FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

HORTICULTURE SEEDLING NURSERIES : A VIABLE BUSINESS MODEL?

SCOPING STUDY REPORT

July 2018

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Feed the Future Kenya Crops and Dairy Market Systems Activity

TECHNICAL REPORT: HORTICULTURE SEEDLINGS NURSERY SURVEY REPORT

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Photo Caption

Front Cover: [REDACTED], a nursery proprietor in Kisii county preparing his banana seedlings.
Back Cover: Various field activities across KCDMS counties of operations

LIST OF ABBREVIATIONS AND ACRONYMS

AFA	Agriculture and Food Authority
ALV	African leafy vegetables
ASDSP	Agricultural Sector Development Support Program
ATC	Agricultural Training Center
CEC	Chief Executive Committee
FPEAK	Fresh Produce Exporters Association of Kenya
FtF	Feed the Future
GoK	Government of Kenya
HCD	Horticultural Crop Directorate
ICRAF	World Agroforestry Center
ICT	Information Communication Technology
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KALRO	Kenya Agricultural and Livestock Research Organization
KCDMSD	Kenya Crops and Dairy Market Systems Development (Activity)
KEPHIS	Kenya Plant Health Inspectorate Services
KHC	Kenya Horticulture Council
KVDA	Kerio Valley Development Authority
MOALF	Ministry of Agriculture, Livestock, and Fisheries
RTI	Research Triangle Institute
SHF	Smallholder farmer
SN	Seedling nursery
TC	Tissue culture
USAID	United States Agency for International Development
VC	Value chain

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BRIEF ON THE ASSIGNMENT

Introduction

The Feed the Future Kenya Crops and Dairy Market Systems Activity (KCDMS) is a five-year (Oct 2017– Sept 2022) program of the United States Agency for International Development (USAID). It is funded as part of Feed the Future, the U.S. Government's global hunger, and food security initiative that helps to increase agricultural production and reduce poverty and malnutrition in Kenya. KCDMS activity is being implemented in 12 counties and is designed to spur competitive, resilient market systems in Kenya's horticulture and dairy sectors. KCDMS also seeks to improve access to information and productivity-enhancing agricultural inputs for smallholder farmers through sustainable commercial supply channels. RTI International has contracted Agri Experience, Ltd (a Kenyan consulting firm focused on seed systems development) to conduct five scoping studies as part of a seed and inputs sector assessment. Agri- Experience began work on the scoping studies in mid-February.

This report is the final version of the scoping study focused on Seedling Nurseries (SN) as viable business models.

Scope of work

This report is the final version of the scoping study focused on Seedling Nurseries (SN) as viable business models.

Scoping Activity: Conduct a scoping mission for (horticulture) seedling nurseries as a viable business model

A. To what extent are seedling nurseries currently active, and valued by farmers? Are they growing?
B. What does the economic model generally look like?
C. What might be the potential contribution of seedling nurseries as a source of planting materials for priority crops for smallholder producers?
D. What are the regulatory requirements, if any?
E. What is the potential demand for such materials?
F. Is the value to customers more than the cost of production given the potential risks?
G. How might such an enterprise be organized?
H. What are the barriers to entry and operation for women and youth?
I. What would be the most appropriate model for distribution?
J. Can the business be sustainable?
K. Which crops would be the most lucrative?
L. What facilitation is needed?

Methodology and interview list

The methodology employed for the work has consisted of the following:

1. Development of key informant interview list
2. Development of data requests (e.g. from Kenya Agricultural and Livestock Research Organization (KALRO) and Kenya Plant Health Inspectorate Service (KEPHIS))
3. Conducting interviews with KCDSM partners
4. Conducting national and county-based interviews
5. Convening of two-day workshop with KALRO scientists and technicians to address research questions for horticulture value chain crops and seedling production
6. Regular team brainstorming regarding findings, information gaps, and recommendations
7. Review of draft findings with KCDMS leaders and partners
8. Development of final report and recommendations

Expertise from a broad range of interviewees has been tapped for the study, including national government institutions, county-based agricultural officials, leading experts from other donor programs, and a wide range of private sector market actors, ranging from input supply companies to input users.

KEY RESEARCH FINDINGS

Introduction

Seedling nursery development in Kenya offers substantial potential for value chain development and strengthening, employment, farmer income as both nursery operators and producers, the inclusion of women and youth, and a progressive spiral of improvement for entrepreneurs who are motivated to start and grow a business.

Demand for quality seedlings currently exceeds the supply by a significant margin, and it is anticipated that this demand will increase as value chains are strengthened hence will lead to increased export opportunities. Fortunately, seedling nurseries operate at healthy profit margins, and farmers are willing to buy the planting materials due to the return on investment to the farmer, although often delayed by a year or more.

There are existing strong stakeholders in the value chains who are eager to do more and to see smallholder farmers (SHF) and other stakeholders benefit from improved planting materials. Principal among these are KALRO, Horticulture Crops Directorate (HCD), Fresh Produce Exporters Association of Kenya (FPEAK), sizeable commercial seedling companies, and existing off-takers in the value chains. The roles of the counties, KEPHIS and HCD, are in flux in the wake of devolution, and there is much to be gained from clarifying roles, ensuring public sector can carry out mandates, and developing robust platforms for dialogue and the transparent provision of information.

Background Information

Seedling nurseries in Kenya can be broadly categorized as follows:

Large commercial nurseries and/or tissue culture (TC) labs

These are sophisticated, licensed, certified private sector operations capable of delivering large volumes of planting material in relatively short periods of time. Propagation is generally done based on advance order and paid deposits. The critical entities in this category are:

Table 1: Large private sector nurseries for planting material of VC crops

Large Commercial Nurseries	Crops of focus
Kakuzi	Avocadoes, mangoes, and passion fruit
Plantech	Leafy vegetables
Longonot Nurseries	Leafy vegetables
Mimea International	TC bananas
China Hort	TC bananas
Stokman Rozen	TC bananas, TC sweet potatoes, and avocado
Solo Plant	Avocados
Genetics Technologies International Ltd. (GTIL)	TC Bananas and sweet potatoes
Oserian Flowers Ltd	TC bananas
Aberdares Technologies Ltd	TC bananas and mangoes

Source: Field interviews

KALRO, university, and other parastatal nurseries and/or TC labs

These are government-owned nurseries and labs. Government institutions with horticulture nursery operations/labs include:

Table 2: Public/Parastatal nurseries for planting material of VC crops

Institution	Mandate crops
KALRO Centers	TC Bananas, Mangoes, Passion, Sweet potatoes, and Avocado
Jomo Kenyatta University of Agriculture and Technology (JKUAT)	Mangoes, TC Bananas, and Avocado
Government of Kenya prisons – Kibos, Migori, Manyani	Avocado, Passion, and Mangoes
Agricultural Training Centers (ATCs)- Mabanga, Chebororwa, Koibatek	Passion, Avocado, and TC Bananas
Kerio Valley Development Authority (KVDA)	TC Bananas, Mangoes, and Avocado

Source: Field interviews

The relevant KALRO centers and their crops of focus are:

Table 3: KALRO centers and VC crops of focus

KALRO Center	Crops of focus
KALRO Embu	TC Bananas and Mango
KALRO Kakamega	TC Bananas and Sweet potato vines
KALRO Kisii	TC Bananas
KALRO Kitale	TC Bananas
KALRO Matuga	Mangoes
KALRO Mtwapa	Mangoes
KALRO Perkerra	Mangoes, Avocado, and Passion
KALRO Thika	Passion, Mangoes, and TC Bananas
KALRO Kandara	Avocado and Mango
KALRO Alupe	Passion and Avocado
KALRO Kibos	Passion, Avocado, TC Banana, and Mango
KALRO Njoro	Sweet potato

Source: KALRO

KALRO is one of the most significant players in the sector. Table 4, below, provides an overview of total KALRO seedling sales from 2008 to 2017.

Table 4: KALRO estimate of seedlings sold in the past 9 years

Crop	Seedlings sold during period 2008-2017	Percentage of total seedlings
Sweet Yellow Passion	190,834	21%
TC Banana	165, 104	18%
Avocado	82,360	9%
Mango	51,292	6%
Purple Passion	44,530	5%
Others – Macadamia, Pawpaw, tree tomato. Etc.	377,153	41.5%
Total	**911,273**	**100%**

Source: KALRO

In addition to the above, KALRO estimates that 2.4 million sweet potato vines are said to have been sold in the past three years from KALRO Njoro station.

Mid-sized commercial nurseries and/or TC labs

These are privately owned nurseries and TC labs which are generally licensed and certified. Most are over five years old and vary significantly in level of sophistication, registration, and certification. Some advanced mid-sized SN harden TC plantlets from commercial TC labs and later sell them to farmers. An example of this is Good Neighbours SN in Bungoma, which gets plantlets from Stockman Rozen, hardens them, and sells the resulting plant to farmers in the western region. If a farmer wants to sell to the export market, seedlings must be traceable to a nursery that is registered (by HCD) and certified (by KEPHIS).

Small commercial nurseries

These are generally farmer or entrepreneur-run nurseries offering planting material for sale either from the farm or along the roadside. Most are less than five years old. In the case of on-farm sales, in some instances, these are farmers who begin producing seedlings, even grafted seedlings, for their orchards and later grew to sell the surplus. Some local seedling nurseries have partnered with KALRO centers for seedling distribution, but not many. Small nurseries vary significantly in terms of sophistication, with one critical factor being prior training and owner uptake and application of the training. While some of these smaller nurseries are licensed, the majority are unlicensed. It is not known how many of these nurseries are in existence. An indicative clue was supplied by the International Center for Agroforestry (ICRAF), which stated that many years ago they attempted to survey tree seedling nurseries in Central Province, and accounted for over 1,000 in that area alone.

A selected list of large and medium-sized established seedling providers is given below in Tables 5 and 6.

Table 5: Locations of selected large commercial nurseries

Nursery	Location
Kakuzi	Muranga
Aberdare	Thika
Plantech	Isinya – Kajiado
Solo Plant	Thika
Stokman Rozen	Naivasha
China Hort	Nakuru – Rongai
Mimea International	Kajiado
Longonot	Naivasha

Source: Public records

Table 6: Locations of selected mid-sized nurseries

Examples of Mid-Sized Nurseries	Location
Grace Rock Nursery	Kiambu
Rich Farm Nursery	Naivasha
Lake Kanyaboli	Siaya
Good Neighbours	Bungoma
Weya Nurseries	Siaya
Wildlife Works Organic	Taita Taveta

Source: Field interviews

For the most part, large commercial nurseries are not located in target counties and are not easily accessed by SHF in target counties. There are a few, but not many, mid-sized commercial nurseries that are accessible by some SHF in target counties – but there is great opportunity for expansion.

Small, usually informal, nurseries predominate, but in some target counties, even these are in short supply, especially small nurseries that exhibit proper propagation and hygienic practices.

Planting materials for the scoping study crops of focus fall into the following categories:

Table 7: Description of planting material categories

Category of planting material	Description	Examples of applicable crops
Certified seed	Packaged, KEPHIS-certified seed either produced locally or imported	ALV, P&F grasses and legumes
Recycled seed	Saved seed	All
Splits	Divided sections with roots	Napier grasses
Cuttings	Sections, primarily of vines	Sweet potato
Tree/vine seedlings (non-grafted)	Seedling propagated from a single seed	Mango, avocado, passion fruit
Tree/vine rootstock	Rootstock seedling propagated from a single seed	Same as above
Tree/vine scions	Seedling "top" (generally fruit bearing) section of a tree propagated from a single seed	Same as above
Grafted seedling	Manual combination of tree/vine rootstock seedling with scion seedling to create combination seedling with strong, disease tolerant rootstock and scion that produces desired horticulture variety	Same as above
Grafted orchard tree/vine	Manual combination of tree/vine rootstock with scion to create combination plant with strong, disease tolerant rootstock and scion that produces desired horticulture variety	Same as above
Shoots/suckers	Small new plantlets that emerge near main plant	Banana
Tissue culture seedlings	Laboratory propagated clones	All but ALV
Slips/suckers	Suckers are from the axil of the leaves on the main stem Slips are suckers below the fruit	Pineapple

Source: Agri Experience compilation

Seedling nurseries/labs can be involved in all of these categories, or only selected categories, depending upon their business model. For example, TC labs will obtain clean, virus-indexed planting material from breeders, clone it, and mature the seedlings in their germination chambers or screen houses before selling. A roadside nursery, on the other hand, may save and propagate seed of the desired variety from an existing farmer orchard and sell it. More sophisticated small or mid-sized nurseries may propagate and sell grafted seedlings if they have been trained, or have access to outside grafting skill expertise.

An essential player in the seedling nursery sector is the Kenya Agriculture and Livestock Research Organization (KALRO). KALRO serves as both a system of seedling nurseries supplying SHF, as well as a supplier of planting material to other nurseries and market actors, although the majority of KALRO planting material is estimated to go directly to SHF. KALRO's input on their current, and potential, seedling nursery business was gathered during a two-day workshop with KALRO on planting

material for value chain crops and pasture and fodder crops, as well as seedling nurseries. It is included in Annex 3.

Summary of Findings

The scoping study findings are outlined below and follow the sequence of the research questions presented in the Scope of Work.

To what extent are seedling nurseries currently active, and valued by farmers? Are they growing?

Seedling nurseries appear to be quite active in general, but specific areas of low activity do exist. Low activity areas tend to be in more remote geographic locations where there are few nurseries overall, such as Migori, Homa Bay, and Busia. Medium and larger scale nurseries report shipping seedlings for long distances, which is indicative of demand in the face of no or low local supply. Besides, counties frequently order/import seedlings across long distances, from other counties. Bungoma and Vihiga counties, for example, import TC bananas and avocado seedlings from Kiambu and Nairobi to supply planting material to their farmers or meet a donor project objective, but the emphasis here tends to be on importing material rather than trying to develop a trained, sustainable planting material source in the county.

Seedling nurseries appear to be highly valued by farmers, notably if they display skill and knowledge about their work, and are trusted by farmers. Many nurseries report selling out of all material produced, and being constrained by capacity in filling advance orders. As with any industry, low-skill/low-trust business may not sell all they produce and will experience challenges beyond the short term as farmers learn that they supply poor quality material.

Recent/current data about active seedling nurseries is hard to obtain, and most likely does not exist in updated form. KEPHIS has a list, dating to January of 2016, of 62 nurseries that appear to have passed annual certification by KEPHIS (Annex 4). In addition, there is a list put together by HCD that outlines registered nurseries as of 2016 (Annex 5). The HCD list has over 300 entries.

Enforcement of certification and registration appears to be weak and uncoordinated, most likely due to lack of resources and, for KEPHIS, more pressing matters such as crop disease management in seed. For example, HCD is mandated to carry out SN registration, but it appears that most nurseries that register with HCD do not follow through to obtain KEPHIS certification.

In some instances, counties provided small lists (e.g., nine contacts were provided by Siaya county), but it was clear that these lists were not comprehensive. KEPHIS regional offices may have more comprehensive listings of nurseries that they have certified for the past 12-month period, but to date, these lists have not been provided so they may not exist or be up to date.

Many seedling nurseries interviewed reported benefitting greatly from early training provided by entities such as the Horticulture Crop Directorate (HCD), but note that this training has fallen off and as a result, the nurseries' initial growth is slowing. It is possible that since devolution HCD has not been funded to provide this training and counties have not taken it up, leaving seedling nurseries without proper access to expertise, ways to train new staff, or a clear path to upgrading or refreshing parental materials.

There are pockets of growth in the value chains due to county emphasis, e.g., mango in Makueni, bananas in Vihiga, and avocado in Kisumu and Siaya. However, it is not clear that the volumes of quality planting materials are keeping up with the potential VC growth.

Special initiatives, such as the KALRO and FPEAK partnership for avocado seedlings (approximately one million seedlings), have delivered planting material at scale, and offer a potential model for public, private partnerships for planting materials. However, many counties want quick results from

agricultural investments and are often not willing to wait for mature fruit orchards to deliver economic value.

Farmers value quality planting material because the resulting plants grow faster and mature earlier, are disease free and are cheaper in the long run due to higher yields. In addition, many nurseries offer technical advice to farmers. Finally, as mentioned earlier, if a farmer wants to sell to the export chain s/he must produce using seedlings obtained from a licensed nursery for traceability purposes. The primary reasons why farmers do not buy seedlings include: 1) they are initially considered expensive by some; 2) they are bulky to transport over a long distance, raising cost; 3) they are not available, and 4) farmers do not know about, or are unsure of the stability of, the underlying market for the produce and the returns to investment.

What does the economic model generally look like?

The response below focuses on small and medium sized local nurseries, as it is these nurseries which will be the focus of recommendations later in the report.

For both small and medium sized nurseries, virtually all reported making money, with reported profit margins ranging from approximately 10% to a high of 40%. The key factors impacting the level of profitability are scale, affordable access to land and water, farmer awareness of nursery business which drives advance orders, and nursery operator knowledge and dedication to protecting unsold planting material from diseases and pests.

There are several positive business factors which drive profitability and sustainability. These include:

- ✓ High agricultural activity/output on a small amount of land
- ✓ Quick turnaround time for revenue generation, generally less than producing the actual crop
- ✓ High farmer demand, once farmers are aware of seedling benefits
- ✓ Increasing (current and potential) market opportunities for farmers to sell produce
- ✓ Farmer willingness to order and pay a deposit in advance
- ✓ Ability to use unsold planting material in own orchard, in the case of farmer-operated seedling nurseries
- ✓ Relatively low barriers to entry
- ✓ Strong private sector associations which are active in creating an enabling environment and driving sector growth, such as FPEAK and the Kenya Horticulture Council (KHC).

Relative to other business sectors in which Kenya seeks to develop growth opportunities for SHF, horticulture offers substantial potential for regional competitiveness, leveraging the already robust industry environment for flowers and export crops such as French green beans, and increased farmer awareness of quality levels required by off-takers due to the potential for traceability. The profit potential for seedling nurseries is currently excellent, as the industry is not overly competitive at this point.

For a small nursery, the breakdown of expenses is estimated to follow the pattern outlined below. The percentages given for infrastructure such as land and other capital investment used over an extended period represent the annual amortization of the cost, not the initial investment.

Table 8: Estimated expense categories for a small nursery

Expense Category	Estimated Proportion
Labour (casual & permanent)	25%
Seed/planting material	15%
Land and water (normal piped water and boreholes for sleeve-watering)	15%

Media – manure, cocopeat, fertilizer	10%
Chemicals	10%
Polythene sleeves, germination trays & others	10%
Greenhouse & shade nets	10%
KEPHIS, business permit and other levies	5%

Seedling prices vary according to variety, region, quality, public vs. private source, transportation costs, and cost of parental material. Examples of the variation are:

- In Central, TC banana is 300 KES while in Western it is 200 KES
- KALRO will typically sell seedlings at lower prices than the private sector, but farmers must come to KALRO centers to purchase them and provide their transport.
- Grafted avocado seedlings will range from 150 – 250 KES depending upon the variety, and yellow passion from 100 to 200 KES.

Currently, the prices are affordable to most smallholder farmers due to the low levels of unsold material at quality nurseries, although extremely resource-poor farmers will say that prices are too high. Given the small financial investment and potentially large return from the resulting tree, one can even make the case that high-quality seedlings are underpriced, or that farmers would pay even higher prices for services such as delivery to their farms, possibly including site inspections and agronomic advice.

Profit margins (pre-tax) are reported to be in the range of 10% to 40%, with the majority in the 30-40% range. As noted earlier, critical determinants of this are scale, expertise/efficiency, and if the land is owned or must be rented. Most operators said that profit levels start low and increase over time.

Sales are made through cash upon purchase for walk-in/speculative production, and via deposit (usually 50%) with full payment upon delivery or pick-up for advance orders. Credit is rarely given, and if so only to highly trusted customers.

It is highly likely that many small seedling nurseries do not pay taxes or the full amount of taxes. All too often, record-keeping and proper financial management among small agricultural businesses in Kenya are not viewed as smart business practices as they may drive higher tax liabilities.

What might be the potential contribution of seedling nurseries as a source of planting materials for priority crops for smallholder producers?

The potential for contribution is almost inestimable. Provision through mostly centralized nurseries entails high transport costs and potential loss of seedling viability during transport. Besides, the positioning of a variety for a horticultural crop is as vital as it is for staple crops. Despite the limited choices, farmers should plant varieties only in the agro-ecological zones for which they are suited. Transporting seedlings across vast distances increases the potential for mismatches between varieties and the agroecological zones for which they are suited, thus driving farmer loss of investment and disillusionment with supposedly "quality" planting materials.

Local nurseries, if well managed and provided with the opportunity for continuous improvement in knowledge and practice, offer enormous value concerning both planting material and farmer extension services.

Local nurseries can also play roles in networking farmers to off-takers, channeling new genetics and fresh planting material to farmers, providing traceable channels for off-takers for export crops, and offering training to farmers on managing their seedlings post nursery.

What are the regulatory requirements, if any?

At present, the national level requirements are:

a. Businesses need a Kenya Revenue Authority PIN

b. Seedling nurseries are supposed to register with HCD (under AFA). The registration form is provided in Annex 6. The cost for this is 500 KES.

c. Seedling nurseries are supposed to be certified by KEPHIS each year. Upon successful inspection, they will receive a certificate of operation for a twelve-month period. The cost for this is 5,000 KES for the initial certificate, and it is renewable annually for the same charge. If a nursery has not met all KEPHIS requirements at once, multiple inspections are involved, and these can be quite costly. For example, one nursery in Siaya has already paid KES 29,000 for inspections but has not yet received its certificate as it has not yet met all requirements. A sample of the KEPHIS certificate is provided in Annex 7.

d. Seedling nurseries propagating seedlings from actual seed are required to use certified seed from KEPHIS or obtain it from a nursery orchard certified by KEPHIS (e.g., for African leafy vegetables (ALV), avocado and mangoes)

KEPHIS site inspections will include factors such as slope, drainage, media sampling to determine soil-borne diseases, nutrient composition, water source and quality, the origin of planting materials, pest and disease pressure, knowledge of manager(s), and quality of shading nets. SN owners are advised to display their licenses.

There is no tag, label, or barcode to indicate that SN materials are from an appropriately licensed and certified source, making it difficult for farmers to verify the authenticity of the planting material. Also, there is no formal mechanism through which a farmer can complain if the seedlings purchased do not prove to be authentically labeled (correct to type) and free of pests and diseases. Consequently, it leads to the increase of non-professional or dishonest SN operators.

Most of the crops of focus fall under the Seeds and Plant Varieties Act, Cap 326, Schedule 1. These are crops that do not undergo mandatory certification, National Performance Trials (NPTs) and subsequent release. They are inspected at the point of entry (in case of imports) and at the nursery of a farmer or company who/which intends to sell to other farmers. Avocados, mangoes, pineapples, bananas and sweet potatoes fall under this category. Planting material for these crops is inspected against diseases (present on the planting material or prevalence in origin) as well as general health of the planting material and trueness to type. Inspection of these materials is considered 'cautionary.

What is the potential demand for such materials?

At the nursery level, estimates of unmet demand for their businesses ranged from 30% to 100% plus. However, these estimates were framed by their own, current, experiences and did not consider drivers such as promotion support, county-based value chain programs, or stronger farmer linkages to off-takers.

There may also be seismic changes in demand due to market forces such as the introduction of new, desired varieties, or increased export opportunities. An example of the latter is the potential for increased avocado exports to the US if the direct Kenya/US flights open.

The harvesting period for avocados from Kenya falls during a non-harvest period in the US, and demand is predicted to be very strong. If currently, operating nurseries are noting 30% to 100% unmet demand, areas where quality nurseries are not functional, but farmers will similarly come to value seedlings, offer exponential growth from very low bases.

Most small local SNs produce seedlings based on their estimate of potential demand for given varieties. 80-90% of business is walk-in business, with the rest being advance order. Generally, the better an

SN's reputation, the higher the percentage of advance orders as farmers want to ensure that they get the seedlings they want. Of course, demand varies by county, but nurseries selling seedlings for multiple crops indicate that avocado is the most popular. Avocado is followed by TC bananas, mangoes, sweet potatoes, ALV, passion fruit, and pineapples, roughly in that order. This order will vary by location, however. For example, in Makueni demand for grafted mango is highest whereas in Vihiga demand for TC banana is highest. As farmers increasingly embrace farming as a business, there should be an associated increase in farmer demand for clean planting material for the VC crops.

Is the value to customers more than the cost of production given the potential risks?

Yes, value to farmers is very high if the variety purchased is healthy, correctly positioned, and true-to-type (the promised variety). As with staple crop production, the cost of planting material represents the lowest level of input cost, particularly when multiple seasons/years of production are factored into the initial cost of the planting material.

Payback time, however, will vary. For example, pineapple seedling purchase will not even break even the first year as each seedling produces one fruit, and the market price of the fruit is approximately the same as the cost of the seedling. However, in subsequent years the farmer will make money. The seedlings are an investment. Other horticulture crops, such as grafted passion fruit vines, will return the investment and make money more rapidly. In all cases, however, if the planting material is suitable, managed well by the farmers, and positioned appropriately, the investment is positive. As noted above, however, payback periods will vary.

It is important to note that mass giveaway programs have often not proved sustainable. Farmers may be given free planting material, but if this is not accompanied by technical training on management and market linkages, the benefits are generally not realized. In other cases, beneficiaries of free planting materials then wait for other free, but critical, inputs. For example, farmers are given free seedlings often expect to get free agrochemicals and are not willing to invest on their own.

One potential opportunity is for farmers with existing orchards to use their current rootstocks, if healthy, and graft new scions onto the rootstocks. Even a farmer with a small nursery can develop a plan of upgrading a specific percentage of his/her trees each year. For example, avocado scions grafted onto existing rootstocks will produce fruit within three to five years compared to planting new, ungrafted seedlings which will take approximately twice as long. Programs such as this also provide opportunities for farmers to sell wood from the trees that are being upgraded to grafted varieties. One interviewee emphasized that Kenya is overrun with fruit trees that are old and non-productive but still have the right rootstocks that can capably support newer varieties.

TC seedlings may represent a specific case. Due to the expensive cost of planting material, the investment payback time is longer. In many cases farmers are not well versed in how to nurture and mature TC materials, thus hampering their productivity. For example, some farmers are very cynical about TC bananas, stating that they do not produce well after some time. However, agronomists indicate that these farmers are removing too many suckers from the banana plants too soon, which hampers their nutrient uptake and thus vigor and life.

How might such an enterprise be organized?

Organization is simple, and varies by size. Key positions are:

- Owner – oversees full operation, sales, finance, etc.
- Nursery or farm manager – oversees production, agronomy, disease and pest management, water, shade houses, etc.
- Technical staff – ideally, a grafting technician, possibly with apprentices. May also employ an irrigation and watering technician if mid-sized.

- Permanent labor – varies depending upon size of nursery. Permanent labor is employed to water, fertilize, monitor and treat pests and diseases, etc. There may also be a permanent person who handles sales, order taking, payments, if owner does not this this him/herself.
- Casual laborers – as needed, seasonally

Depending upon the size and sophistication of the nursery and orchard, staff can vary from an owner/operator with one or two seasonal laborers to larger staff size. The most important infrastructure investments are water storage, which is critical, and irrigation (e.g., drip). Manual watering can, however, cover many seedlings if the water source is easily accessible. Entrepreneurs will assess the cost of drip irrigation versus the cost of labor for manual watering, with the scale of the nursery being the key determinant.

Greenhouses are not as crucial for seedlings of the horticultural VC crops as they are for horticultural crops such as vegetables, although they would indeed be helpful with pest management. We visited sophisticated, high-quality nurseries for the value chain crops that did not, however, have greenhouses, including one nursery serving a 300-acre orchard and producing mango, avocado, and passion fruit seedlings.

What are the barriers to entry and operation for women and youth?

Men run most of the informal SN enterprises while women and youth are often involved as laborers. There are, however, excellent examples of women who have established seedling nurseries and realized great success, such as the entrepreneurs behind Good Neighbours in Bungoma and Grace Rock Nurseries in Kiambu.

Both women and youth have unique potential as SN operators. Women offer high potential because the work is detailed and quality-driven. They market well, are often trusted at high levels, and network with other women's groups for knowledge and sales. The workload is not laborious, but usually requires good thinking and planning – characteristics which suit women with entrepreneurial minds. Women can also be highly motivated by the quick returns, which can provide for school and medical fees as well as continued investment in their farms.

Youth offer potential because they value the quick returns, and are often very savvy with IT and thus able to successfully access digital resources for continued learning and improvement, as well as marketing.

Barriers to entry exist for both groups, however. For women, barriers to entry include lack of land ownership (often coupled with lack of access to water), cultural practices that identify tree farming as the man's activity, lack of capital, lack of access to IT, lack of flexibility to travel to access knowledge, planting materials, etc.

Barriers to entry for youth include lack of access to land and water, startup capital, training and knowledge, and patience to stick with the business for the time required to build it and be professional. These are challenges common to most youth and youth groups. In addition, the rural to urban migration impacts youth. Many interviewees mentioned youth SN operators who had engaged for quick money, only to leave for the city as soon as they had earned some funds.

On the flip side, for both groups there are strong attractions: SNs can offer good profitability; SNs do not involve traditional field labor which is looked down upon by many youths and a challenge for many women given their other responsibilities; training is not overly challenging; there are useful online resources to help with agronomic questions; markets are expanding; farmers appear eager to invest in seedlings; and both youth and women attract donor funds, which if well targeted and designed to support a market systems approach can be very useful.

What would be the most appropriate model for distribution?

The current model seems to be most appropriate: farmers choose SNs that they trust and either order materials in advance or take their chances with walk-in purchases. Farmers may also be willing to pay more for content that is labeled and traceable to legitimate origins, quality standards, etc.

Ideally, SHF should have options for SNs, and alternatives to pay for different levels of planting material quality and authentication/traceability.

Selling seedlings through agro-dealers is not advisable, as the viability of the seedlings can be compromised by transport and agro-dealers generally sell on consignment. Farmers will also usually want to know that the seedlings are locally adapted, as well, which is ascertainable when buying from a local nursery. SNs, given their large numbers, may also be located closer to farmers than agro-dealers, making the transport of bulky seedlings less costly. It would, however, make sense to link SNs to good, local agro-dealers as possible collaborators on extension and supply of appropriate, authentic chemicals to treat pests and diseases.

In addition, there may be an opportunity to link SNs to off-takers working with local farmer groups for supplying planting material.

Can the business be sustainable?

Seedling nurseries can be and are proving to be, sustainable. They also offer excellent opportunities for growth and business diversification. At present, competition does not appear to be overly intense, with most nurseries reporting that farmers will travel great distances (even from several counties away) to access planting material. However, most nurseries appear to be unprofessional, often due to lack of access to knowledge and training. These nurseries may prove to be unsustainable, mainly if other nurseries – either existing or new – offer better choices to farmers.

Which crops would be the most lucrative?

The answer to this question will vary greatly by county, suitability of the location for production, export and other market opportunities, the time required to produce a crop, and production risks. (E.g., while not a value chain crop, citrus is currently threatened by the ominous production threat of citrus greening disease, which can change the profitability equation almost overnight.)

The most appropriate answer to this question should be provided by the value chain assessments as it will be market potential which will drive demand, and thus supply and pricing, for quality planting material.

A key consideration, however, may prove to be time needed to harden seedlings so that they can be sold. This, again, varies by crop and by type of planting material. For example, a passion fruit seedling propagated from seed will take six to nine months to be ready for sale, whereas a grafted passion fruit seedling will be ready based upon the longer hardening time required for the rootstock (the limiting factor for most grafted seedlings) plus the additional time needed for the scion to adhere to the rootstock. This can take up to 12 months in total, which delays revenue flow for the nursery. TC seedlings, in general, can be ready in four to six weeks. Sweet potato vines, if maintained in tunnel greenhouses, can be sold upon demand if supplied with constant water and nutrition.

It is safe to say that there are no "loss leaders" in the nursery business and that seedlings for all crops can be profitable over time if the nursery is focused on, and can deliver, quality. As SNs multiply, however, speculative production may lead to losses if production decisions do not meet demand.

What facilitation is needed?

For a small nursery, the costs of entry are relatively low although they may still be beyond the reach of a resource-constrained entrepreneur without assistance. Local nurseries, whether small or medium-sized, need the following inputs outlined in Table 9 below.

Table 9: Infrastructure and inputs needed to establish small and medium-sized nurseries

Input	Small nursery	Medium-sized nursery
Land	Generally, quite small, could even be 1/16 of an acre	Will have 1 acre or more, and may include orchard with mature trees
Water source	May be local stream or captured rainfall. Use of piped water generally requires special permission.	Will have reliable source such as borehole. Use of piped water generally requires special permission.
Water storage	Generally small, but important for having seedlings ready during dry season, before planting season. Watering is generally manual.	Will have decent storage, which often drives scale. Generally, includes rainfall capture, may include borehole, tanks, and pumps. Will generally also include at least some drip.
Planting material	Most may be recycled, but may also come from KALRO if relevant center is nearby. Certified seed for ALV,	May be linked to KALRO center for at least some planting material, may have own farm for propagation or may import certified seed from large commercial farms. Certified seed for ALF.
Planting medium	Generally, soil, and may not be clean. Some will use medium (clean or not) or sterilized soil.	Will generally, but not always, use better growing medium (e.g., cocopeat). Sterilization may still be an issue though.
Planting containers	Usually plastic sleeves or trays. Generally, just placed on ground.	Also, plastic sleeves or trays, may be above ground.
Screen houses	Usually no screen house	May have some or all screen houses
Pest and disease management	May be traps or insect scouting with pesticide use. Chemicals for disease	More training on how to manage pests. More resources for pest and disease management, and generally better knowledge, through experience
Fertilizer	Little needed, particularly if using planting medium.	Little needed, particularly if using planting medium
General labor	May be only owner, possibly with a few casuals	Owner plus several full times plus casuals as needed
Specialized (grafting) labor	Usually not utilized, unless owner has been trained and it is this knowledge that is driving business establishment	Will generally use at least some of the time, as farmers want grafted seedlings, but grafting expertise is in short supply
Business management tools	Almost none. Some record-keeping may be employed, but almost always phone-based.	Generally, very rudimentary, and may also be primarily phone-based, although there are exceptions
Marketing tools	Generally only word of mouth, although some youth may use ICT	Facebook page, signage, linkage to county, participation in agricultural shows and organized field days
KEPHIS and other levies	Many or may not be licensed and certified. Most are not.	Should be licensed and certified.

Source: Field interviews

Facilitation to support either start-up nurseries or to expand existing small or medium-sized nurseries will vary greatly according to what infrastructure the nursery already has, in addition to what land it must have to support the expansion. Facilitation will, in general, fall into one or more of the following categories:

- ✓ Linkage to sources of, and support for purchasing and/or transporting, initial planting material
- ✓ Water and irrigation
- ✓ Screen houses and other disease and pest control
- ✓ Training and ongoing mentoring
- ✓ Promotion
- ✓ Grafting expertise, if dealing with grafted plants
- ✓ Business management tools, including ICT.

RECOMMENDATIONS FOR MARKET SYSTEM DEVELOPMENT

The priority recommendations for market systems development for seedling nurseries as viable businesses serving SHF in the target counties are outlined below. Not surprisingly, many of these recommendations overlap with the recommendations of the Value Chain Planting Material scoping study, as much of the planting material for the VC crops, specifically avocado, mango, and passion fruit, is supplied through seedling nurseries. To provide a complete overview of the recommendations, however, the overlapping recommendations are presented in full in both studies, but in blue for easy identification. The recommendations are grouped in three general categories:

- Increasing the supply of planting material through seedling nurseries
- Improving the quality of seedling nurseries as businesses, and the planting material they produce
- Enabling tools/activities

Increasing the supply of planting material through seedling nurseries

1. ***Partner with KALRO to support them in supplying planting material to private sector distributors versus end-user farmers:*** KALRO houses strong horticultural expertise and infrastructure. In addition, they have strong training capability. However, at present most of the planting material they produce is sold directly to farmers rather than being used to prime the pump of private sector scaling and distribution. There is considerable upside to working with KALRO to fulfill their initial mandate for seed production: supplying private sector scalers and distributors. For VC crops, this would mean focusing on supplying higher performing seedling nurseries in the target counties, who can then distribute to other county nurseries. Design and implementation of a collaborative effort with KALRO, to support them to move from a largely SHF focus to a focus on the scaling nurseries who can serve exponentially more SHF, can dramatically increase SHF access to planting materials. Implementation would involve identifying and linking KALRO with strategic nurseries in target counties, developing training and mentoring plans, and coaching participants on planning for parent material needs. In addition, it may make sense to develop a revolving fund to enable smaller or start-up nurseries to purchase planting material from KALRO. Finally, KALRO may require support to develop the institutional management tools to manage planting material supply on an ongoing basis, possibly involving and ICT platform for ordering and product updates.

2. ***Support the strengthening or establishment of several strategic SNs in each county –*** The target counties do not, for the most part, include a strong network of SNs to supply SHF. Support for existing high potential nurseries, or the establishment of new strategic nurseries, in target counties will begin to lay the groundwork for "hub and spoke" distribution of planting materials to eventually reach SHF. These strategic SNs will be focused on the county-prioritized VC crops and linked to both KALRO expertise/supply and business development expertise and resources. Networking meetings should also be facilitated so that these strategic nurseries can begin to interact with, and be inspired by, each other. The goal here is for these strategic nurseries to provide a sustainable, market-based foundation for regional VC growth through improved supply of planting material. Regional KEPHIS offices can also be formally linked for training and mentoring. A key aim will also be crowding in by other high potential and competitive nurseries, to foster a competitive environment.

3. ***Support the startup of new, formal SNs –*** Companies such as Kenya Highland Seed have successfully upgraded roadside nurseries into small, formal sector nurseries, although primarily for vegetable seedlings. In targeted counties a similar approach, tied to cost-shared innovation support, could help to establish a base number of upcoming nurseries – possibly primarily women and youth-run – to support nursery expansion in the county. In the early stages, these new

nurseries could be linked to larger commercial nurseries for hardening of newly generated or TC materials, or for establishing rootstocks to be grafted with clean scions.

Improving the quality of seedling nurseries as businesses, and the quality of the planting material they produce

4. ***Train existing small and medium formal SNs*** – A critical need expressed by small and mid-sized nurseries is access to training and knowledge. To build sustainability, for technical training this can be tied to specialists in the sector such as those provided by the horticulture trade associations or KALRO. Entrepreneurs who wish to run a successful SN need to know the most common diseases and pests and how these can be controlled. Training would also entail nursery management skills including seedlings establishment, hardening, and grafting. An equally important training need is for basic business training, particularly if it is hoped that the businesses become long-term successes. Topics such as financial management, how to deal with banks, operations, strategy, ICT usage, and human resources are all critical for entrepreneurial success. In addition, SN operators would need to be trained on regulatory requirements and how to satisfy them.

5. ***Develop an approach for "laddered" categories of seedling nurseries*** – This approach entails defining an entry-level position for certification as a seedling nursery, but also defining (possibly) two to four levels of advancement for seedling nurseries as they grow and improve. Rather than the current bimodal certification approach (certified or not, with most seedling nurseries choosing not to be certified), the recommendation is to work with industry trade associations and regulators to establish a "ladder" of certification levels. Low levels will represent the ability to meet basic quality standards for seed-propagated material, while higher levels will represent skill in grafting, pest and disease protection, etc. Nurseries can aspire to reach higher certification levels, and farmers can choose the nursery levels, and pricing, based upon their individual needs and resources. The proposed system is like the system of rating hotels with stars: for lower categories (fewer stars) buyers expect to pay less but also know what to expect. Buyers have choices, and hotels can aspire to rise to a category with more stars; the standards are clear. For many industries with laddered levels of certification or advancement, business entities fully understand what it takes to get to the next level, and often have capacity building support or technical assistance available to reach the next level. If applied to SNs, the approach might certify roadside nurseries that source clean, true to type planting material and maintain hygienic practices at the nursery, but do not have screenhouses or other infrastructure investments, at the low end of the ladder. At the highest end would be a sophisticated nursery with screen houses, tested water, advanced pest control techniques, barcoded traceability for planting material and more. If this approach is to be pursued, it is advisable to develop and implement it through market actors such as regulators and industry associations. This type of approach can also drive farmer education about nursery capabilities, and expertise, much like the hotel star rating system has done for tourists.

6. ***Scale the quality and availability of grafting technicians*** – As demand continues to grow, meeting it will require more grafting technicians, particularly in the target counties. There is currently an acute need for additional grafting expertise in the sector to support nursery quality and skill development, in addition to the conversion of orchards to new varieties. Grafting technicians (who could also be trained to provide advice on agronomic practices) could be licensed by a trade association, listed on a standard industry platform, and available to work on a free-lance basis. Numerous options for training are available, from entities such as KALRO to private sector planting material providers.

7. ***Potential introduction of bar coding system to SNs for traceability and authentication*** – As markets evolve, particularly export markets, traceability will become an important determinant of SHF qualification for entry into the value chain. KALRO is very interested in exploring this

approach, and the trade associations may be interested as well. Bar coding traceability fits nicely into the "ladder" referenced in #5, above.

Enabling tools/activities

8. ***Work with key sector regulators and developers to bring clarity to the various roles to be played by each, particularly in the wake of devolution –*** There is significant confusion in the market related to the regulatory responsibilities of KEPHIS, HCD, various associations, KEBS, and counties. In addition, where there is regulatory clarity, implementation is often sporadic, or even non-existent. Since devolution, many functions that were, at one time, carried out at the national level are now not being undertaken at all, with the result that the industry risks losing credibility as participants operate in the absence of a clear regulatory framework. It is highly likely that regulators such as KEPHIS and HCD will require some level of support to increase their activities, so the question of longer term sustainability becomes important.

9. ***Establishment of information platform*** – There is a huge need for easily accessed, transparent, current information covering market actors, varieties produced, types of propagation used, location, contacts, etc. This type of platform could also be used for outward marketing messages. It is highly advisable that the platform be established through a sustainable market actor such as a trade association, or a service provider who commits to maintaining the platform in exchange for revenue generating activities such as being the key conduit for information provision and implementing marketable communications tools.

10. ***Support for online tools for marketing and technical advice*** – Online farmer groups such as Digital Farmers Kenya, WE Farm, Mkulima, and FarmBizAfrica can be supported further to create linkages for planting materials and market opportunities. We have not yet fully surveyed these tools to determine their additional potential (many of them are already involved in horticulture, but often horticulture for vegetable crops), but particularly with respect to youth farmers we believe there may be considerable upside, particularly with respect to transparent provision of information.

    One challenge we note is that most of the online platforms exist as farmer-to-farmer information sharing sites. All too frequently, the information shared through these channels is incorrect, distorted, contradictory or at best, confusing. Many of these platforms lack technical, authoritative and credible backstopping for solutions sought by farmers. Based on our observations, inquiries on these platforms related to SN are generally limited to "where do I get certified seedlings for crop X?" There may be scope to support a current platform, or develop a new platform that can be tagged onto an existing business model, possibly an industry association.

11. ***Farmer awareness/promotion of nurseries at county level*** – Many farmers are unaware of the value added by formal sector nurseries, or the location or contact numbers of the nurseries. Pilots of modest promotional efforts will be useful test runs for farmer interest and ability to act upon new information. These promotional efforts may include vernacular radio, participation in fairs and demoes, and promotion through digital avenues such as WhatsApp groups in each county.

CONCLUSION

Seedling nurseries represent the locations where planting material for most VC crops, as well as other KCDMS focus crops such as pasture and fodder trees and shrubs, are "born." The environment for any newborn matters, as does the skill of the person managing that environment. Improving seedling nurseries represents a business opportunity not often seen in more developed countries: the market

need is large and growing, and the "fixes" are not overly burdensome. Careful and thoughtful implementation of a well-designed plan to improve both the number of seedling nurseries in the target counties, as well as the quality of all nurseries, over time, will pay significant dividends. Agri Experience is grateful for the opportunity to conduct the scoping study for seedling nursery businesses and thankful to the many entrepreneurs who shared their stories, and their hopes, with us during this study.

ANNEXES [REDACTED]

Photo 1: [REDACTED] roadside SN in Kisumu. Photo 2: Grafted mango seedlings ready for sale in Siaya
Photo 3:Wildlife Works nursery in Taita Taveta. [REDACTED] Photo 4: Mango rootstock ready for grafting at [REDACTED] in Siaya

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