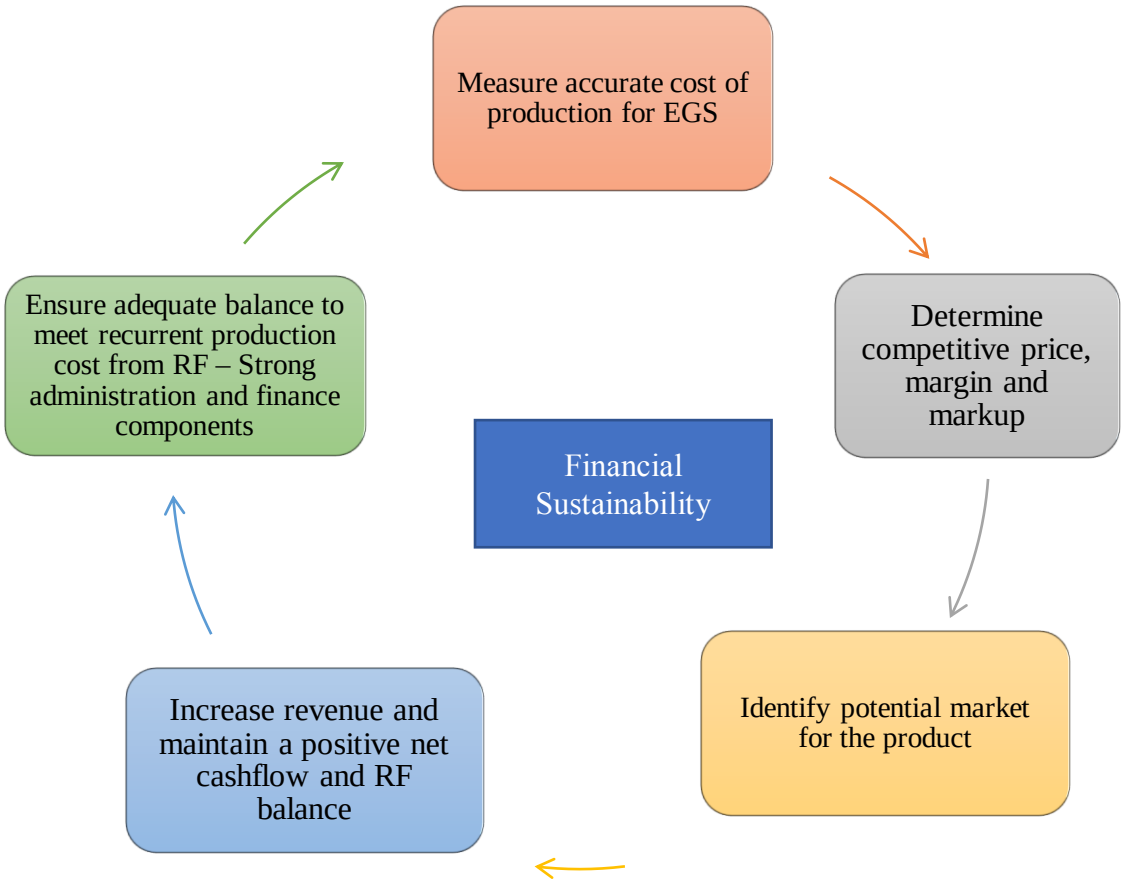


**Figure 6.** Interconnection of financial performance and sustainability of EGS business.

followed:

Step 1: Identify the minimum capacity of production at every stage of EGS production to meet the minimum sales target based on available planting materials and future requirements using the seed multiplication calendar.
Step 2: Use running costs per unit of production to measure total recurrent cost of production for the entire production quantity
Step 3: Identify prices per unit of sales to forecast revenue for the reporting period based on quantity of sales.
Step 4: Once total recurrent costs of production have been identified, the tool will look at the available funds and analyze if there is sufficient revolving funds available to meet the recurrent production costs.
Step 5: If the institution manages to meet its sales targets with actual sales figures properly recorded, the NARI can generate positive RF and net cash flow in their income statement.

## CONCLUSION

Sweetpotato has gained a lot of significant role nationally as a food and nutrition security crop. Quality planting materials are very essential to increase the production

and productivity of sweetpotato. However, shortage of clean planting materials at the time of planting is a key challenge for Ethiopian farmers. Farmers used to maintain the planting materials in their home gardens until the rainy seasons come. Due to recurrent drought the farmers are losing their materials and are being forced to stop sweetpotato production. SPVD is another challenge that affects the quality of the planting materials and seriously reduces the root yield. Therefore, for access to clean and sufficient planting materials at the right time, cleaning the planting materials in tissue culture, acclimatizing, multiplication of pre-basic seeds in insect proof net tunnels and basic seeds in isolated open fields is very essential.

SARI has the infrastructure and technical capacity to sustainably produce and sell basic seed. The institution is aggressively promoting and marketing sweetpotato seeds, which has positive influence on increasing the demand for the seeds.

Based on the cash flow analysis; it is projected that the sales revenue will adequately cover production and other contingency costs and make profits. This further confirms that the institution can sustainably produce both pre-basic and basic seed. This sweetpotato seed business model is the first of its kind in public institution in Ethiopia and can be used as a reference for seed business of other crops.

## ACKNOWLEDGEMENT

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