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

PLANTING MATERIALS FOR VALUE CHAIN CROPS

SCOPING STUDY REPORT

July 2018

USAID
FROM THE AMERICAN PEOPLE

KCDMS | Kenya Crops and Dairy Market Systems Activity

Feed the Future Kenya Crops and Dairy Market Systems Activity

TECHNICAL REPORT: PLANTING MATERIALS FOR VALUE CHAIN CROPS

Submitted July 12, 2018

Cooperative Agreement No. AID-615-A-17-00006

Prepared for Harrigan Mukhongo
United States Agency for International Development/Kenya
C/O American Embassy
United Nations Avenue, Gigiri
P.O. Box 629, Village Market 00621
Nairobi, Kenya

Prepared by Agri-Experience for
RTI International
P.O. Box 12194
Research Triangle Park-NC
27709-2194
http://www.rti.org

Kenya Crops and Dairy Market Systems Activity (KCDMS)
The Westwood Office Building, 8th Floor-Westlands
P.O. Box 1181 Village Market, 00621
Nairobi, Kenya

Photo Caption

Front Cover: Banana plantlets hardening nursery
Back Cover: Various field activities across KCDMS counties of operations

LIST OF ABBREVIATIONS AND ACRONYMS

AD	Agro dealer
ALV	African Leafy Vegetable
ATC	Agricultural Training Centers
CIP	International Potato Center
DUS	Distinctiveness, Uniformity, and Stability
EU	European Union
FPEAK	Fresh Produce Exporters Association of Kenya
GTIL	Genetics Technologies International Limited
HCD	Horticultural Crops Directorate
ICIPE	International Center of Insect Physiology and Ecology
ICRAF	World Agroforestry Center
ICT	Information and communication technology
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KALRO	Kenya Agricultural & Livestock Research Organization
KCDMSD	Kenya Crops and Dairy Market Systems Development (Activity)
KEBS	Kenya Bureau of Standards
KEPHIS	Kenya Plant Health Inspectorate Service
KHC	Kenya Horticulture Council
KSC	Kenya Seed Company
ME	Middle East
NGO	Non-government organization
NPT	National Performance Trials
RTI	Research Triangle Institute
SASHA	Sweet potato Action for Security and Health in Africa
SHF	Smallholder Farmers
SN	Seedling Nursery
TC	Tissue culture
USAID	United States Agency for International Development
VC	Value chain
VP	VegPro Group

WVC	World Vegetable Centre

TABLE OF CONTENTS

BRIEF ON THE ASSIGNMENT

Introduction

The 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 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 presents the scoping findings focused on planting material availability and quality for specified horticultural crops – value chain crops identified by USAID and RTI. The specified horticultural crops of focus that are the subject of this study are: African leafy vegetables, avocados, bananas, mangoes, pineapple, sweet potatoes, and yellow passion fruit.

The target counties are:	Kakamega, Bungoma, Busia, Vihiga Homa Bay, Migori, Kisii, Kisumu, Siaya Kitui, Makueni, Taita Taveta

Scoping for the planting materials for value chain crops, however, focused largely on national suppliers such as large commercial nurseries, seed companies and tissue culture labs, regulators, projects, and researchers. Direct involvement at the county level is often low, although not completely absent.

Scope of work

The scope of work for this study was to address the following questions.

Scoping Activity: Lead seed sector mapping component of initial value chain assessments, focusing on availability and quality of seed for specified horticultural crops

A. What varieties are preferred by off-takers, exporters and the local market for identified horticulture crops?
B. Are there any likely or high potential changes to off-taker preferences, and if so what?
C. What are the primary sources for new varieties of identified horticulture crops?
D. What are the primary sources of seed and planting materials for these preferred varieties?
E. What are the major methods by which producers get access to the seed varieties desired by exporters, off-takers, and local markets?
F. What constraints exist in terms of access (distribution), affordability, and quality of this seed?
G. How does availability compare with demand?
H. What needs to be done to solve constraints in the supply chain with respect to availability, distribution, price, and quality control?

In addition, Agri Experience was asked to provide specific recommendations for consideration by the KCDSMD team. The product was directed to be an approximately 15-page report with relevant appendices.

Methodology and interview list

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

1. Development of key informant interview list
2. Overview of relevant literature (generally less than 7 years old)
3. Development of data requests (e.g. from Kenya Agricultural & Livestock Research Organization (KALRO), Kenya Plant Health Inspectorate Service (KEPHIS)
4. Conducting interviews with KCDSM partners

5. Conducting national and county-based interviews
6. Convening of a two-day workshop with KALRO scientists and technicians to address research questions for horticulture value chain crops and seedling production
7. Regular team brainstorming regarding findings, information gaps, and recommendations.
8. Review of draft findings with KCDSMD leaders and partners.
9. Development of final report and recommendations.

Expertise from a broad range of interviewees has been tapped for the study, including national institutions such as KALRO and KEPHIS, county-based agricultural officials, leading experts from, e.g., other donor programs, and a wide range of private sector market actors, ranging from input supply companies to input users. The lists of interviewees and literature review contributing to the study are included in annexes 1and 2.

KEY RESEARCH FINDINGS

The planting material sector for the value chain (VC) crops of focus is highly fragmented, dominated by informal nurseries serving smallholder farmers (SHF), generally short of supply relative to demand, and slow to deliver improved planting materials such as grafted seedlings. There is, however, the great potential for growth and innovation. Most county officials interviewed expressed interest in project involvement for all VC crops, although there were some notable exceptions (for example, Kitui expressed interest only in mango.) Some county officials outlined country priorities that included both VC crops and non-VC crops (e.g., Makueni expressed interest in both mangoes and citrus.)

A high-level view of SHF production of VC crops in target counties is provided in Table I. African leafy vegetables and bananas are currently produced in all counties. Besides, at the county-wide level SHF generally, produce from one to three additional VC crops.

Table 1: SHF production of focus value chain crops in target counties

	Type of material	Zone of Poverty Reduction HR1a					Zone of Poverty Reduction HR1b				Zone of Poverty Reduction SA2		
RTI FOCUS COUNTIES		**HOMABAY**	**MIGORI**	**KISII**	**KISUMU**	**SIAYA**	**KAKAMEGA**	**BUNGOMA**	**BUSIA**	**VIHIGA**	**KITUI**	**MAKUENI**	**TAITA TAVETA**
ECOLOGICAL ZONE													
Focus value chain crops													
Banana	*Vegetative*	√	√	√	√	√	√	√	√	√	√	√	√
Avocado	*Seed/grafted*			√			√	√		√			√
Mango	*Seed/grafted*								√		√	√	√
Pineapples	*Vegetative*	√	√	√					√				
Passion fruit	*Seed/grafted*						√	√				√	√
Sweet potatoes	*Vegetative*	√	√	√	√	√	√	√	√	√			
ALV	*Seed*	√	√	√	√	√	√	√	√	√	√	√	√
Important food crops													
Maize	*Seed*	√	√	√	√	√	√	√	√	√	√	√	√
Beans	*Seed*	√	√	√	√	√	√	√	√	√	√	√	√
Irish potatoes	*Seed*							√					√
Millet	*Seed*		√		√	√	√	√	√		√	√	√
Sorghum	*Seed*		√		√	√		√	√		√	√	√
Rice	*Seed*				√				√			√	√
Cowpeas	*Seed*	√	√		√	√	√	√	√	√	√		√
Greengrams	*Seed*				√	√					√	√	√
Pigeon peas	*Seed*					√					√	√	√
Important horticulture crops													
Tomatoes	*Seed*	√	√	√	√	√	√	√	√	√	√	√	√
Onions	*Seed*	√	√	√	√	√	√	√	√	√	√	√	√
Capsicum	*Seed*	√	√	√	√	√	√	√	√	√	√	√	√
Kales/cabbage/ spinach	*Seed*	√	√	√	√	√	√	√	√	√	√	√	√
PRESENCE OF AN AGRODEALER ASSOCIATION		NO	NO	NO	NO	YES	YES	YES	YES	YES	NO	YES	YES

KEY

	Highlands (Above 1601 m.a.s.l)
	Mid-altitude (1001-1600 m.a.s.l)
	Low altitude (Below 1000 m.a.s.l)
	RTI preliminary focus

Source: RTI/Agri Experience compilation
(Note: RTI preliminary focus refers to KCDMSD's early estimate of the intersection between value chain crops and counties)

Planting material for the VC crops comes in a variety of forms.

Types of planting material for avocados, mangos and passion fruits

- Seed: direct seeding (seed saved from a picked fruit or mature vegetable plant) applies for mango, avocado, passion fruits and African leafy vegetables
- Seedlings: small to more mature (hardened) plants directly propagated from seed
- Rootstock: base of the plant with an established and healthy root system onto which a cutting or bud from another plant is grafted. A specific rootstock is preferred because of tolerances to soil-borne diseases. Rootstocks can be selected from mother blocks or can be already existing, and mature, in an orchard
- Scion: the top part of the plant that produces leaves, flowers, and fruits. The scion is from a variety with attributes the grower desires, e.g., high yield, appearance, or taste. The scions are selected from mother blocks
- Grafted seedling: grafting is a horticultural technique whereby tissues of plants are joined to continue their growth together. The upper part of the combined plant is the scion while the lower part is the rootstock. The resultant plant is a grafted seedling.

Types of planting material for bananas

- Tissue culture: a method of plant propagation done in a laboratory which results in clonal propagation of clean planting material if done properly
- Suckers: lateral shoots that develop from the rhizome and emerges from the soil usually near the parent plant. It is a form of asexual, or vegetative, reproduction, that makes the banana plant perennial.

Types of planting material for sweet potatoes

- Cuttings: pieces of a plant that are used in horticulture for vegetative (asexual) propagation. A piece of the stem or root of the source plant is placed in a suitable medium such as moist soil and, if the conditions are suitable, the plant piece will begin to grow as a new plant independent of the parent
- Tissue culture: see above

Types of planting materials for pineapples

- Crowns: leafy tops of pineapples
- Suckers: see above

Planting materials for African Leafy Vegetables

- Seed: see above
- Seedling: see above

Note: we have defined African leafy vegetables as common nightshade, giant nightshade, spider plant, amaranthus, pumpkin leaves, cowpea leaves, slender leaf/crotalaria, and stinging nettle. Collards are kales, while popular in Africa, are not indigenous vegetables.

Summary of findings

Farmer access to quality planting materials of VC crops is limited. Farmers travel long distances, sometimes across multiple counties, to access good quality planting materials. The demand for planting materials is not met for any of the focus VC crops. Demand pressure and supply are very seasonal; nurseries and seed companies target planting material availability to be ready at the onset of rains which, for seedling nurseries, means that they need all-important access to water during the dry period before planting. Informal seed systems thrive in the focus value chains. Scattered informal seedling nurseries, often referred to as roadside nurseries, fill the demand gap but all too often with materials that are of poor quality, not properly identified, and a source of pests and diseases. Field visits to 5 of the target counties (Busia, Bungoma, Kisumu, Makueni, and Kakamega), proved that there is a keen interest in promoting value chain crops. This is evident through several current or planned county-based subsidy programs which distribute planting materials of VC crops to farmers.

The scoping study findings are outlined below, and follow the sequence of the research questions addressed:

A. What varieties are preferred by off takers, exporters and the local market for identified horticulture crops?

Table 2 outlines the varieties, by VC crop, most preferred for local consumption and by off-takers for either processing or export. The sources represent a compilation of interviews, including public sector, non-government organization (NGO)/donor, and private sector.

Note: Varieties that were mentioned by KALRO but not by another interviewee are highlighted in blue.

Table 2: Varieties preferred for local consumption or sale, and for export

Crop	Preferred varieties for local consumption	Preferred for commercial	Preferred for export
Avocado	Fuerte Hass Pueblo (rootstock) Pinkerton Hardy, Ruehle, Teague, Waldin, Tambarina, Simmods, Winter Mexican, Kyoyl, Zutano, Bacon, Tonnage, Dannish W.I. Bank TX 531, Booth 7, Booth 8, Ettinger, Lula, Sama, Linda, Nabal, Reed Local landraces	Hass Fuerte Pinkerton Puebla Choquette Local landraces	Hass (Europe (EU)) Fuerte (Middle East (ME)), China) Pinkerton (ME)
Banana	Ndizi Ng'ombe Nusu Ng'ombe Uganda Green (Kiganda) Kisukari Grand Nain Giant Cavedish Chinese Cavendish Williams Hybrid Gerald Tucker PHIA 17 & 18	Ndizi Ng'ombe (Cooking) Nusu Ng'ombe (Cooking) Uganda Green (Cooking) Kisukari (Dessert) Grand Nain (Dessert) Giant Cavedish (Dessert) Chinese Cavendish (Dessert) Williams Hybrid (Dessert) Gerald Tucker (Dessert) PHIA 17 & 18 (Dessert; other uses- roasting and brewing)	Kisukari (EU, ME) Giant Cavedish (ME, EU) Uganda green (ME, EU)
Mango	Apple	Apple	Apple

Crop	Preferred varieties for local consumption	Preferred for commercial	Preferred for export
	Tommy Atkins Kent Vandyke Kensington Sensation Haden Ngowe Kent Local landraces	Tommy Atkins Kent Vandyke Kensington Sensation Haden, Ngowe Keit Local landraces	Kent Tommy Atkins Keit Vandyke
Yellow passion	KPF 4 KPF 11 KPF 12 C-5 Brazil	KPF 4, KPF 11 KPF 12	KPF 4 KPF 11 KPF 12 Exported to Uganda, United Arabian Emirates, Tanzania
Pineapple	Smooth cayenne MD2 Sweet cayenne Local landraces	Smooth cayenne Local landraces from Uganda	Smooth Cayenne MD2
Sweet potatoes	Kenspot 1,2,3,4,5 Vitaa Kabode SPK 004 Mugande	Kenspot 1,2,3,4,5 Vitaa Kabode SPK 004 Kemb 10 Kemb 20 Bungoma KSP 20	Bungoma (EU) Kenspot 3,4 (EU)
African leafy vegetables (alv)	Common African Nightshade (Local landrace –Eldoret) Giant night shade Spider plant (Large Veg 003) Amaranthus (Large Veg 004) Pumpkin leaves Cow pea leaves (KAT 80) Crotalaria (slender leaf) Stinging nettle	Common African Nightshade (Local landrace -Eldoret Giant night shade Spider plant (Large Veg 003) Amaranthus (Lag Veg 004) Pumpkin leaves Cow pea leaves (KAT 80) Crotalaria Stinging nettle	Very low quantities are exported, and varieties are not known.

Source: *Field interviews with KALRO, Horticulture Crops Directorate (HCD), KEPHIS, Farmers, Africa Harvest, International Potato Center (CIP), World Vegetable Center (WVC), FIPS, Royal Seeds, DECA, Soloplant, (VP) VegPro Group, Kakuzi, and Aberdare Technologies*

B. Are there any likely or high potential changes to off-taker preferences, and if so what?

There are many changes in off-takers' preferences that are already underway and are likely to continue to expand demand for relevant varieties. These include the trends highlighted below.

1. Interest in non-maize food security crops such as bananas and sweet potatoes will rise even further.
2. Rising demand from hotels, supermarkets and urban markets will be driven by local urban and international tastes.
3. Expanded emphasis on improved diets to combat lifestyle diseases, and better nutrition for children and expectant mothers, is becoming increasingly common.

4. Increased ability by Kenya to meet international export standards is underway, thus driving demand of varieties preferred by off-takers for export.

With respect to new or anticipated changes to off-taker preferences, we recommend linking to the value chain reports to fully address this question. There were, however, several anticipated changes of note that were raised during interviews related to planting material. These were:

1. U.S consumer preferences will drive the variety choice for increased avocado production in Kenya if direct flights between Kenya and the US are inaugurated, thus opening the opportunity for avocado exports to the US, as anticipated; and
2. Dual purpose crops such as sweet potato (tubers for human consumption and vines for animal consumption) will rise in importance, particularly for dairy farmers.

C. What are the primary sources for new varieties of identified horticulture crops?

New varieties of VC crops are introduced to Kenya either as locally bred or imported varieties. KALRO is a major source of new varieties for many of the VC crops, often working in collaboration with global breeding centers such as the International Potato Center (CIP) for sweet potato or the World Vegetable Center (WVC) for African leafy vegetables.

Regulation of the entry of new varieties of the VC crops into Kenya falls into different categories. For African leafy vegetables and sweet potatoes, KEPHIS requires the formal release of the varieties. The subject varieties must be entered multi-location National Performance Trials (NPTs), and trials for Distinctiveness, Uniformity, and Stability (DUS), and evaluated. This process can take from one to up to three or even four years and is costly for the sponsor of the tests. If the tests all prove satisfactory, the variety is presented to the National Release Committee for release and gazettement as a new entrant on the National Variety Release list. The most recent version of this list from KEPHIS for the important VC crops, as of April 2017, is attached in Annex 3.

Mango, passion fruit, pineapple, bananas, and avocado are required to be formally released, but the varieties developed locally by KALRO are tested thoroughly and registered. Imported varieties must go through phytosanitary testing and quarantine upon import but are not required to be released.

The number of varieties and comments developed and released or registered by KALRO for each value chain crop are outlined in table 3. The full list from KALRO is in Annex 4.

Table 3: KALRO varieties of value chain crops

Crop	Number of varieties	Observations/ Comments
Avocado	29	Only one variety has a recent registration, which was in 2011. It's not clear if this variety has been commercialized as only KALRO had information on it The earlier varieties developed date back approximately 30 years, or more
Banana	12	The last registration for cooking varieties was in 1998 and 2011 for the dessert varieties. Current varieties are susceptible to myriad diseases and/or pests, such as Sigatoka, Xanthomonas, Fusarium wilt, nematodes and weevils
Mango	11	The last registration dates back 20 years
Yellow passion	5	Last registration was 9 years ago. The yellow passion is favored more as a rootstock because of tolerances to woodiness virus to which the purple passion is highly susceptible.

Crop	Number of varieties	Observations/ Comments
Pineapple		There are no registered varieties, and it's unclear where the farmers source clean planting materials. For on-farm materials, Uganda is the most likely source (informal) of the planting materials
Sweet potatoes	28	20 of these releases have been 2010 or later. Further research is currently ongoing for orange flesh sweet potatoes with a higher dry matter content
African leafy vegetables	5 (black nightshade) 1 (spider plant) 2 (amaranthus)	These are all recent releases, and commercialization levels are still low.

Source: Summary of field interviews with KALRO, WVC, and KEPHIS data

For most of the VC crops KALRO is the main/sole originator of locally bred varieties. Other released/registered varieties are imported. To bring planting material for a VC crop variety into Kenya, the following protocols must be observed.

1. Provision of a phytosanitary certificate from the exporting country indicating that the materials conform to the variety description and are free from pathogens
2. The exporting country must meet the importing country's quality standards. In Kenya, these standards relate mainly to trueness-to-type of the variety and absence of pests and diseases
3. The phytosanitary documents should be sent prior to the consignment to KEPHIS or accompany the consignment.
4. Incoming planting material undergoes the required phytosanitary tests and is quarantined until it is ascertained that the material to be imported is safe.

If the consignment meets the regulators' standards, it is then released to the importer. Interviewees did not complain about this process or its efficiency, although only a limited number of importers were interviewed. KEPHIS Muguga, the central horticulture phytosanitary and quarantine facility for imported planting material, stated that test results generally took from 7 to 14 days.

During the two-day workshop conducted with KALRO specialists in the VC crops, the scientists provided extensive information about the VC crops, opportunities and challenges, and KALRO's recommendations for moving forward. The questionnaires completed by KALRO at this workshop – one for each VC crop – are included in their entirety in Annex 5.

D. What are the primary sources of seed and planting materials for these preferred varieties?

As outlined earlier, each VC crop can be grown using various types of planting material. These planting materials are, furthermore, available from both formal and informal sources. The sources are described below.

Formal seedling nurseries: The nurseries are registered by Horticulture Development Council, and their core mandate is the production of clean seedling planting materials. The nurseries have processes and checks in place. KEPHIS carries out inspections of the planting materials for pathology upon request. The formal seedling nurseries will mainly grow seedlings on order or for own use. If selling seedlings commercially, the nursery must obtain an annual certificate from KEPHIS stating that it meets KEPHIS standards for disease and pest control, water quality, etc. These nurseries can range from a primarily

automated facility to a smaller, but semi-sophisticated nursery that handles grafted and other material. Examples: Kakuzi, DECA Plantation, and Peter Kathuli, a small nursery owner in Makueni county.

Informal seedling nurseries: These are commonly referred to as roadside nurseries. These nurseries are opportunistic and not regulated. Roadside nurseries generally have no clear structures and can propagate trees, fruits, grasses and vegetable seedlings. Some also do ornamentals.

Tissue culture laboratories: Plant tissue culture involves cloning clean, the virus-indexed material in an artificial medium under sterile conditions in a jar, flask, dish or test tube. Examples of TC labs in Kenya are Genetics Technologies International Limited (GTIL), Jomo Kenyatta University of Agriculture and Technologies (JKUAT), Mimea International, PlantTech, ChinaHort, and Asepsis. Table 4 provides crops of focus for selected TC labs.

Table 4: Selected TC labs and crops of focus

Selected TC Laboratories	Crops of focus
GTIL	Banana Cassava Sweet and Irish potaoes
JKUAT	Bananas Grafted mango,avocado,passion fruit
MIMEA	Bananas TC eucalyptus trees
ASEPSIS	Irish potato Sugarcane, bamboo

Public- KALRO: Kenya Agricultural and Livestock Research Organization (KALRO) is a government institution created under the Kenya Agricultural and Livestock Research Act of 2013 to establish suitable legal and institutional framework for coordination of agricultural research in Kenya with the following goals: i) promote, streamline, coordinate and regulate research in crops, livestock, genetic resources and biotechnology in Kenya; and ii) expedite equitable access to research information, resources, and technology and promote the application of research findings and technology in the field of agriculture. KALRO has set up seedling nurseries for the value chains fruit trees and sweet potatoes which are sold to the farmers directly. (See details in Annex 5).

Public- Agricultural Training Centers (ATC): Farmer demo centers for training and extension. The centers are regulated through the Ministry of Agriculture. Of the target counties, Bungoma, Busia, Kitui, Kakamega, Siaya, Makueni and Kisii all have both formal and informal nurseries at ATCs.

Public- Kenya Prisons nurseries: Conducts propagation (grafting) of fruit crops and sells seedlings directly to farmers. Of the target counties, Migori, Kisumu, Kakamega, Taita Taveta, and Busia all have prisons which sell seedlings to farmers.

Neighbors: Farmers locally exchange planting materials at a small or no cost.

Table 5 summarizes interviewee responses regarding the types of preferred planting material, and both formal and informal sources for the material.

Table 5: Sources of preferred planting material for value chain crops

Crop		Sources of planting materials	
		Formal	Informal

	Type of planting materials		
Avocado Mango Yellow passion	Rootstock Seed grafted seedlings	KALRO Agriculture Training Centers Prisons Formal seedling nurseries FPEAK commercial members	Informal nurseries, neighbors/ exchange Own farm propagation
Banana	Tissue culture (TC) suckers	TC labs KALRO, Formal seedling nurseries	Informal nurseries, neighbors
Pineapple	Crown suckers	KALRO nurseries, Formal seedling nurseries	Informal markets, neighbors
Sweet potatoes	Cuttings tissue culture	NGOs, KALRO TC labs- KEPHIS	Neighbors
African leafy vegetables	Seeds seedlings	Seed companies, County programmes, and Agrovets	Informal markets

Source: Field interviews with HCD, KALRO, KEPHIS, commercial nurseries, JKUAT, farmers, Agro dealers, and seed companies.

Despite the multi-source list above, most planting material for VC crops for SHF appears to come from the informal sector, particularly roadside nurseries and neighbor exchange. As there have been no studies about sources of planting material for the VC crops, to our knowledge, it is hard to say with certainty, but most interviewees concurred with this assessment. Unfortunately, as noted earlier, much of this material is diseased and thus highly flawed.

E. What are the major methods by which producers get access to the seed varieties desired by exporters, off-takers, and local markets?

Producers either:

1. Purchase seed (African leafy vegetables);
2. Purchase ungrafted seedlings and either use the seedling as is, or use them (as either scion or rootstock) to make grafted seedlings;
3. Purchase tissue culture plantlets;
4. Get planting material from a neighbor; and/or
5. Save seed or propagate seedlings or other planting material such as suckers from their own planting material, either formal or informal (all VC crops).

All the above sources have both formal and informal players. Further adding to the complexity is the reality that formal does not always mean high quality and informal, low quality. In some cases, the official players might offer low-quality products, for example in the case of a mid-sized nursery that has been registered by HCD and certified for the year by KEPHIS, but which is experiencing unmitigated infestations of pests and diseases. In other cases, an informal player might offer very high-quality products, for example in the case of a small, uncertified nursery whose owner has undergone grafting and additional training and who has decided to open his or her own small business.

Many, if not most, off-takers pay close attention to the quality of the produce they are buying. If the selling farmer is using unhealthy planting material his/, her produce will either be rejected by the off-taker or will fetch a lower price. For many farmers sourcing planting material from informal sources, if they are not knowledgeable about the drivers of quality, they will achieve suboptimal revenue from the same amount of land, labor and other inputs they would have utilized with higher quality planting material.

For export purposes, it is a general requirement that the planting material is traceable back to a formal sector source. Off-takers or commercial exporters are therefore very concerned with traceability of planting material used by their contract growers or speculative producers. The Kenya Horticulture Council (KHC) is the umbrella organization comprising Fresh Produce Exporters Association of Kenya (FPEAK), Fresh Produce Consortium and the Flower Council of Kenya. It has stepped up its efforts in ensuring that smallholder farmers are using high quality, traceable planting material and proper agronomic practices for their horticulture crops so that they are not blocked from access to export market chains. This may represent a real opportunity for partnership.

The actual process of obtaining commercial material is either via pre-ordering or walk-in. All roadside nurseries are primarily walk-in. All large, formal retail businesses are mostly pre-order with a down payment (generally 50%). KALRO is a mix, but also requires a deposit for pre-orders. Medium sized nurseries are also a combination with some nurseries saying that they were 70% pre-order and only 30% speculative/walk-in production, with others citing much larger percentages of the speculative output based on the nursery owner's perception of local demand.

Due to the lack of data for walk-in business, it is difficult to estimate the proportion of walk-in versus pre-order for crop sectors. It does appear, however, that formal and semi-formal small and mid-sized nurseries are moving more towards a pre-order model, as demand is high and down payments lower their risk of doing business.

Table 6 summarizes commercial providers, pre-order timelines, and cost of planting materials for the VC crops.

Table 6: Providers, cost, and pre-order timeline for planting materials

Crops	Commercial providers	Pre- order timelines (months)	Cost of planting materials (KES)
Avocado	Soloplant, informal nurseries, large commercial farms, KALRO	Formal- 6-12 Informal- 0	Formal nurseries- 350 and above Informal nurseries- 100-150
Banana	JKUAT, TC labs, KALRO, commercial & informal nurseries, neighbors, and large commercial farms	Formal- 0- 3 Informal-0	Formal nurseries- 100-150 Informal nurseries- 0-5
Mango	JKUAT, Kakuzi, KALRO, large commercial & informal nurseries, large commercial farms	Formal- 2 Informal- 0	Formal nurseries- 350 & above Informal nurseries - 100- 150
Yellow passion	KALRO and Aberdare Technologies	Formal- 2 Informal- 0	Formal nurseries- 100 Informal nurseries- 30-50
Pineapple	Neighbors, KALRO, and Kakuzi	Formal – Not known Informal- 0	Formal nurseries- Not known Informal - 0, or price of fruit
Sweet potatoes	Neighbors, KALRO, NGOs, KEPHIS TC labs, large commercial farms	Formal – 14 days Informal- 0- .5	Formal nurseries- 1- 35 Informal nurseries- 0
African leafy vegetables	Informal open-air markets, Agrovets, large commercial nurseries	Formal- 0-2 Informal- 0	Informal nurseries - 2 Formal nurseries- 1

Source: Field interviews with private sector providers

F. What constraints exist in terms of access (distribution), affordability, and quality of this seed?

a. Challenges related to planting materials availability

- Demand is high and seasonal

- For formal sector nurseries, pre-orders and down payments may increasingly favor larger farmers with deeper pockets
- Seed and seedling producers are often impacted by drought, so planting materials are scarce at exactly the time farmers need to replace lost stock
- There are few tissue culture laboratories for bananas and sweet potatoes
- For ALV, seed supply from the formal sector is erratic, while potentially more reliably supplied seed from informal bulking centers is often of low quality and mixed with other varieties.

b. Challenges related to planting materials distribution

- Severe lack of registered and certified nurseries close to farmer locations
- Planting materials of all VC crops, except for seed of African leafy vegetables, are bulky and highly perishable
- Farmers in target counties often travel long distances to access quality planting materials
- There are pest and disease risks inherent in movement of planting material from one area to another
- Poor positioning of varieties sent from non-local areas, resulting in low farmer return on investment in planting material
- Cultural constraints hamper distribution of new varieties, e.g. the belief that sweet potato varieties should be free due to previous donor/NGO market disruption
- Ideally, specialty vehicles and containers are needed to properly transport seedlings
- There are almost no public, transparent, easy-to-use information sources about where to access quality planting materials
- KALRO stations, while working hard to help farmers, are not easily accessed by distant farmers, and KALRO resources for outreach are few.

c. Challenges related to planting material quality

- Quality propagation and grafting are problems for all but the largest and most sophisticated companies, due to lack of training, refresher trainings, and easily accessed knowledge and reference materials
- Planting materials used are often not true to type
- As noted earlier, for small and medium nurseries much of the planting material is diseased and thus highly flawed. These nurseries are frequently infected by diseases, especially insect-vectored and mechanically transmitted viruses (e.g. via secateurs). There do not appear to be reliable, constantly available sources of virus-indexed planting materials for many VC crops, which, in theory could replace diseased stocks.
- Agro dealers are generally not broadly trained to help/provide extension advice to horticulture farmers
- Viability of African leafy vegetable seed is low and can lose vigor and germination either as a result of poor handling or if stored poorly at an Agro dealers, or elsewhere
- Many banana suckers for sale are not true to type
- Farmers have little confirmation of variety they are purchasing – generally based on trust of the nursery operator, if known
- Most VC crop trees in Kenya are fairly old, and have not been grafted with newer, more productive varieties, or with a clean, disease-free scion of the existing variety
- Informal production of ALV seed is often contaminated and mixed, hence there is no guarantee of seed purity or quality.

d. Challenges related to planting materials affordability

- Many SHF consider the initial cost of good quality planting materials to be out of reach, even though the investment return is highly positive
- Some VC crops have relatively long payback periods for farmers. (For example, pineapple revenue in year one will just cover the planting material cost; in year two it will cover annual costs and start to become profitable.)

- High transportation costs can be incurred by the farmers, and is not affordable by many SHF
- The movement towards down payments is challenging for many SHF, possibly women especially. (Because of this, women will often gravitate towards purchasing seedlings of "quick return" crops such as tomatoes and onions, versus the VC crops, with the exception of ALV.)

G. How does availability compare with demand?

Demand for quality planting materials across all crops is higher than supply, with two caveats notes in the following paragraphs, although demand is quite seasonal (high demand when the rains come) and spikes after a dry year/season. Most nurseries interviewed sold all material they raised. ALV suppliers' general sell out each year. Pre-order behavior with material down payments are increasingly becoming the norm for formal sector nursery providers. Grafting technicians are in high demand. Farmers often travel long distances to obtain planting materials or have a planting material provider ship it to them across long distances. Kenya Seed Company (KSC) frequently sells out of certain varieties. These factors point to high demand relative to supply.

One caveat to this trend relates to tissue culture labs. These labs tend to have higher capacity than they are utilizing, and in recent years have been frustrated, and financially wounded, by counties ordering TC material and not paying for it.

Also, this is a market area where government/NGO subsidized labs are competing with the private sector labs, thus undercutting business for the private sector. Demand may also be affected by the fact that the tissue culture material is considered expensive by most farmers, as the payback period can be extended, and if the farmer does not know how to manage and nurture the TC material (e.g., taking too many suckers too quickly from a TC banana plant will contribute to its demise), the farmer may lose his/her investment. Major customers of TC labs appear to be counties, donor/NGO projects, larger commercial production ventures, and educated farmers with access to mid- or large-sized farms.

A second caveat is that perceptions on demand for crops such as sweet potato (particularly orange-fleshed) and African leafy vegetables may be somewhat inflated, relative to actual demand, due to the presence of major donor-funded projects which have been engaged in strong marketing and promotion of these crops. Examples include the World Vegetable Center (WVC)) and Sweet Potato Action for Security and Health in Africa (SASHA). It is not clear that actual SHF demand in Kenya has caught up with the pace of promotion, particularly for sustainable commercial approaches. Farmers appear to be very tied to free, recycled or highly subsidized planting material for both ALV and sweet potato.

H. What needs to be done to solve constraints in the supply chain with respect to availability, distribution, price, and quality control?

Clearly a great deal of work needs to be done. The most important and immediate efforts should, however, focus on the following. (See section V., below, for more details.)

1. Ensuring that government plays the key role of enabling private sector versus crowding out private sector or over- or under-regulating private sector.
2. Expanding the overall availability of quality planting material for the VC crops for SHF.
3. Identifying and supporting the growth and professionalism of satellite nurseries: nurseries that can serve as hub distributors for multiple national producers of clean planting material and distribute the planting material further to local nurseries in the target counties, which may even serve as hardening nurseries before sale to farmers.
4. Working with HCD, KEPHIS, the counties, Kenya Bureau of Standards (KEBS), and the relevant trade associations to bring more clarity to the work of sector regulation, training, promotion, and local and export market development.
5. Developing and implementing, in partnership with industry associations, a "laddered" certification approach for seedling nurseries to enter the formal sector and attain increasingly higher levels of professional qualification and certification.

6. Creating strong information and networking platforms for market actors, in consonance with business oriented and transparently available sector information;

Specific recommendations to support each of these priority areas of focus are provided in the following section. While we do not supply specific implementation details for the recommendations, we are ready to provide input on potential market actors and facilitation and/or capacity building approaches if desired.

An important overall sector perspective was provided, in writing, by FPEAK. The submission covered challenges, opportunities, and recommendations, and placed substantive emphasis on policy and regulatory issues. The FPEAK submission is included in its entirety in Annex 6.

RECOMMENDATIONS FOR MARKET SYSTEM DEVELOPMENT

The priority recommendations for market systems development in planting material for the VC crops are outlined below. Not surprisingly, many of these recommendations overlap with the recommendations of the Seedling Nursery 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.

Enabling environment for private sector, including regulatory clarity

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. ***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.

3. ***Explore the current role of government entities and parastatals through the lens of market system development; identify obstacles to market development*** – Broad availability of planting material for VC crops is often stymied by the reality that government has a key role to play, including developing new varieties and providing early generation planting material, but often this role is not fulfilled at a meaningful level. Meanwhile, government entities are competing with private sector to produce and distribute planting material, generally using infrastructure donated by donors. The dual impact of this situation has a very negative effect on competition, sustainability, and innovation in the sector. The results are already being seen in the TC sector; TC labs are unable to compete at the end-customer level with the highly subsidized government labs (for example KALRO and JKUAT), and are running below capacity.

4. ***Establish dialogue with counties to explore the pros and cons of tenders for subsidized planting material*** – Much harm can be, and is, being done by these tenders and sensitization is needed to develop longer term, sustainable supply chains.

Availability of planting material

5. ***Identify commercial VC farms that currently produce planting material for their own use and facilitate them to expand production and become a commercial seed/seedling operator*** – One example of this is Deca Plantations, a large fruit farm producing over 50 varieties of fruit including most VC crops, which expressed interest in this approach.

6. ***Lower the risk for current planting material providers outside the target counties to expand to the target counties*** – This could be accomplished either by exploring and facilitating adoption of cost-effective transport options into one or more target counties, or by supporting expansion of production locations.

7. ***Link seed companies to sources of ALV varieties, and support seed companies currently selling seed of ALV in Kenya to expand to target counties***

8. ***Explore strengthening existing ALV seed bulking initiatives to see if they can transition to certified seed companies –*** While there are few examples in the region of successful transitions like this, it is worth investigating potential candidates for support in Kenya, particularly if KEPHIS will allow ALV seed to be produced as standard seed. Linking the County Agriculture extension staff on the existing nurseries to periodically conduct training on emerging technologies and nursery seedling management.

9. ***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 possibly be licensed by a trade association, listed on a common 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.

10. ***Explore if specialized transport trucks would facilitate greater movement of planting material from large producers to the target counties.*** Exploit opportunities offered by reverse logistics in addressing distribution challenges and costs.

Satellite nurseries

11. ***Do a national survey of mother block maintainers of varieties*** – Good, clean, true-to-type planting material must come from high quality, well maintained mother blocks. However, it is not clear where these exist in the country, how clean they are, and whether they are doing the maximum good in terms of driving increased volumes of quality planting material to SHF. Under the laddered approach, mother block nurseries could be a discrete, high rung. The location and prevalence of these nurseries should be mapped against counties and their priorities to understand challenges in getting good planting material for nurseries in the county.

12. ***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.

Laddered certification approach

13. ***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 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, bar coded 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.

Information and networking platforms

14. ***Establish a planting material stakeholder platform and dialogue, particularly for the vegetatively propagated planting material*** – The planting material sector for the VC crops is currently quite underdeveloped but faced with strong potential growth in most of the underlying crops. How the sector develops in the coming years will be critical in terms of long-term success and viability of the VCs. Vibrant stakeholder platform(s) and dialogue will be vital to building a strong foundation and bringing together disparate players who all have critical roles to play, namely: commercial planting material providers, KEPHIS, KALRO, off-takers, industry associations such as KHC and FPEAK, equipment and infrastructure providers, and more. Often planting

material issues get buried under the weight of broader stakeholder platforms; for success with this platform it will be important to maintain a central focus on VC planting material volume and quality. An additional reason for establishing the stakeholder platform and fostering dialogue is the increasing need for self-regulation in the sector.
Fortunately, Kenya has a strong track record of success with self-regulation in the horticulture sector, with flowers and export produce, and the considerable expertise that is behind these sectors – particularly with association – can be brought into the VC planting materials sector.

15. ***Develop industry information platform*** – Information is notoriously hard to collect, and often outdated when found, in the sector. However, as the industry grows business to business (B2B) information about planting material for the VC crops will become even more critical. Ideally the platform will be housed sustainably at an industry association or service provider.

16. ***Organize public/private learning trips to "best practices" countries that are also relevant learning experiences for African stakeholders*** – A strong, well-designed public/private learning trip can catalyze great change, as was seed in the wake of the crop seed sector learning trips to South Africa and Zambia in recent years. A key deliverable for this type of trip, however, is to bring together the right level of public and private sector players. Focus of such a trip would include: regulatory practices, farmer access to planting materials, private sector investment and the enabling environment, legal frameworks, control of rogue operators, links to breeding institutions, Information Communication Technology tools employed, and more. Possible sites include Turkey and India.

As the above recommendations are generally sector-wide in scope, it is useful to return to the narrower focus of the specific value chain crops. Table 7 summarizes our recommendations for consideration for improving the quality, quantity, and availability of planting material for each value chain crop.

Table 7: Recommendations for consideration for planting material of value chain crops

Crop	Recommendations
African Leafy Vegetables	▪ Encourage private seed companies to invest in seed distribution. Currently, KSC and EAS are the only seed companies distributing ALV seeds. Private vegetable seed companies such as Kenya Highland Seed can be linked to breeders or originators and supported to include ALV varieties in their catalogues ▪ Facilitate SHF awareness of the nutritional benefits of African leafy vegetables, and benefits of certified seed to commercial producers, to spur demand ▪ Explore if selected ALV bulking centers can produce standard certified seed and transition into seed companies
Avocado	▪ Shift KALRO to a more market systems approach of research and supporting seedling nurseries operators instead of directly supplying PM to farmers ▪ Facilitate setting up of clean mother blocks for sourcing both clean rootstocks and scions ▪ Encourage private investment in un-explored RTI focus counties such as Bungoma, Vihiga and Kakamega. For example, VegPro may be interested in expanding avocado production and PM distribution to the western counties ▪ Incentivize large commercial farms to explore/consider distributing clean planting materials to farmers ▪ Lower the cost of farmer access to clean planting materials through setting up of satellite nurseries ▪ Train suppliers on proper identification of clean grafting materials and grafting techniques to reduce risks of farmers planting materials that are diseased or not true to type, and improve availability of properly grafted avocado seedlings

Crop	Recommendations
Banana	▪ Build business capacity for private tissue culture laboratories operators on, e.g., marketing, financial management, etc. ▪ Facilitate dialogue between public and private sectors on effects of subsidy programs ▪ Work to shift government institutions such as KALRO & JKUAT back to their core mandates of research and provision of early generation planting material, versus competing with the private sector, to use public capacity to scale private sector ▪ Facilitate private companies to explore technologies such as banana micro propagation that would lower the cost of PM ▪ Incentivize private companies to set up 'satellite nurseries' and demo farms in counties with banana as a key value chain crop
Mango	▪ Encourage large private commercial farms to diversify to seedling production and consider distributing directly to small scale farmers (e.g. DECA) ▪ Lower the cost of SHF access to clean planting materials through incentivizing the private companies in setting up of satellite nurseries to supply "last mile" nurseries ▪ Introduce training programs on grafting techniques, and planting material management, for nursery operators ▪ Create a database of clean planting materials providers in target counties
Pineapples	▪ Further explore pineapple producing counties' sources of clean planting materials for SHF. Explore successful SHF pineapple models in other countries. ▪ Seek to better understand government position on pineapple and planting material ▪ Explore private sector investment in technology such as TC or micro propagation (which might be more cost effective compared to the traditional growing methods) *Note: recommendations here need to be closely synched with the Value Chain study*
Sweet potatoes	▪ Explore a sustainable market systems approach that can encourage private sector involvement in multiplication and distribution ▪ Explore approaches for lowering the cost of vine distribution/transport to farmers
Yellow passion fruit	▪ Incentivize large commercial nursery farms to diversify into production and distribute to small scale farmers ▪ Encourage setting up of satellite nurseries to increase farmer access to clean planting materials ▪ Training on safe grafting techniques to reduce virus transmission

CONCLUSION

Lack of high-quality planting material in sufficient volumes for the value chain crops is a critical constraint to sector growth. Fortunately, there are many potential solutions, most of which are market-based and ripe for development facilitation. Furthermore, there is a strong underlying current for market growth due to export opportunities for many crops and underlying market trends in home consumption related to nutrition and crop diversification in the face of climate change. There is great reason for optimism. A critical key to success will, however, be the creation of an enabling environment for private sector investment and growth. Agri Experience is extremely grateful for the opportunity to work on this important scoping study and welcomes the opportunity to provide additional input to KCDMS as needed.

ANNEXES

Annex 1: List of the key people who provided responses during in-depth interview sessions

#	Title	Surname	Other Name (s)	Organization	Location	Position
1	Mr.	Kathuli	Peter	Farmer	Makueni	Proprietor
2	Mr.	Adala	Alex	Agro dealer (AD) Association	Vihiga	Chairman
3	Hon.	Adhanja	Munyendo Ochieng	County	Siaya	County Executive Committee Member (CEC)Agriculture
4	Mr.	Amudavi	David	Infonet-Biovision (ICIPE)	Nairobi	Executive Director
5	Ms.	Atieno	Phoebe	Hub Agro dealer	Homabay	Owner/Director
6	Mr.	Bid	Rahul	Deca Plantations	Thika	Proprietor
7	Mr.	Chebii	Thomas	KALRO	Perkerra	Sweet yellow passion, Avocado, Banana, Mango
8	Mr.	Chepkwony	Nehemia	MOALF	Nairobi	Asst Director of Agriculture, Head of Horticulture
9	Mr.	Collins	Richard	KAKUZI	Thika	Regional New Crop Development Manager
10	Dr.	Esilaba	Anthony	KALRO	HQs	Natural Resource Management / Agronomy
11	Mr.	Finyange	Pole	KALRO	Matuga	Sweet yellow passion, Pineapple, Mango
12	Mr.	Fox	Richard	Finlays	Nairobi	Director
13	Mr.	Francombe	Peter	Royal Seeds	Nairobi	Managing Director
14	Mr.	Franzel	Steve	ICRAF	Nairobi	Senior Adviser
15	Mr.	Gokhale	Dilip	AfricAsia Seed	Nairobi	Director
16	Dr.	Kasina	Muo	KALRO	NSRC	Economic Entomologist
17	Mr.	Khamala	Habakkuk	AD Association	Kakamega	Chairman
18	Mr.	Kibet	Simeon	KEPHIS	Nairobi	GM, Quality Assurance
19	Ms.	Kibui	Rachael	Nation Media	Nairobi	Seeds of Gold writer

#	Title	Surname	Other Name (s)	Organization	Location	Position
20	Mr.	Kiduyu	Philip	KEPHIS	Kisumu	Inspector
21	Ms.	Kiragu	Wangare	Africa Harvest	Nairobi	Project Manager-Banana
22	Ms.	Kirigua	Violet	KALRO	Nairobi	Horticulture Seedling Nurseries, Markets
23	Dr.	Kisinga	Julius	Hub Agro dealer	Kitui	Owner/Director
24	Mr.	Kivuva	Benjamin	KALRO	Nairobi	Sweet potato
25	Mr.	Kwambai	Thomas	KALRO	Kitale	Sweet potato, Mango, Pineapple
26	Dr.	Lusike	Wasilwa	KALRO	Nairobi	Director, Crop Systems
27	Ms.	Lusweti	Rebecca	Bungoma	Bungoma	Deputy Director of Agriculture
28	Ms.	Luta	Antonina	HCD	Nairobi	Technical Officer
29	Dr.	Machuki	Hosea	FPEAK	Nairobi	Chief Executive Officer
30	Mr.	Magara	Zakayo	HCD	Nairobi	Managing Director
31	Ms.	Mageto	Nora	Hub Agro dealer	Kisii	Owner/Director
32	Mr.	Maina	Simon	KEPHIS	Nairobi	Head, Seed Certification
33	Mr.	Malemba	Geoffrey	KEPHIS	Kisumu	Regional Coordinator
34	Ms.	Marangu	Doreen	Africa Harvest	Nairobi	Project Manager-Sweet potato
35	Mr.	Mbani	Lameck	Hub Agro dealer	Migori	Owner/Director
36	Ms.	McEwan	Margaret	CIP	Nairobi	Senior Project Manager
37	Dr.	Mokitoi	Ludikicus	KALRO	Kakamega	Centre Director
38	Mr.	More	Suhas	VP Food	Nairobi	General Manager (Operations & Commercial)
39	Mr.	Moturi	Franc	County	Busia	Deputy Director of Agri Business
40	Ms.	Muli	Anne	Mimea International	Nairobi	Managing Director
41	Ms.	Munguti	Florence	KEPHIS	Muguga	Centre Manager
42	Mr.	Muriuki	S.J.N	KALRO	Kandara	Horticulture Seedlings Nurseries, Avocado, Mango, Pineapple
43	Mr.	Mutiso	Mulei	ATC	Kisii	Farm Manager
44	Mr.	Mutonyi	James	AGMARK	Nairobi	Managing Director

#	Title	Surname	Other Name (s)	Organization	Location	Position
45	Mr.	Mwaluma	Liverson	Hub Agro dealer	T/Taveta	Owner/Director
46	Ms.	Mwangi	Alice	Hub Agro dealer	Nairobi	Owner/Director
47	Hon.	Mwanje	Osia	County	Busia	CECM Agriculture
48	Ms.	Mwihaki	Grace	Gracerock Nurseries	Rironi	Proprietor
49	Mr.	Mzame	Francis	Hub Agro dealer	Taita Taveta	Vice Chair
50	Mr.	Ndegwa	James	Aberdare Technologies	Thika	Agro Services Manager
51	MS	Ndirangu	Teresia	Bungoma	Bungoma	Crops Officer
52	Mr.	Ndolo	Philip	Mimea International	Nairobi	Managing Partner
53	Mr.	Ndungu	John	KALRO	Njoro	Sweet potato/ Nutrition
54	Mr.	Ndungu	John	KALRO	Thika	Passion Fruit, Avocado, Banana. AIVs
55	Mr.	Ngala	Vincent	Hub Agro dealer	Makueni	Owner/Director
56	Ms.	Ngariere	Charles Omondi	Hub Agro dealer	Homabay	Owner/Director
57	Ms.	Ngige	Jane	Kenya Horticulture Council	Nairobi	Chief Executive Officer
58	Mr.	Ngila	Kimotho	Dryland	Machakos	Director
59	Mr.	Njonjo	Peter	VP Food	Nairobi	Group Public Relations
60	Dr.	Njuguna	Joseph	KALRO	Thika	Sweet Yellow Passion, Pineapple, Mango
61	Ms.	Nosareva	Anna	Solo Plant	Thika	Marketing Manager
62	Mr.	Nyaga	Anthony	KALRO	PTC	Horticulture Seedlings Nurseries, Avocado, Mango, Passionfruit
63	Prof	Nyende	Aggrey	JKUAT		Director, Bio Technology
64	Mr.	Nyongesa	Geoffrey	AD Association	Busia	Vice Chair
65	Hon	Nzunga	Lawrence	County	Makueni	CEC Agriculture
66	Ms.	Odhiambo	Beatrice	KEPHIS	Kisumu	Inspector
67	Ms.	Odongo	Beatrice Akinyi	Hub Agro dealer	Kisumu	Owner/Director
68	Mr.	Ogana	Fred	EAMDA	Nairobi	Managing Partner
69	Mr.	Okelo	John	Hub Agro dealer	Migori	Owner/Director

#	Title	Surname	Other Name (s)	Organization	Location	Position
70	Mr.	Oketch		County	Kisumu	County Director of Agriculture
71	Ms.	Okoko	Nasambu	KALRO	Kisii	African Indigenous Vegetables, Banana, pineapple
72	Mr.	Okongo	Zachary	AD Association	Siaya	Chairman
73	Ms.	Omari	Fatuma	KALRO	Matuga	Africa Indigenous vegetables
74	Mr.	Ombuna	Darice	ATC	Kisii	Principal
75	Dr	Omondi	P. Simon	KALRO	Headquarter	APVC Specialists
76	Mr.	Omry	Karplus	Amiran	Nairobi	Marketing Manager
77	Mr.	Onyango	Charles	World Vegetable Centre	Nairobi	Project Coordinator
78	Hon	Onzere	Lincoln	County	Vihiga	County Director of Agriculture
79	Mr.	Otieno	Collins	HCD	Nairobi	Senior Technical Officer
80	Mr.	Otieno	Micah	Ranalo Agrovet	Kisumu	Director
81	Ms.	Otipa	Miriam	KALRO	Kabete	Crop Health
82	Mr.	Owuor	Apollo	FPEAK	Nairobi	Chairman
83	Mr.	Patel	Ummang	Vegpro	Nairobi	Director
84	Mr.	Patel	Atul	VP Food	Nairobi	Coast region Outgrowers Manager
85	Dr	Priest	David	FIPs	Nairobi	Deputy Director
86	Dr	Sheikh	Amin	AD Association	Bungoma	Treasurer
87	Ms.	Tiva	Betty	Tiva Agrovet	Kisumu	Director
88	Mr.	Tomer	Weiss	Solo Plant	Thika	General Manager
89	Mr.	Wahome	Anthony	AD Association	Busia	Chairman
90	Mr.	Wanjala	Sylvanos	Bungoma	Bungoma	County Agribusiness Officer
91	Mr.	Wanjala	Mathews Chirasha	County	Bungoma	CEC Agriculture
92	Dr	Wasike	Victor	KALRO	Muguga	African Indigenous vegetables/ Conservation of Plant Genetic Resources

#	Title	Surname	Other Name (s)	Organization	Location	Position
93	Ms.	Watani	Grace	KALRO	Thika	Horticulture Seedling Nurseries, Passion Fruits, Mango, Avocado, Mango
94	Mr.	Wayua	Francis	KALRO	Kakamega	Farm Manager
95	Mr.	Wekesa	Boniface	AD Association	Bungoma	Chairman
96	Ms.	Weya	Belinda	Infonet-Biovision (ICIPE)	Nairobi	Project Officer
97	Mr.	Yako	Wilfred	HCD	Nairobi	Senior Technical Officer

Annex 2: Literature reviewed (Note: only most relevant are included)

Fintrac Inc. (2013). Kenya Agricultural Value Chain Enterprises Project Value Chain Analysis.

Fintrac Inc. (2014). USAID KAVES Dairy Value Chain Analysis.

Fintrac Inc. (2017). Passion Fruit Value Chain Analysis.

Hortfresh Journal. (2014). *KALRO Sweet Yellow Passion that Withstand Critical Diseases that Ravaged Purple Passion*.

International Trade Centre. (2014). Kenya Road Map for Development & Stregthening of the Processed Mango Sector.

Jurgen Griesbach. (2005). Avocado Growing in Kenya.

Kenya National Audit Office. (2014). Report of The Auditor General on Horticulture Crops Development Authority.

Kyallo et al. (2014). Horticulture Validated Report.

Lule, M., Dubois, T., Coyne , D., Kisitu, D., Kamusiime, H., & Bbemba, J. (2013). A Training Course for Banana Farmers Interested in Growing Tissue Culture Bananas.

Match Maker Associates. (2017). Mapping of Production of Fruits and Vegetables in Kenya.

Mwololo, J. K., Mburu, M. K., & Muturi, P. W. (2012). Performance of Sweetpotato Varieties Across Environments in Kenya. *International Journal of Agronomy and Agriculture Research*. Retrieved from http:/www.innspub.net

Ndungu, S. (2014). A Report on Conventional Pinapple Production in Kenya.

Nguthi, F., Karembu, F., & Kamau, D. (2007). TC Banana Farming.

Annex 3: KEPHIS releases the list of Value Chain crop varieties

African leafy vegetables: National night shade variety list (Species: Night shade (Solanum scabrum)

Variety name	Release name	Year of release	Owner(s) licensee	Maintainer and source	Areas of production	Maturity dura- tion	Yield (t/ha)	Special attributes
1.Nightshade-1	Abuku Mnavu-1	2016	Prof. Abukutsa Mary O. Onyango	Prof. Abukutsa Mary O. Onyango & Enos Abukutsa Memorial Holdings Ltd	100-2600M asl Kakamega, Kisii, Nyamira, Vihiga, Kiambu, Nairobi, Meru, Busia, Nakuru	5weeks Harvest duration: 8 weeks	20-40	1. Green scabrum 2. Mild taste 3. Very High antioxidant activity
2.Nightshade-2	Abuku Mnavu-2	2016	Prof. Abukutsa Mary O. Onyango	Prof. Abukutsa Mary O. Onyango & Enos Abukutsa Memorial Holdings Ltd	100-2600m asl Kakamega, Busia Kisii, Nyamira, Vihiga, Kiambu, Nairobi, Meru Transmara, Nakuru	5weeks Harvest duration: 8 weeks	20-40	4. Purple scabrum 5. Very High antioxidant activity
3.Nightshade-3	Abuku Mnavu-3	2016	Prof. Abukutsa Mary O. Onyango	Prof. Abukutsa Mary O. Onyango & Enos Abukutsa Memorial Holdings Ltd	100-2600m asl Kakamega, Kisii, Nyamira, Vihiga, Transmara, Bungoma, Busia, Meru, Kwale, Nakuru	5weeks Harvest duration: 6 weeks	20-30	6. Villosum species 7. Bitter taste 8. Relieve stomach related ailments
4.BG16	KK Bigi	2017	KALRO and University of Eldoret	KALRO (Kakamega)	250-2000m ASL UH, UM, LM, Lowland zone	45 Days	5	Long period of leaf harvesting (60 days); Mild in taste; High mineral content: 1. Ca mg/100 g =140 2. Mg mg/100 g = 43 3. Zn mg/100 g = 0.5
5. Ex-Hai	KK Ayaro	2017	KALRO and University of Eldoret	KALRO (Kakamega	250-2000m ASL UH, UM, LM, Lowland zone	40 Days	3	Early maturity; Mild in taste; High mineral content: 1. Ca mg/100 g = 126 2. Mg mg/100 g = 45 3. Zn mg/100 g = 0.4

National spider plant variety list

Species: Spider plant (Cleome gynandra)

Variety name	Release name	Year of release	Owner(s) licensee	Maintainer and source	Areas of production	Maturity duration	Yield (t/ha)	Special attributes
1.Spiderplant-1	Abuku Spiderplant-1	2016	Prof. Abukutsa Mary O. Onyango	Prof. Abukutsa Mary O. Onyango & Enos Abukutsa Memorial Holdings Ltd	100-2400m asl Kakamega, Kisii, Nyamira, Vihiga, Kiambu, Nairobi, Meru, Bungoma, Murang'a, Nakuru	4-5 weeks	20-40	9. Tall variety 10. High iron content

National amaranth list

Species: Amaranth (Amaranthus spp.)

Variety name	Release name	Year of release	Owner(s) licensee	Maintainer and source	Areas for optimal production	Matur- ity dura-tion	Yield (t/ha)	Special attributes
AM 38	KK Livokoyi	2017	KALRO and University of Eldoret	KALRO (Kakamega)	250-2000m ASL UH, UM, LM, Lowland zone	45 Days	5	Long period of leaf harvesting (30 days); High mineral content: 1. Ca mg/100 g = 158 2. Mg mg/100 g = 92 3. Zn mg/100 g = 0.5
Ex-Zim	KK Mrambi	2017	KALRO and University of Eldoret	KALRO (Kakamega)	250-2000m ASL UH, UM, LM, Lowland zone	45 Days	6	Long period of leaf harvesting, (45 days) High mineral content: 1. Ca mg/100 g = 462 2. Mg mg/100 g = 238 3. Zn mg/100 g = 0.4

Annex 4: National Sweet Potato Variety List

Species: Ipomea batatas

NOTE; mango, passion, pineapple, bananas, and avocado are not on the national variety list

Variety name/code	Official Variety Release Name	Year of release in Kenya	Year of release in Other Countries	Owner(s) / Licensee	Maintainer and planting material source	Optimal production altitude range (Masl)	Duration to maturity (months)	Tuber yield (t ha^{-1} y^{-1})	Percent dry matter content	Special attributes
1. Mtwapa 8	Mtwapa 8	1998		KARI	KARI (Mtwapa)	1-1500	3.5	10-20		Low fibre, high beta carotene
2. Jayalo	Jayalo	1998		KARI	KARI	1-200	4	10-15		Good for piece meal harvesting
3. 22/77	22/77	1998		KARI	KARI	1-800	3.5	10-20		Good for piece meal harvesting
4. KSP 20 (Wanjugu)	KSP 20 (Wanjugu)	2000		KARI	KARI (Katumani)	250-1750	3-4	20		High carotene levels Red skinned
5. SPK 004	SPK 004	2001		KARI	KARI-Kakamega	1300-2000	3-4	13-20		High beta-carotene
6. Kemb 10	Kemb 10	2001		KARI	KARI-Kakamega	1300-2000	3-4	16-25		High yielding
7. SPK 013	SPK 013	2001		KARI	KARI-Kakamega	1200 - 1400	4-5	21-35		Low underground stability
8. Mugande	Mugande	2001		KARI	KARI-Kakamega	1300-2000	4-5	15-25		Early maturing,
9. Ksp0047	Ksp0047	2010		KARI	KARI KATUMANI	Warm, Semi-arid areas, 800 – 1000 m.a.s.l. Good for hill masses of Taita, and Makueni districts.	3-4	25	24	Light orange fleshed high ß carotene content
10. Ksp0072	Ksp0072	2010		KARI	KARI KATUMANI	Warm, Semi-arid areas, 600 – 1400 m.a.s.l. Yield well in coffee zone of eastern and central.	3-4	22	25	Light orange fleshed high ß carotene content

Variety name/code	Official Variety Release Name	Year of release in Kenya	Year of release in Other Countries	Owner(s) / Licensee	Maintainer and planting material source	Optimal production altitude range (Masl)	Duration to maturity (months)	Tuber yield (t ha^{-1} y^{-1})	Percent dry matter content	Special attributes
11. Ksp0084	Ksp0084	2010		KARI	KARI KATUMANI	Warm, Semi-arid areas, 600 – 1800 m.a.s.l. Recommended for the coffee and lower areas	3-4	20	26	Light orange fleshed high ß carotene content Duo purpose
12. Ksp0154	Ksp0154	2010		KARI	KARI KATUMANI	Warm, Semi-arid areas, 800 – 1800 m.a.s.l. Good for the Coffee zone (Thika, Muranga South, Kandara, Kangundo)	3-4	23	25	Light orange fleshed high ß carotene content
13. Mwavuli	Mwavuli-1	2011	NA	KARI-Kakamega	KARI-Kakamega	1200-1800	4-5	22.0 (40.0)		High root yield, High DM, dual purpose
14. 91-218	Limara	2011	NA	KARI-Kakamega	KARI-Kakamega	1200-1700	4-5	15.4 (25.0)		Very Resistant to virus disease
15. 292-H-12	Rachar	2011	NA	KARI-Kakamega	KARI-Kakamega	1200-1680	4-5	14.2 (34.0) *		Virus resistant
16. 56682-03	Haraka	2011	NA	KARI-Kakamega	KARI-Kakamega	1300-1600	4-5	16.3 (28.5)		Orange-fleshed, High DM
17. K117	Lisamu-DP	2011	NA	KARI-Kakamega	KARI-Kakamega	1200-1600	5-6	15.1 (34.4)		Orange-fleshed, high DM
18.Kabode	Kabode	2013		KARI	KARI-Kakamega	1,200-1,800	4-5 months	16-25		High β-carotene content; Tolerant to sweet-potato viruses;
19.VITAA	Vitamu	2013		KARI	KARI-Kakamega	1,200-1,800	4-5 months	15-22		High β-carotene; High dry matter content; Tolerance to virus diseases.

Variety name/code	Official Variety Release Name	Year of release in Kenya	Year of release in Other Countries	Owner(s) / Licensee	Maintainer and planting material source	Optimal production altitude range (Masl)	Duration to maturity (months)	Tuber yield (t ha^{-1} y^{-1})	Percent dry matter content	Special attributes
20.KNSP 013	Kenspot-1 (Nyawo)	2013		KARI	KARI-Njoro	1,700-2,300 metres in Eldama-Ravine, Lare, Njoro, and Kakamega	6-7 months	15-25		Fairly high Dry Matter; Yellow-fleshed; Average acceptability
21.KNSP 016	Kenspot-2	2013		KARI	KARI-Njoro	1700-1900 metres in the highlands of Kakamega, Lanet and Kabianga	6-7 months	15 - 46		Moderate Dry Matter; White-fleshed; High acceptability rating.
22.KNSP 010/6 (1)	Kenspot-3	2013		KARI	KARI-Njoro	1,900-23,00 metres in Njoro, Eldama-Ravine, Kakamega	6-7 months	10 - 27		High Dry Matter content; Orange-fleshed (avg. β-carotene content; Average acceptability.
23.KNSP 06/1 (2)	Kenspot-4	2013		KARI	KARI-Njoro	1,700-2,300 metres in Eldama-Ravine, Kakamega, Njoro, Kabianga	6-7 months	10 - 26		High Dry Matter content; Orange-fleshed (high β-carotene content); Average acceptability.
24.KNSP 02/16 (1)	Kenspot-5	2013		KARI	KARI-Njoro	1,700-2,100 metres in Eldama-Ravine, Kabianga and Kakamega	6-7 months	10 - 23		Moderate dry matter; Orange-fleshed (high β-carotene content; Moderately resistant to sweet-potato viral diseases; Moderate acceptability.
25. NASPOT-1	DOUBLE-DOUBLE	2015		KALRO	KALRO Kakamega	Western, Eastern Kenya, North Rift region	3-4 months	27 t/ha		Dual purpose variety-roots for human consumption and vines for livestock. Moderately resistance to SPVD

Variety name/code	Official Variety Release Name	Year of release in Kenya	Year of release in Other Countries	Owner(s) / Licensee	Maintainer and planting material source	Optimal production altitude range (Masl)	Duration to maturity (months)	Tuber yield (t ha^{-1} y^{-1})	Percent dry matter content	Special attributes
26. CUNY	CUNY	2015		KALRO	KALRO Kakamega	Western Kenya	4-5 months	28 t/ha		High dry matter content and yellow fleshed, has average level of sugars. Tolerant to Alternaria.
27. K/KA/2004/215	JANKAROTI	2015								Orange-fleshed-rich in beta carotene, acceptable levels of dry matter content, moderately tolerant to SPVD
28. NAMNYEKERA	NAMNYEKERA	2015								Yellow-fleshed with moderately resistance to weevil attack due to its deep rooting characteristics, resistance to Alternaria

Source: KEPHIS

Annex 5: KALRO development/release of value chain crop varieties

Note: See Annex 3 for KALRO sweet potato releases

African Leafy Vegetables

KALRO variety released	Year of release	Varieties preferred for local consumption	Varieties preferred for commercial sale in Kenya
Common African Nightshade (Local landrace -Eldoretti)	2010	✓	✓
Giant night shade	2013	✓	✓
Spiderplant Lag Veg 003),	2013	✓	✓
Amaranthus (Lag Veg 004)	2013	✓	✓
Pumpkin leaves	2010	✓	✓
Cow pea leaves (KAT 80)	2010	✓	✓
Slender leaf (Crotalaria)	2010	✓	
Jute mallow	2010	✓	

Bananas

Variety	Type	Year of Release	Varieties preferred for local consumption	Source of planting materials
Ndizi Ng'ombe	Cooking	1998	✓	• IITA • KALRO Centres (Kisii, Thika, Kitale, Kakamega, Embu, Njoro, Matuga)
Nusu Ng'ombe	Cooking	1998	✓	
Uganda Green	Cooking	1998	✓	
Shalamuli	Dessert	1998	✓	
Kisukari	Dessert	1998	✓	
Giant Cavendish	Dessert	1998	✓	
Grand Nain	Dessert	2004	✓	
Chinese Cavendish	Dessert	2004	✓	
Williams Hybrid	Dessert	2008		
Pelipita	Dessert	2008		
Gerald Tucker	Dessert	2011	✓	
PHIA17	Dessert	2011	✓	

Avocados

In 2011 variety G577 Tolerant to *Phytophthora* disease, adaptable to medium and high AEZ and compatible with improved varieties was released. KALRO introduced the Avocado varieties listed below in the late 1970s – 80s.

Season	Varieties
Early	Hardy, Ruehle, Teague, Waldin, Tambarina, and Simmods
Early to mid-season	Winter Mexican, Kyoyl, Zutano, Bacon, Tonnage, and Dannish W.I. Bank
Mid-season	TX 531, Booth 7, Booth 8, Choquette, Fuerte, Ettinger, Lula, and Puebla
Mid to late season	Hass, Pinkerton, Sama, and Linda
Late	Nabal and Reed

KALRO responses to Africa Leafy Vegetables value chain questions

1. Crop that is the subject of these answers:
    - African Indigenous Vegetables
2. Members of the team providing these answers:
    - Nasambu, Wasike, Wayua, Violet, and Fatuma
3. What types of planting material are used for this crop? (seed, seedlings, TC, cuttings, etc.… Be specific)
    - Seeds (cowpea, African nightshade, amaranth, spider plant, jute mallow, slender leaf, Vine spinach, Ethiopian kale, pumpkin leaves)
    - Seedlings (African nightshade, amaranthus). Seedlings are mostly sown during the dry season to be transplanted when the rains come or to potential commercial growers.
4. What KALRO varieties have been released and are being produced in Kenya? In what year were they released?

KALRO variety released	Year of release	Varieties preferred for local consumption	Varieties preferred for commercial sale in Kenya	Varieties preferred for export (None)
Common African Nightshade (Local landrace -Eldoretti)	2010	✓	✓	
Giant night shade	2013	✓	✓	
Spiderplant Lag Veg 003),	2013	✓	✓	
Amaranthus (Lag Veg 004)	2013	✓	✓	
Pumpkin leaves	2010	✓	✓	
Cow pea leaves (KAT 80)	2010	✓	✓	
Slenderleaf (Crotalaria)	2010	✓		
Jute mallow	2010	✓		

    - Source of planting materials
        - KALRO Centres (GeRRI, Kisii, Kakamega, Thika, Embu, Katumani)
        - Universities (JKUAT, Maseno, JOOUST, University of Eldoret)
        - CGIARs - World Vegetable Centre – Arusha, Tanzania
        - Commercial companies (Simlaw Seeds)
        - Farmers own saved seed
        - Local markets
        - Collection from the Wild
5. What varieties are preferred for local consumption?
    - See Table above
6. What varieties are preferred for commercial sale in Kenya?
    - See Table above
7. What varieties are preferred for export? To where?
    - None
8. Do you think that off-takers will be changing their buying patterns in the future? If so, how? (Different varieties, characteristics, etc.)
    - Yes. There is demand for planting materials due to changing eating habits occasioned by increased awareness of the nutritional values and utilization. For example, the youth and children prefer the mild types and broad-leaved giant nightshade – for the nightshade.

9. Are there high potential opportunities for business growth due to new varieties? If so, what?
    - Yes. The youth can engage in employment opportunities by growing vegetables for institutional markets. There is also potential to establish nurseries for seedlings for amaranth and nightshade. In Busia, KALRO has linked AIV farmer groups to institutional markets (schools and hospitals). As a result, 30% of vegetable procurement is allocated to AIVs.

10. When new varieties have entered the system in the last 5 years, where have they come from – local breeding or imports?

New variety	Source
Giant nightshade	Import (from WVC - Arusha)
Lag Veg 004	Local breeding
Lag Veg 003	Local breeding

11. How do new varieties enter the system? What are the challenges?
    - Through breeding and selection of local landraces, from the wild, and through imports, e.g. WVC - Arusha
    - Challenges include:
        - Diseases, especially bacterial wilt
        - Pests, e.g. spider mites
        - Palatability, taste and preferences
        - Adopting the new varieties into local recipes
        - Low viabilities if the AIVs are not pollinated well
12. How old are the currently produced varieties (answers can be general if exact year is not known, but try to estimate age)?
    - See Table on Q4 above
13. Where do farmers source their planting materials for this crop? (Be specific about varieties if needed.)
    - Farmers own seed
    - Fellow farmers
    - Local markets
    - Collection from the wild
    - Clean planting materials are sourced from the following sources (see Q4):
        - KALRO Centres (GeRRI, Kisii, Kakamega, Thika, Embu, Katumani)
        - Universities (JKUAT, Maseno, JOOUST, University of Eldoret)
        - CGIARs - World Vegetable Centre – Arusha, Tanzania
        - Commercial companies (Simlaw Seeds)
14. Is KALRO selling planting material? Please provide data for at least the last three years on total volume, plus your estimate of the percentage of volume going to smallholder farmers versus larger commercial customers versus NGO projects.
    - Yes. The quantities sold are very small, e.g. 10 kg in a year. Most of the seeds are given out for free

Variety of planting material sold	Total volume sold in the last 3 years	Percentage volume going to		
		Smallholder farmers (per year)	Large commercial customers	NGO projects
Common nightshade	20	20		

Lag Veg 004	10	10		
Lag Veg 003	10	10		
Grain amaranth				20

15. Where do you hear of agribusinesses sourcing their planting materials for this crop? (Be specific about varieties if needed.)
    - See Q.13
16. How does availability compare with demand? Please describe the supply/demand equation here: which is larger? By how much? Why? Is the disparity seasonal?
    - Demand for seed is higher than supply, this is what is informing the high price of the seeds. Supply of quality seed can only meet about 50% of the demand. Most of the seed found in the market is either mixed, physically impure and of unknown source and viability. Demand in the short rains is usually higher than in the long rains. The AIVs are usually planted in the short rains, when they perform better.
17. What challenges are you aware of related to planting material access (farmer ability to physically find the material)?
    - Access to quality seed is limited. Seed supply is based broadly on commodity seed (not specific varieties / qualities).
18. What challenges are you aware of related to planting material availability (farmer ability to get it every season, when wanted)?
    - Reliability of access of seeds is not guaranteed, due to seasonality; also, previous seed demand – people consume everything. The seeds must be sourced from far places e.g. across counties.
19. What challenges are you aware of related to planting material affordability for farmers?
    - Vegetable seeds cost are generally high, a glass of nightshade, amaranth, Spiderplant costs KES 200/
20. What are the main quality problems you experience/hear about with planting material for this crop, and how significant do you think these quality problems are for farmers?

Main quality problems	Significance
Poor seed viability because of poor pollination	• Lead to low yields (leaf and seed yields) • Low quality
Low physical purity due to mixtures, dead seeds and damaged seed	• Leads to low yields, viability, marketability
Low genetic purity, due to mixtures	• Different maturity times, compromising harvest schedules. This could negatively impact on quality of delivered products and hence price
Seed-borne diseases	• Low yields, poor quality and loss of revenue
Inappropriate seeds for the regions	• Low yields, poor quality

21. What needs to be done to solve constraints in the supply chain with respect to: 1) availability, 2) access (distribution), 3) affordability, and 4) quality of this planting material, as mentioned above?

Constraint in the supply chain	Suggested solution
1. Availability	• Strengthen, support and capacity build vegetable seed producers • Avail information on variety of seed, quantities available and price
2. Access (distribution)	• Capacity building: Link seed producers to stockists and distributors • Avail information on production at the stockist level and through mass media (seeds of gold)
3. Affordability	• Support seed production at farmer group level
4. Quality of planting material:	
4.1 Poor seed viability due to poor pollination	• Rear pollinators/provide pollinator nesting points
4.2 Low physical purity due to mixtures, dead seeds, damaged seed	• Capacity building farmers on seed production and processing (GAP)
4.3 Low genetic purity, due to mixtures	• Access seeds from reputable source such as KALRO, AVDRC
4.4 Seed-borne diseases	• Access seeds from reputable source such as KALRO, AVDRC
4.5 Inappropriate seeds for the regions	• Adopt recommendations from KALRO

22. Of all the potential solutions you have mentioned, what do you think are the most important?
    1. Strengthen, support and capacity build vegetable seed producers
    2. Avail information on variety of seed, quantities available and price
    3. Link seed producers to stockists and distributors
    4. Access seeds from reputable source such as KALRO, AVDRC

23. Is there anything else you want us to know, or that you think is important for the project?
    The AIV landscape is fast evolving. The inclusion of AIV in local procurement initiated in Busia County has the potential to be replicated in other counties resulting in increase in consumption and trade. Further, current dissemination efforts as well as raising awareness of the nutritional value of the AIVs could change perceptions and further spur consumption and consequently production/supply.

The role of KALRO:

- Develop and disseminate AIV technologies to end users
- Capacity build extension providers and farmers
- Provide Good Agricultural Practices (GAP)

Constraints

- Lack of access to quality seeds of preferred types and varieties of AIVS
- Lack of attention given to AIVs by the formal seed sector

Poor quality

KALRO responses to avocado value chain questions

1. Crop that is the subject of these answers:
    - Avocado
2. Members of the team providing these answers:
    - Violet Kirigua, Evelyn Nasambu Okoko, Francis Wayua, S. J. N. Muriuki and Lusike Wasilwa
3. What types of planting material are used for this crop? (Seed, seedlings, TC, cuttings, etc.… Be specific)
    - Seedlings
    - Seed (some farmers do not plant grafted avocado)
4. What KALRO varieties have been released and are being produced in Kenya? In what year were they released?
    - KALRO introduced the varieties listed below in the late 1970s – 80s

Season	Varieties
Early	Hardy, Ruehle, Teague, Waldin, Tambarina, and Simmods
Early to mid-season	Winter Mexican, Kyoyl, Zutano, Bacon, Tonnage, and Dannish W.I. Bank
Mid-season	TX 531, Booth 7, Booth 8, Choquette, Fuerte, Ettinger, Lula, and Puebla
Mid to late season	Hass, Pinkerton, Sama, and Linda
Late	Nabal and Reed

    - In 2011, variety G577 Tolerant to *Phytophthora* disease, adaptable to medium and high AEZ and compatible with improved varieties was released
5. What varieties are preferred for local consumption?
    - Hass
    - Fuerte
    - Pinkerton
    - Puebla
    - Choquette
    - Bacon
    - Land races
6. What varieties are preferred for commercial sale in Kenya?
    - Hass
    - Fuerte
    - Pinkerton
    - Land races – popular in the domestic markets
7. What varieties are preferred for export? To where?
    - Hass Variety – EU, Middle East
    - Fuerte – Middle East, China
8. Do you think that offtakers will be changing their buying patterns in the future? If so, how? (Different varieties, characteristics, etc.)
    - The current preference particularly for the export market is Hass Variety
    - Future will be towards the return of Fuerte for oil production
    - Also, the large high-oil producing varieties will be propagated for certain agro-ecological zones.

9. Are there high potential opportunities for business growth due to new varieties? If so, what?
    - Expanding export markets – growing demand in Europe and middle East
    - Interest by China market.
    - Growing processing sector of avocado products – virgin oil (Olivado), avocado juice, cosmetic industry
    - Growing health concerns leading to higher uptake of fruits than other formulations such as carbonated juices and other drinks
    - Use of avocado in salads e.g. guacamole in fast food industry and *kachumbari* in meat roasting facilities
    - Crop growing conditions in Kenya (and Africa) where it is grown almost organically with few pesticides, no mechanization and better tasting fruits due to favorable climate.
10. When new varieties have entered the system in the last 5 years, where have they come from – local breeding or imports?
    - KALRO has not made any introductions in the last 5 years.
    - However, the large fruit types are preferred in the local market for home consumption
11. How do new varieties enter the system? What are the challenges?
    - Introduced as superior varieties for testing, adoption and eventually commercialization.
    - Challenges – popularization of the new varieties and availing the material in large quantities.
    - Limited domestic consumption of introduced varieties as compared to the landraces that are larger and more preferred
    - Requirement for more intensive care and inputs compared to the existing landraces and known varieties
12. How old are the currently produced varieties (answers can be general if exact year is not known, but try to estimate age)?
    - Current varieties being grown are over 20 years old.
13. Where do farmers source their planting materials for this crop? (Be specific about varieties if needed.)
    - KALRO Centres (Thika, Kisii, Embu, Macadamia Research Center (MRC)/PTC, Kitale. Kibos, Kakamega, Alupe, Molo, Njoro and Muguga)
    - Private nurseries – e.g. Kakuzi, Kamiu in Embu
    - Public institutions – e.g. MoA Agricultural Training Centres, TARDA, HCD
14. Is KALRO selling planting material? Please provide data for at least the last three years on total volume, plus your estimate of the percentage of volume going to smallholder farmers versus larger commercial customers versus NGO projects.

	Year	No. of seedlings*			% to smallholder farmers			% larger commercial customers			% to NGO projects.		
		Thika	MRC/ PTC	Embu	Thika	MRC/ PTC	Embu	Thika	MRC/ PTC	Embu	Thika	MR C/P TC	Embu
	2015	26614	63600		100	50		0	30		0	20	
	2016	27664	74000		100	50		0	30		0	20	
	2017	33142	11000		100	50		0	20		0	30	
Totals		87410	149600		100	50		0	27		0	23	

* Data from Kandara, PTC and Embu

15. Where do you hear of agribusinesses sourcing their planting materials for this crop? (Be specific about varieties if needed.)
    - KALRO Centers (Kandara, Kisii, Embu, Kitale, Njoro, Kakamega, and Alupe)
    - Private nurseries – Registered commercial nurseries e.g. Kamiu in Embu
    - Public institutions – e.g. MoA Agricultural Training Centers, TARDA
16. How does availability compare with demand? Please describe the supply/demand equation here: which is larger? By how much? Why? Is the disparity seasonal?
    - Demand for planting material for Hass variety is very high as farmers seek to supply the EU market where it is the preferred variety.
    - Fuerte variety is currently not demanded due to the above preference. However, this is the variety preferred by Olivado for oil extraction.
17. What challenges are you aware of related to planting material access (farmer ability to physically find the material)?
    - Location – some of the nurseries are positioned far from farmers, who must travel long distances to acquire the material.
    - Transport costs are too high due to distances to the nurseries.
    - Cost of seedlings is too high
    - Need for provision of high quality, clean (free from phytophthora) propagation material.
18. What challenges are you aware of related to planting material availability (farmer ability to get it every season, when wanted)?
    - Often seedlings are not available when needed by the farmers (at the beginning of the rain season).
    - Very few specialized nurseries that offer high health (quality) planting materials.
19. What challenges are you aware of related to planting material affordability for farmers?
    - The price is high particularly for the resource poor farmers.
20. What are the main quality problems you experience/hear about with planting material for this crop, and how significant do you think these quality problems are for farmers?
    - Farmers are supplied planting material infected with diseases – infested orchard and low productivity
    - Failure by nursery operators to observe recommended grafting heights
    - Most nursery operators have not embraced the high health system that is needed for this crop towards reducing spread of phytophthora and subsequent dieback of avocado
    - Unsuitable varieties for the growing area – significant as this result in low yields and some cases inability to access markets
    - Mixed varieties supplied by the smaller nurseries – may affect marketing of avocado as the farmer will not be able to meet volumes demanded by the market.
    - Few and scattered mother orchards/blocks for true to type rootstocks/scions. Influences what nursery operators can access at any time.
21. What needs to be done to solve constraints in the supply chain with respect to: 1) availability, 2) access (distribution), 3) affordability, and 4) quality of this planting material, as mentioned above?
    - Establishing mother orchards to ensure preferred varieties can be accessed by nursey operators.
    - Enhance capacity (to increase number of seedlings) and efficiency in existing nurseries and seedlings at a cheaper cost.
    - Training small nursery operators on Good Nursery Management Practices (GNMP) for production of quality seedlings.
    - Ensure adoption of high health production of avocado seedlings
    - Registration and certification of nursery enterprises including setting a traceability system and strengthening enforcement of registration.
    - Recruitment and training of service providers on GNMP
22. Of all the potential solutions you have mentioned, what do you think are the most important?
    - Establishing mother orchards to ensure preferred varieties can be accessed by nursey operators.
    - Enhance capacity (to increase number of seedlings) and efficiency in existing nurseries and seedlings at a cheaper cost.

- Training small nursery operators on Good Nursery Management Practices (GNMP) for production of quality seedlings.
- Promoting high health production of avocado seedlings

23. Is there anything else you want us to know, or that you think is important for the project?
    - KALRO needs to import new varieties of avocado to keep up with the trends
    - Need to provide nursery operators with tools to ensure high health production of seedlings
    - Increase nursery infrastructure for propagating avocado in production areas

Season	Varieties
Early	Hardy, Ruehle, Teague, Waldin, Tambarina, and Simmods
Early to mid-season	Winter Mexican, Kyoyl, Zutano, Bacon, Tonnage, and Dannish W.I. Bank
Mid-season	TX 531, Booth 7, Booth 8, Choquette, Fuerte, Ettinger, Lula, and Puebla
Mid to late season	Hass, Pinkerton, Sama, and Linda
Late	Nabal and Reed

KALRO responses to banana value chain questions

1. Crop that is the subject of these answers:
    - Banana

2. Members of the team providing these answers:
    - Muriuki, Nasambu, Kwambai, Chebii, Wayua, Wasike and Violet

3. What types of planting material are used for this crop? (seed, seedlings, TC, cuttings, etc.… Be specific)
    - Tissue culture plantlets (seedlings)
    - Suckers (Maiden, sword and corms)

4. What KALRO varieties have been released and are being produced in Kenya? In what year were they released?

Variety	Type	Year of Release	Varieties preferred for local consumption	Source of planting materials
Ndizi Ng'ombe	Cooking	1998	✓	• IITA • KALRO Centers (Kisii, Thika, Kitale, Kakamega, Embu, Njoro, and Matuga)
Nusu Ng'ombe	Cooking	1998	✓	
Uganda Green	Cooking	1998	✓	
Shalamuli	Dessert	1998	✓	
Kisukari	Dessert	1998	✓	
Grand Nain	Dessert	2004	✓	
Giant Cavendish	Dessert	1998	✓	
Chinese Cavendish	Dessert	2004	✓	
Williams Hybrid	Dessert	2008		
Pelipita	Dessert	2008		
Gerald Tucker	Dessert	2011	✓	

Variety	Type	Year of Release	Varieties preferred for local consumption	Source of planting materials
PHIA17	Dessert	2011	✓	

KALRO's role:

- Develop and disseminate banana technologies to end users
- Capacity build extension providers and farmers

5. What varieties are preferred for local consumption?
   - See Q.4
6. What varieties are preferred for commercial sale in Kenya?
   - All the above

7. What varieties are preferred for export? To where?

Variety	Type	Year of release	Varieties preferred for export
Ndizi Ng'ombe	cooking	1998	
Nusu Ng'ombe	Cooking	1998	
Uganda Green	Cooking	1998	✓ Middle East
Shalamuli	Dessert	1998	
Kisukari	Dessert	1998	✓ EU
Grand Nain	Dessert	2004	
Giant Cavedish	Dessert	1998	
Chinese Cavendish	Dessert	2004	
Williams Hybrid	Dessert	2008	
Pelipita	Dessert	2008	
Gerald Tucker	Dessert	2011	
PHIA 17	Dessert	2011	
PHIA 18	Dessert	2011	

8. Do you think that off-takers will be changing their buying patterns in the future? If so, how? (Different varieties, characteristics, etc.)
   - Yes, currently there is high demand for FHIAH 17
   - In addition, new packaging methods –hands packed in boxes or crates will be applied to reduce losses during transportation.
9. Are there high potential opportunities for business growth due to new varieties? If so, what?
   - Varieties acceptable in the international market can create market opportunities due to interruption of supply from some major production areas because of incidences of Tropical Race 4 (TR4) of Fusarium wilt. However, there is need to upgrade our production technologies.

10. When new varieties have entered the system in the last 5 years, where have they come from – local breeding or imports?
    - Yes, mainly through import (from IITA, INBAP)

11. How do new varieties enter the system? What are the challenges?
    - Introductions/Evaluation/Recommendation.
    - Challenges include:
      - Adoption of new technologies is sometimes very slow.
      - Problems in acquisition of new materials due to breeder right restrictions.
      - Supply of new materials may be lower than the demand.

- Pests and diseases

12. How old are the currently produced varieties (answers can be general if exact year is not known, but try to estimate age)?
    - Between 7 and 20 years
13. Where do farmers source their planting materials for this crop? (Be specific about varieties if needed.)
    - Mainly KALRO mother blocks/nurseries (Kisii, Thika, Kakamega, Njoro, Matuga, Mtwapa and Kitale)
    - University-JKUAT nursery,
    - Private commercial nurseries –Aberdares, GTL, Mimea,
    - Small youth run private nurseries

14. Is KALRO selling planting material? Please provide data for at least the last three years on total volume, plus your estimate of the percentage of volume going to smallholder farmers versus larger commercial customers versus NGO projects.
    - YES, both suckers and TC plantlets,

Variety of planting material sold	Total volume sold in the last 3 years	Percentage volume going to		
		Smallholder farmers (per year)	Large commercial customers (per year)	NGO projects
TC material	156,000	40,000	10,000	2000
Suckers	22,500	5,000	1500	1000

15. Where do you hear of agribusinesses sourcing their planting materials for this crop? (Be specific about varieties if needed.)
    - KALRO nurseries
    - Government institutions nurseries
    - Farmer training centers
    - Private commercial nurseries
16. How does availability compare with demand? Please describe the supply/demand equation here: which is larger?
    - Sometimes demand outstrips supply especially when there appears an unprecedented market.
    - By how much?
        - Can be 40% supply.
    - Why?
        - Periodic upsurges in demand with large orders coming from Counties. Is the disparity seasonal? No, it is occasional.
17. What challenges are you aware of related to planting material access (farmer ability to physically find the material)?
    - Long distance between source of planting materials and areas of production leading to uneven distribution of TC laboratories and nurseries located mainly in central Kenya.
18. What challenges are you aware of related to planting material availability (farmer ability to get it every season, when wanted)?
    - Most nurseries target the rainy season for readiness of planting materials hence sufficient quantities might not be there off-season.
19. What challenges are you aware of related to planting material affordability for farmers?
    - A substantial number of farmers cannot afford the current prices of TC banana suckers KES 100-150/- per plantlet).
20. What are the main quality problems you experience/hear about with planting material for this crop, and how significant do you think these quality problems are for farmers?

Main quality problems	Significance

Occasionally there are off-types, mixed varieties but the frequency is very low.	➢ Low crop yield ➢ Loss of sales
Diseases, i.e. viral in the nursery plants	Total loss of sales

21. What needs to be done to solve constraints in the supply chain with respect to: 1) availability, 2) access (distribution), 3) affordability, and 4) quality of this planting material, as mentioned above?

Constraint in the supply chain	Suggested solution
1. Availability	• Create linkages between farmer groups and relevant KALRO Centre's • Strengthen, support and capacity build Nursery entrepreneurs • Avail information on popular varieties of bananas planting material quantities available and price
2. Access (distribution)	• Encourage farmer groups to establish banana hardening nurseries. • Link nursery operators to producer farmer groups and agricultural related NGOs
3. Affordability	• Create linkages between farmer groups and relevant KALRO Centers • Encourage farmer groups to establish banana hardening nurseries. • These should address this issue since farmer groups will be able to determine profitable and affordable prices for group nursery hardened seedlings for their farmers.
4. Quality of planting material:	
4.1 Off-types and mixed varieties	• Revisit the issue of production protocol and modify if necessary. • Carry out proper labelling at mother blocks before collecting suckers to the laboratories
4.2 Viral diseases	• Capacity building farmers on good agricultural production and processing practices (GAP)
	• Access suckers from reputable source such as KALRO mother blocks,
	• Carry out virus indexing on-farm and at the laboratories before releasing *in vitrio* TC plantlets to the hardening nurseries

22. Of all the potential solutions you have mentioned, what do you think are the most important?
    - Create linkages between farmer groups and relevant KALRO centers
    - Encourage farmer groups to establish banana hardening nurseries
23. Is there anything else you want us to know, or that you think is important for the project?
    - KALRO to spearhead training of farmer groups involved in banana hardening.
    - KEPHIS and HCD to take an active role in nursery regulation.

KALRO responses to mango value chain questions

1. Crop that is the subject of these answers:
    - Mango
2. Members of the team providing these answers:
    - T. K. Chebii, T. K. Kwambai, S. J. N. Muruiki, and Violet Kirigua
3. What types of planting material are used for this crop? (seed[1], seedlings, TC, cuttings, etc.… Be specific)
    - Seeds are used to raise rootstocks and grafted seedlings for filed planting.
4. What KALRO varieties have been released and are being produced in Kenya? In what year were they released?
    - Recommended varieties include:
        - Tommy Atkins, Kent, Van Dyke, Kensington, Sensation, Haden, Apple, Ngowe, Peach, Sabre and Sabine.
5. What varieties are preferred for local consumption?
    - Apple, Tommy Atkins, Kent, Ngowe, Van Dyke, Kensington, Sensation, Haden, Boribo, and local landraces.
6. What varieties are preferred for commercial sale in Kenya?
    - Apple, Tommy Atkins, Kent, Van Dyke, Kensington, Sensation, Haden, Ngowe, and Keit
7. What varieties are preferred for export? To where?
    - Apple, Tommy Atkins, Kent, Keit, and Van Dyke.
    - Exported to EU Markets and middle East countries
8. Do you think that off-takers will be changing their buying patterns in the future? If so, how? (Different varieties, characteristics, etc.)
    - Yes.
    - How:
        - Based on consumer preferences, this will change because of varietal factors such as the fruit quality (size, taste, shelf life, fiber content, juice content, shape) and ease of handling.
9. Are there high potential opportunities for business growth due to new varieties? If so, what?
    - Yes.
    - What?
        - New mango varieties with good quality and higher yields will attract farmers and market demand,
        - Promotion of value addition through cottage industries and major processing leading to increased commercialization and competitiveness.
        - Also increased fresh consumption.
10. When new varieties have entered the system in the last 5 years, where have they come from – local breeding or imports.
    - None
11. How do new varieties enter the system? What are the challenges?
    - New varieties are introduced, evaluated through variety adaptation trials, analyzed and recommended for commercial production.
    - Challenges:
        I. The Adoption of new varieties by the farmers is sometimes very slow due to perceptions farmer always like what they already know.
        II. The planting materials for the new varieties might take long to be propagated or reach farmers.

[1] *Some farmers have mango trees directly planted from seed, which is not a recommended practice*

12. How old are the currently produced varieties (answers can be general if exact year is not known, but try to estimate age)?
    - Varieties are over 20 years.

13. Where do farmers source their planting materials for this crop? (Be specific about varieties if needed)
    - KALRO fruit tree nurseries (Kandara, Perkerra, and Matuga),
    - Government institutions (KVDA, LBA, Prisons)
    - Private nursery operators.
14. Is KALRO selling planting material? please provide data for at least the last three years on total volume, plus your estimate of the percentage of volume going to smallholder farmers versus larger commercial customers versus NGO projects.
    - Yes
    - Mango seedlings supplied to small scale farmers;
        - KALRO Kandara: 24,900
        - KALRO Matuga: 30,000
        - KALRO Perkerra: 5,491
        - other KALRO centres to be followed up.

No.	Centre	No. of seedlings*	% to smallholder farmers	% larger commercial customers	% to NGO projects.
1	Perkerra	5,491			
2	Matuga	30,000			
3	Kandara	24,900			
4	PTC				

15. Where do you hear of agribusinesses sourcing their planting materials for this crop? (Be specific about varieties if needed.)
    - Most agribusinesses source their planting materials of improved mango varieties from:
        - KALRO Nurseries (Kandara, Mtwapa, Matuga, Perkerra, Embu, and Katumani) Institution Nurseries (Prisons, KVDA, and Universities)
        - Privately registered nurseries
16. How does availability compare with demand? Please describe the supply/demand equation here: which is larger? By how much? Why? Is the disparity seasonal?
    - The availability for grafted mango seedlings is always lower than the demand particularly during the main planting season hence some farmers plant un-grafted seedlings which are inferior in quality and take up to seven years to fruit.
    - The reason is that operational nurseries are thinly scattered within the mango growing areas.
    - Also, planting materials are more available just before the main rainy seasons compared to short rains because of rainfall amount and reliability for tree survival.
17. What challenges are you aware of related to planting material access (farmer ability to physically find the material)?
    - Inadequate clean planting material
    - nurseries not readily available
    - Desired varieties are limited.
    - Relatively high cost of seedlings as perceived by farmers.
    - Distance to certified nurseries.
18. What challenges are you aware of related to planting material availability (farmer ability to get it every season, when wanted)?
    - Few registered nurseries
    - Limited knowledge and skills among nursery operators.

- Also, limited sources of propagation materials for nursery operators.

19. What challenges are you aware of related to planting material affordability for farmers?
    - High price of mango planting materials and high cost of transportation.
20. What are the main quality problems you experience/hear about with planting material for this crop, and how significant do you think these quality problems are for farmers?
    - Poor quality rootstocks and scion materials and poor propagation techniques by some nursery operators.
    - Sometimes the wrong varieties are sold to farmers in the wrong growing environments due to ignorance and dishonest sellers.
21. What needs to be done to solve constraints in the supply chain with respect to: 1) availability: 2) access (distribution): 3) affordability: Improving nursery's efficiency to reduce final costs of seedlings and 4) quality of this planting material as mentioned above?
    - Availability:
        - Train nursery operators and, initiate more nurseries within the mango growing areas,
    - Access (Distribution):
        - Ensure planting materials are available to farmers in growing areas at the right time through collaborative efforts,
    - Affordability:
        - Ensure sufficient planting materials are accessible to farmers, train farmers and nursery operators on fair pricing and where possible provide subsidies,
    - Quality of this planting material:
        - Ensure fruit tree nursery are registered and certified, ensure nursery operators use quality propagation materials (varieties and stock parts, assist nursery operators be accessible to appropriate propagation materials (varieties) within their areas, train nursery operators and farmers on use of quality seedlings
22. Of all the potential solutions you have mentioned, what do you think are the most important?
    - Train nursery operators on general nursery management practices and establishment of nurseries close to growing areas.
23. Is there anything else you want us to know, or that you think is important for the project?
    - There should be established mother block orchards for both rootstocks and scions within the growing areas for easy access to the nursery operators.
    - Facilitate access to business development services to enable nursery operators run commercial nurseries.

KALRO responses to passion fruit questions

1. Crop that is the subject of these answers:
   - Yellow passion fruit

2. Members of the team providing these answers:
   - T. K. Kwambai, S. J. N. Muriuki & T. Chebii and Pole

3. What types of planting material are used for this crop? (seed, seedlings, TC, cuttings, etc.… Be specific):
   - Seed & seedlings

4. What KALRO varieties have been released and are being produced in Kenya? In what year were they released?
   - KPF 4, KPF 11, KPF 12, C-5 & Brazil.
   - Year of release: 2010

5. What varieties are preferred for local consumption[2]?:
   - KPF 4, KPF 1, KPF 12, C-5 & Brazil in that order

6. What varieties are preferred for commercial sale in Kenya?
   - KPF 4, KPF 11 & KPF 12 in that order

7. What varieties are preferred for export? To where?
   - KPF 4, KPF 11& KPF 12.
   - Exported to Uganda, United Arab Emirates and Tanzania

8. Do you think that off-takers will be changing their buying patterns in the future? If so, how? (Different varieties, characteristics, etc.):
   - Yes.
   - Market preferences of varieties based on juice volume and fruit quality (fruit skin and pulp colour, taste, fruit size) and establishment of processing plants i.e. value addition.

9. Are there high potential opportunities for business growth due to new varieties? If so, what?
   - Yes.
   - Increased production capacity and supply, increased fruit quality and resistance to diseases such as fusarium wilt

10. When new varieties have entered the system in the last 5 years, where have they come from – local breeding or imports?
    - Introductions, evaluation for adaptation and adoption, Performance yield trials and release by the national release committee.

11. How do new varieties enter the system? What are the challenges?
    - Introductions through collaboration with other research organizations and imports.
    - Challenges:
      - Breeders rights barriers/limitations.

12. How old are the currently produced varieties (answers can be general if exact year is not known, but try to estimate age)?

[2] Generally purple passion fruit, Giant yellow and banana passion are common in the local market.

- About 9 years old

13. Where do farmers source their planting materials for this crop? (Be specific about varieties if needed.):
    - KALRO Matuga: -KPF 4, KPF 11, KPF 12, C-5 & Brazil),
    - KALRO Thika: -KPF 4, KPF 11 & KPF 12,
    - HCD regional offices: -KPF 4,
    - Prisons nurseries: - KPF 4,
    - Roadside nurseries: -assorted varieties,
    - Private owned nurseries: assorted varieties

14. Is KALRO selling planting material? Please provide data for at least the last three years on total volume, plus your estimate of the percentage of volume going to smallholder farmers versus larger commercial customers versus NGO projects.
    - Yes.
        - KALRO Thika – 92, 084;
        - KALRO Matuga (250,000).
        - The proportions of volumes going to smallholder farmers versus larger commercial farmers versus NGO projects is 20%: 30%:50%, respectively

15. Where do you hear of agribusinesses sourcing their planting materials for this crop? (Be specific about varieties if needed.):
    - KALRO Thika: - KPF 4, KPF 11 & KPF 12
    - Matuga: -KPF 4, KPF 11, KPF 12, C-5 & Brazil
    - Government institutions e.g. HCD (KPF 4), Prisons nurseries (KPF 4)

16. How does availability compare with demand? Please describe the supply/demand equation here: which is larger? By how much? Why? Is the disparity seasonal?
    - The demand is huge (approximately 70%) compared to supply.
    - However, there are fluctuations attributed to market situation for the fruit.
    - Also, there is higher demand in the long rains compared to the short rains because of lack of irrigation facilities for farmers and even nurseries.

17. What challenges are you aware of related to planting material access (farmer ability to physically find the material)?
    - The nurseries are not always available within most of the production areas making planting materials inaccessible to farmers.
    - Accessing from distant nurseries become expensive and limits awareness for most farmers.
    - Seedlings are not available all year round.
    - Accessibility challenges:
        a. Some nurseries very far from production regions
        b. Seedlings are not available year round
        c. Insufficient production of seedlings
        d. Poor storage conditions for seeds leading to poor germination

18. What challenges are you aware of related to planting material availability (farmer ability to get it every season, when wanted)?
    - There is no assurance of availability of planting materials in existing nurseries.
    - There is inconsistent propagation due to poor nursery planning and/or lack of adequate seed material.
    - Poor handling and storage of seeds leading to poor germination.
    - There are no streamlined linkages between nurseries and starter propagation materials.

19. What challenges are you aware of related to planting material affordability for farmers?
    - The price of seedlings is relatively expensive particularly for small scale and youth farmers. This is particularly the case for seedlings sourced from distant nurseries.
    - Prices may be same for grafted and seed propagated seedlings depending on areas, which has to do with awareness both for the sellers and farmers.
    - At times, there is no big difference between grafted and seed propagated seedlings
    - The cost of planting material is high – up to KES 100 per stem
    - Transportation costs for purchased seedlings are high as farmers come from far places. This adds to extra costs for the farmer

20. What are the main quality problems you experience/hear about with planting material for this crop, and how significant do you think these quality problems are for farmers?
    - Quality problems include;
        - Many nurseries not registered for certification,
        - some nurseries using unprotected (netting) structures
        - infected materials particularly viruses, poor seed viability, seedling age, supply or use of materials not true to type
    - Significance of the problem:
        - It is quite significant because they compromise productivity, market value, product quality and sustained business.
        - Also, may causes crop loses and spread of diseases
    - Other Issues:
        a. Few nurseries undertaking virus indexing to ensure sale of virus-free planting material
        b. Few nurseries produce planting material under insect -proof netting
        c. A few nurseries are registered and certified by KEPHIS and HCD

21. What needs to be done to solve constraints in the supply chain with respect to: 1) availability, 2) access (distribution), 3) affordability, and 4) quality of this planting material, as mentioned above?
    I. Availability – will require establishment or promotion strategic propagation nurseries in production areas based within counties or regions.
    II. Access – Encourage entrepreneurial distribution of planting materials during production/planting season.
    III. Affordability – encourage affordable pricing based on cost benefit analysis
    IV. Quality of this planting material – Increase number of certified passion fruit nurseries through registration (by HCD) and certification (by KEPHIS), training of nursery operators and farmers, availing of quality starter seed materials to nursery operators.
22. Of all the potential solutions you have mentioned, what do you think are the most important?
    - Strategic nurseries, distribution of planting materials and training of nursery operators.
23. Is there anything else you want us to know, or that you think is important for the project?
    - There is need to ensure nurseries are linked to source of quality propagation materials for sustained supply.
    - Also, appropriate approaches for awareness creation on planting material availability should be put in place.

KALRO responses to pineapple questions

1. Crop that is the subject of these answers:
    - Pineapple
2. Members of the team providing these answers:
    - Finyange Pole, Lusike Wasilwa, Nasambu Okoko, and Francis Wayua
3. What types of planting material are used for this crop? (seed, seedlings, TC, cuttings, etc.… Be specific)
    - Seedlings-Mainly suckers
4. What KALRO varieties have been released and are being produced in Kenya? In what year were they released?
    - None
    - Reason: We do not have one now.
5. What varieties are preferred for local consumption?
    - Smooth cayenne and Sweet Cayenne
6. What varieties are preferred for commercial sale in Kenya?
    - Smooth cayenne
7. What varieties are preferred for export? To where?
    - There is only one variety - Smooth cayenne.
    - It is mainly for local consumption and processed into value added products by Del-Monte that are exported to Europe and Middle East.
    - In addition, some traders make fruit salads and juices for local consumption
    - There is also sweet cayenne whose production systems can be improved to upgrade it to export status
8. Do you think that off takers will be changing their buying patterns in the future? If so, how? (Different varieties, characteristics, etc.)
    - Yes
    - Depends on availability of more diverse varieties and preferences, the juicier the varieties; then the more specialized growers will emerge to grow what the market demands.
    - Quality standards. Pineapple fruit quality is measured by:
        i. a) Fruit skin and pulp color. b) Taste. c) Size. d) Juice content. e) Skin texture. f) Presence or absence of bruises, pests or disease damage on the fruits.
9. Are there high potential opportunities for business growth due to new varieties? If so, what?
    - There are high potential opportunities for business growth but with the same old variety since at the moment there has been little research on variety development.
    - The opportunities are in multiplication of planting materials. Since the only method now is using suckers, there is need to set up nurseries for propagating the planting materials whereby land is purposely set aside to propagate the materials just the way sisal planting materials are multiplied.
10. When new varieties have entered the system in the last 5 years, where have they come from – local breeding or imports?
    - Maybe through imports
    - Yes
    - Depends on availability of more diverse varieties and preferences, the juicer the varieties; then more specialized growers will emerge to grow what the market demands.
    - Quality standards. Pineapple fruit quality is measured by:
        i. a) Fruit skin and pulp color. b) Taste. c) Size. d) Juice content. e) Skin texture. f) Presence or absence of bruises, pests or disease damage on the fruits
11. How do new varieties enter the system? What are the challenges?
    - Through breeding and release by the multi-institutional variety release committee
    - Introductions from other countries (USA, Hawaii) after having undergone evaluation and adaptation trials and thereafter some release by the multi-institutional variety release committee

12. How old are the currently produced varieties (answers can be general if exact year is not known, but try to estimate age)?
    - The Smooth Cayenne was introduced in the country after the Second World War in 1945.

13. Where do farmers source their planting materials for this crop? (Be specific about varieties if needed.)
    - Farmers source for planting materials from neighbors
    - From farmers with larger areas of production
    - KALRO-Thika, also provides farmers with pineapples suckers.
14. Is KALRO selling planting material? Please provide data for at least the last three years on total volume, plus your estimate of the percentage of volume going to smallholder farmers versus larger commercial customers versus NGO projects.
    - Yes, KALRO sales pineapple seedlings periodically when demanded
    - These materials are sourced from farmers with clean mother-blocks that apply good agricultural production systems (GAP).
15. Where do you hear of agribusinesses sourcing their planting materials for this crop? (Be specific about varieties if needed.)
    - From farmers who have well established pineapple farms
    - From roadside during harvesting, markets and churches
    - From KALRO Centers (very few seedlings)
16. How does availability compare with demand? Please describe the supply/demand equation here: which is larger? By how much? Why? Is the disparity seasonal?
    - Availability compared with demand is such that the demand for the planting materials now is higher than the supply by approximately 30%. This is so because many smallholder farmers visit KALRO Centers asking for planting materials and we are unable to provide them.
    - The disparity is not seasonal but constant throughout the year. However, the demand for the planting materials is during the rainy season.
17. What challenges are you aware of related to planting material access (farmer ability to physically find the material)?
    - Lack of accredited nurseries where the planting materials are available
    - Inadequate knowledge by operators on pineapple seedlings propagation techniques
    - Most of the farms where the planting materials are available are in remote areas such as Kochia in Homabay County, where most farmers cannot access them
18. What challenges are you aware of related to planting material availability (farmer ability to get it every season, when wanted)?
    - Scarcity
    - Quality of planting material – some infested with pests (mealybugs and nematodes) and diseases (soft root rot and leaf spot),
    - Distance to source of planting material
    - Cost of planting material
19. What challenges are you aware of related to planting material affordability for farmers?
    - the cost of planting material
    - bulkiness of planting material
    - poor or inappropriate packaging material
20. What are the main quality problems you experience/hear about with planting material for this crop, and how significant do you think these quality problems are for farmers?
    - Lack of uniformity (size) for the planting materials.
    - The suckers are harvested at different stages of development leading to variations fruiting periods.
    - Some material is infested by diseases and pests (mealy bugs and nematodes) moved from the mother crop
21. What needs to be done to solve constraints in the supply chain with respect to: 1) availability, 2) access (distribution), 3) affordability, and 4) quality of this planting material, as mentioned above?

- Availability
    i. Establish more accredited nurseries and mother blocks
- Access
    i. Establish the nurseries in areas that are accessible in terms of good road network and well distributed in the pineapple growing area
    ii. Need to use barcoding to track number of available planting materials
- Affordability
    i. Use of propagation technologies that are not expensive such as the use of suckers
- Quality of this planting material
    i. Through proper selection of suckers that are from parents with vigorous growth
    ii. Ensure that the planting material is free from pests and diseases
    iii. Ensure that the planting material is true to type

22. Of all the potential solutions you have mentioned, what do you think are the most important?
    - Establishment of accredited nurseries for propagation of more planting materials.
    - The nurseries should be located in areas that are easily accessible
    - Seedlings to be propagated should be of high quality

23. Is there anything else you want us to know, or that you think is important for the project?
    - There is need for KALRO to start a breeding programme for pineapples so as to develop or introduce new varieties that are high yielding and at the same time drought tolerant and with farmer and market preference (including industrial applications for various value-added products).
    - Need to develop rapid multiplication techniques for pineapple. It is important to note that suckers form below- or above-ground and can be removed for use as planting material.
    - KALRO should introduce current varieties of pineapple
    - Need to introduce new varieties for commercialization in the new areas of pineapple (coastal lowlands, Nyanza, Rift Valley and Western regions) production
    - Gross margins for pineapple plant material production should be determined
    - Develop factsheets management of pests and diseases under nursery propagation and for high health production of seedlings
    - Vast areas of land are required to produce pineapple planting material. The topography of this land must be considered.
    - The type of soil used in propagation, the pH, soil organic matter, and soil density have impact on seedling quality and vigor of planting material

KALRO responses to Sweet Potato value chain questions

1. Crop that is the subject of these answers:
   - Sweet potato
2. Members of the team providing these answers:
   - Dr. J. Maling'a, Dr. Benjamin Kivuva, Dr. Anthony Esilaba and John Ndung'u
3. What types of planting material are used for this crop? (Seed, seedlings, TC, cuttings, etc… Be specific).
   - Vine cuttings
4. What KALRO varieties have been released and are being produced in Kenya? In what year were they released?
   - Year of release: 2013, 2011, 2015, 2001

SN	Variety	Flesh colour	Maturity	Agro- ecozone	Where mostly grown	Year of release
1	Kenspot 1 (Nyawo)	Yellow	5-7 months	1700-2300 metres, North, Central and South Rift, Nyanza/ Western-Kenya	Eldama Ravine, Lare, Njoro and Kakamega	2013
2	Kenspot 2	White	5-7 months	1700-1900 metres-Highlands of western Kenya, Central and South Rift	Highlands of Kakamega, Lanet and Kabianga	2013
3	Kenspot 3	Orange	5-7 months	1900-2300 Masl-Central Rift and western	Njoro, Eldama Ravine, Kakamega	2013
4	Kenspot 4	Orange	5-7 months	1700-2300 Masl - North, Central and South Rift, Nyanza and western Kenya	Eldama Ravine, Njoro, Kabianga and Kakamega	2013
5	Kenspot 5	Orange	5-7 months	1700-2100 metres, North, Central and South Rift, Nyanza and western Kenya	Eldama Ravine Kabianga and Kakamega	2013
6	KSP 20	Creamy			Most parts of the country	2001
7	SPK 004	Orange			Most parts of the country	2001
8	SPK 013	White			Most parts of the country	2001
9	Vitaa	Orange	4-5 months	1200 – 1800 Masl	Most parts of the country	2011
10	Kabode	Orange	4-5 months	1200 – 1800 Masl	Most parts of the country	2011
11	Mugande	White	4-5 months	1200 – 1900 Masl	Most parts of the country	2001
12	Namunyekera	Light yellow	4-5 months		Most parts of the country	2015
13	Cuny	Light orange	4-5 months		Most parts of the country	2015
14	SPK 031	Orange	4-5 months	1200 – 1800 Masl	Most parts of the country	2008
15	Kemb 10	Yellow			Most parts of the country	2001
16	Bungoma	yellow	4-5 months			1998

5. What varieties are preferred for local consumption?

No.	Variety
1	Kenspot 1
2	Kenspot 2
3	Kenspot 3
4	Kenspot 4
5	Kenspot 5
6	Vitaa
7	Kabode
8	SPK 004
9	Mugande
10	Bungoma
11	Kemb 10
12	Kemb 20
13	KSP 20

6. What varieties are preferred for commercial sale in Kenya?

	Variety
1	Kenspot 1
2	Kenspot 2
3	Kenspot 3
4	Kenspot 4
5	Kenspot 5
6	Vitaa
7	Kabode
8	SPK 004
9	Kemb 10
10	Kemb 20
11	Bungoma
12	KSP 20

7. What varieties are preferred for export? Where to?

No.	Variety	Region
1	Bungoma	United Kingdom
3	Kenspot 3	United Kingdom
4	Kenspot 4	United Kingdom

8. Do you think that off-takers will be changing their buying patterns in the future? If so, how? (Different varieties, characteristics, etc.)
   - Yes
   - How?
     A. They will include post-harvest handling and grading at farm gate
     B. Factor in food safety screening from farm to fork
     C. Consider meeting consumer preferences
     D. Consider meeting Industrial processing to diverse products requirements
     E. Improved consumer preferred varieties
        I. Prevailing local and international market forces
        II. Changing dietary habits of consumers at various economic levels
9. Are there high potential opportunities for business growth due to new varieties? If so, what?
   - Yes
   - How?
     a. They are a source of remedies for Vitamin A deficiencies for children below 5 years, and for expectant mothers, due to beta carotene
     b. Rising demand from High end hotels and supermarkets
     c. Fortification of breads and other baked products entering the market
     d. Involvement of youth and women in production and generating value added products creating jobs and a source of income
     e. The potential of the sweet potato to tolerate drought conditions with climate change issues
     f. Great potential as animal forage
10. When new varieties have entered the system in the last 5 years, where have they come from – local breeding or imports?
    - Local Breeding and selections
11. How do new varieties enter the system? What are the challenges?
    - The variety is first released by variety release committee after recommendation by national performance trials committee
    - These varieties are promoted through field/open days, shows, radio, print media in collaboration with CBO, FBO and County Governments
    - Challenges: Lack of sufficient clean seed at onset of rains
12. How old are the currently produced varieties (answers can be general if exact year is not known, but try to estimate age)?
    - Age of varieties: 5 years, 15 years, 20 years
13. Where do farmers source their planting materials for this crop? (Be specific about varieties if needed.)
    - KALRO Centers
    - County Governments
    - Certified Seed Producers
    - NGOs
    - CBOs
    - FBOs
    - Farmers to Farmer

14. Is KALRO selling planting material? Please provide data for at least the last three years on total volume, plus your estimate of the percentage of volume going to smallholder farmers versus larger commercial customers versus NGO projects.
    - KALRO Njoro
    - Total volume for the last three years: 2.4 million vines
    - Buyers: County governments, farmers, FBOs, CBOs
    - 30 percent farmers: 70 percent County governments/NGOs/CBOs

15. Where do you hear of agribusinesses sourcing their planting materials for this crop? (Be specific about varieties if needed.)

- KALRO centres, Kephis, Olerai, Oserian, Tangakona (Vitaa, Kabode, Kenspot 1, Kenspot 2, Kenspot 3, Kenspot 4, and Kenspot 5)

16. How does availability compare with demand? Please describe the supply/demand equation here. which is larger? By how much? Why? Is the disparity seasonal?
    - Low availability compared to demand
    - Availability Vs Demand: 30:70

    a. The demand during the start of the rains is huge
        i. The drought before the planting seasons causes the inadequate clean seed availability
17. What challenges are you aware of related to planting material access (farmer ability to physically find the material)?
    - Distances from certified nurseries
    - Lack of enough certified nurseries
    - Seed is conserved at the field and prone to bad weather conditions
18. What challenges are you aware of related to planting material availability (farmer ability to get it every season, when wanted)?
    - Unavailability of virus free material
    - Demand very high at the start of season with supply capacity being low
    - Transport costs from source
    - Perishability of harvested seed
19. What challenges are you aware of related to planting material affordability for farmers?
    a. Lack of financial capital to purchase the seed at onset of rains especially small-scale farmers
20. What are the main quality problems you experience/hear about with planting material for this crop, and how significant do you think these quality problems are for farmers?
    - Virus infected vine cuttings; Highly significant because the disease is mainly transmitted through planting materials and result to significant yield reductions
    - Perishability if transported for long distances
21. What needs to be done to solve constraints in the supply chain with respect to:1) availability, 2) access (distribution), 3) affordability, and 4) quality of this planting material, as mentioned above?
    - Establish more certified and trained seed multipliers at farm level
    - Promote Tissue culture vine cleaning technology for generating clean mother stocks
    - Promote commercial large-scale seed multipliers under greenhouse technology
    - Model and Promote a viable seed product and distribution system
22. Of all the potential solutions you have mentioned, what do you think are the most important?
    a. Support Tissue culture vine cleaning technology for generating clean mother stocks
    b. Promote commercial large-scale seed multipliers under greenhouse technology
23. Is there anything else you want us to know, or that you think is important for the project?

- Quality seed contributes significantly to good yields for any crop: an effective sweet potato seed production and distribution system is vital.

Annex 6: FPEAK's interview responses

Respondent's name: Hosea Machuki

Position: CEO

Answers to all questions below should relate to the target crops/value chains or to seedling nurseries…

1. What do you see as the key policy barriers to improving both the quantity and quality of planting material available? *Although there exist seed regulations governing production and sale of seeds/Seedlings in Kenya, policy doesn't give weight on availability of the same a basic input in production. Seeds in Kenya are expensive due to taxes as compared to the rest of the East African/African Countries. There are gaps in policy environment on planting material development where funding is worrying, poor distribution networks where the private sector has been left to develop the sector. The government intervention on the same is not proactive, only responding when there is a crisis*

2. What do you see as the key regulatory barriers (both in terms of documented regulations as well as regulatory implementation) to improving both the quantity and quality of planting materials available?

   According to the National Seed Policy document for Kenya, the source and quality of most of the planting materials and seed purchased, multiplied and marketed by the informal seed sector may not be known, yet this is the major source of planting material for the farmers. For example, "road- side" nurseries for forest and fruit trees do not have clearly documented sources. Other informal sources of seed include farm saved seed; farmer to farmer exchange, local markets, KEPHIS is responsible for seed certification as per standards stipulated in The Seeds and Plant Varieties (Seeds) regulations under CAP 326.

   The process of getting planting materials approved in Kenya is lengthy and at times bureaucratic; however, the sector has attracted increased number of players in sector from the private sector due to the increased demand for quality seeds/seedlings as the agriculture sector has been showing progressive positive growth.

3. What do you see as key research, and research delivery, challenges and opportunities with KALRO?

   Opportunities

   a. There is high regard of KALRO by the research and development community in Kenya;
   b. There is existence of research/technology gaps in the agricultural sector due to the dynamism of the sector;
   c. There is access to assets/infrastructure for agricultural research;
   d. KALRO has diverse partnerships and international linkages useful in its work;
   e. There are devolved agricultural functions with focus on thematic areas situated in the countryside
   f. There is support and good-will from various stakeholders through funding and partnership; and
   g. There is high demand for research products and services in the country, a lot of room to cover.

   Challenges

   a. Low/insufficient funds, especially low Government funding; Little influence over budgetary allocation;
   b. Outdated/obsolete equipment and inadequate facilities in key areas and in some institutes;
   c. Inadequate capacity to catalyze agricultural technology dissemination;
   d. Inadequate key investments for growth;
   e. Delayed implementation of human resources management policies, plans/ terms of services;
   f. Manual internal business systems;
   g. Inadequate linkages with County Governments;
   h. High turnover of skilled staff to other institutions;
   i. Inadequate support systems for farmers to adopt technologies; and
   j. Changing market requirements (standards) and consumer preferences.

4. What do you see as the key opportunities and challenges for establishing new, and upgrading existing, seedling nurseries in the focus counties?

Opportunities

a. Investments in improving water supply will not only improve human health and increase agricultural production but will also assist in expanding farmer nurseries;
b. Developing and promoting water-harvesting practices;
c. An increase in expansion of farmer nurseries will translate to increased tree planting that will have direct consequences on the environment;
d. Develop national strategy for germ-plasm supply and preservation;
e. Strategies for providing support in the form of training and advice on Nursery management;
f. Conduct a cost-benefit analysis of different types of farmer nurseries in the context of smallholder farmer production and livelihood strategies; and
g. There is a need to facilitate the establishment of community-based tree seed supply and distribution systems involving the private sector and community based organizations to ensure availability of planting materials.

5. What possible role can FPEAK play in supporting the project objectives relative to improving planting material? What kind of facilitation might be needed to support FPEAK in playing this role?
    - FPEAK provides a focal and coordination point for the horticulture industry.
    - We support growers by providing technical and marketing information and market linkages.
    - Provide training on Good Agricultural Practices, Good Nursery management practices to the growing community.
    - Run active lobbying and advocacy programs to enhance the sector's competitiveness.
    - FPEAK will require funding support to offer the above services to Nursery operators
    - FPEAK has an established MoU with Jomo Kenyatta University. We plan to establish a seedling nursery that will provide clean, disease free seedlings for avocado, mango, bananas, passion and other crops. If RTI supports this initiative, the problem of clean planting material could be solved.

6. What other suggestions do you have for us to include in our scoping report? Kindly feel free to refer to any of the key research questions attached.

There is need to estimate the gap between the demand and supply of horticultural seeds/ seedlings; and the role played by the informal seeds/seedling suppliers in respect to filling the gap.

What could be the impact of using uncertified planting materials to quantity and quality of horticultural production?

Annex 7: Selected photographs

Below are several photographs related to the report, selected to provide some visual context for the scoping work.

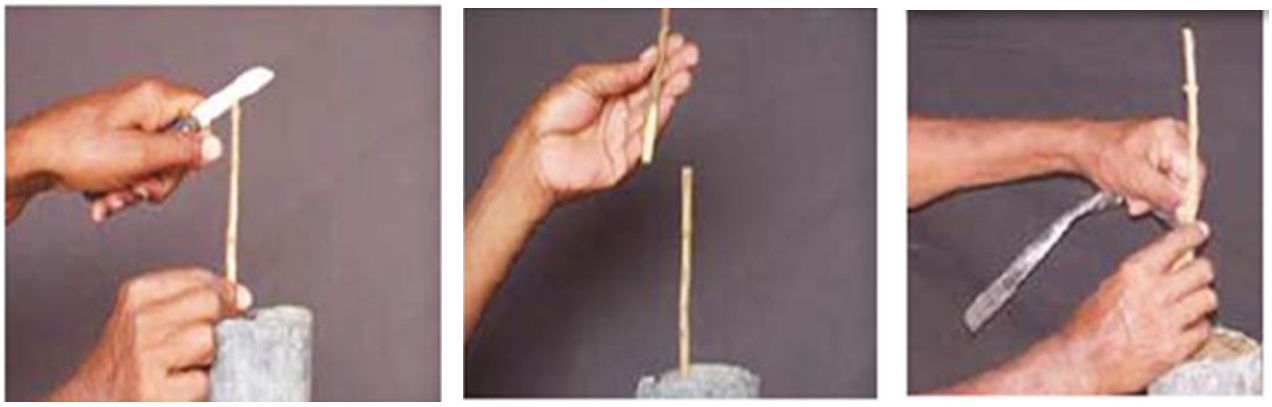

Figure 1: Grafting techniques: Splitting of the rootstock, preparing the scion and tying of the union

Figure 2: after grafting is done, it takes 6-9 months for the seedling to be transplanted to the field

Photo 1: Sweet potato vines Photo 2: Tissue culture laboratory

Photo 3: Banana plantlets hardening nursery Photo 4: Grafted mango seedling