Orange-fleshed Sweetpotato (OFSP)

INVESTMENT IMPLEMENTATION GUIDE

RAC Reaching Agents of Change
Support Vitamin A Sweetpotato

CENTRO INTERNACIONAL DE LA PAPA
CIP
A member of the CGIAR Consortium

UNIVERSITY of GREENWICH
Natural Resources Institute

Helen Keller INTERNATIONAL

Orange-fleshed Sweetpotato (OFSP)

Investment Implementation Guide

MARCH 2015

Orange-fleshed Sweetpotato Investment Implementation Guide

ISBN: 978-92-9060-461-7
DOI: 10.4160/9789290604617

International Potato Center
P.O. Box 1558, Lima 12, Peru
cip@cgiar.org • www.cipotato.org

Produced by CIP – Sub-Saharan Africa Regional Office (SSA), Nairobi

Correct citation for the implementation guide:
Stathers, T., Mkumbira, J., Low, J., Tagwireyi, J., Munyua, H., Mbabu, A. and Mulongo, G. (2015). *Orange-fleshed Sweetpotato Investment Implementation Guide*. International Potato Center, Nairobi, Kenya. vi, 57 p.

Production Coordinator
Hilda Munyua

Copyediting
Kellen Kebaara

Design and Layout
Tanya Stathers
Movin Were, Cartoons
Communications Department (cover)

Printing
Straight Jacket Media Ltd. (Nairobi, Kenya)

Press run: 1000

March 2015

PREFACE

Vitamin A deficiency is one of the most damaging forms of undernourishment. In Sub-Saharan Africa (SSA), 43 million children under the age of five are vitamin A deficient. Every year, more than 4.8 million children in SSA die before the age of five. During the past decade, considerable investments have been made to build the evidence base to show that pro-vitamin A rich orange-fleshed sweetpotato (OFSP) can be a cost-effective means to combat vitamin A deficiency in children under five years of age. OFSP has shown to be an extremely rich source of bio-available pro-vitamin A, which is largely retained when the sweetpotato is boiled, steamed or roasted. Research has demonstrated that young children can meet their daily vitamin A requirements from just one medium-size sweetpotato root. Evidence from projects confirms higher adoption rates and greater increases in vitamin A intake among young children and women of reproductive age when agricultural interventions are combined with nutrition and behaviour-change communication and market facilitation. Lessons from various projects indicate that the time is ripe to invest in larger programmes with adequate resources that are able to draw out the potential benefits from OFSP in fighting vitamin A deficiency and hunger.

The Reaching Agents of Change (RAC) project, implemented by the International Potato Center (CIP) and Helen Keller International (HKI), advocates for increased investment in OFSP to combat vitamin A deficiency among young children and women of reproductive age. RAC also builds the institutional capacity to design and implement gender-sensitive projects to ensure wide access and consumption of OFSP in SSA. Discussions with regional advocates and champions identified a strategic role that regional economic communities (RECs) and member states could play in promoting investments in OFSP through agricultural investment plans informed by the Comprehensive Africa Agriculture Development Programme (CAADP). But potential investors often raise questions regarding what it would take to invest, how much one should invest and how one should invest in order to improve food and nutrition security, reduce vitamin A deficiency and increase incomes of rural households. RAC leadership decided to develop the OFSP investment guides to help investors and project implementers dealing with OFSP to answer these questions.

The decision tool was developed through an extensive consultative process that included key stakeholders in SSA. In developing the investment guide products, the RAC team first produced a draft that it presented to RAC champions and advocates for comments. Later, RAC engaged a high calibre consultant to help repackage the information and produce targeted investment guide products.

The package of investment guides comprises three products – an investment guide, an implementation guide and a summary, each with a PowerPoint presentation for the online version. The decision tool comes complete with an interactive Excel budget calculator. In working out the cost of investing in OFSP, we took a project approach, starting the investments from scratch. However, some countries may not need to invest in some of the items that are costed in the guide such as human resources or any other element if they already have the required capacity.

The *OFSP Investment Guide* targets national level technical experts in public, private and development institutions; the *OFSP Investment Implementation Guide* targets those involved in implementing OFSP investment programmes such as local government or NGO field staff; and the *OFSP Investment Summary* targets policy-makers at local, national and regional levels. It is our hope that the investment guide products will assist and inspire OFSP programme implementers and OFSP investors and attract adequate financial support to combat vitamin A deficiency in SSA. The investment guide products are produced as part of the RAC project funded by the Bill & Melinda Gates Foundation.

Adiel Mbabu
Regional Director – CIP-Sub-Saharan Africa
and Reaching Agents of Change Project Manager
International Potato Center, Nairobi

ACKNOWLEDGEMENTS

Various teams supported the writing of the OFSP investment guide products. This decision tool was prepared by Tanya Stathers of the Natural Resources Institute (NRI), University of Greenwich, in close collaboration with Jonathan Mkumbira, Jan Low, Julia Tagwireyi, Hilda Munyua, Adiel Mbabu and Godfrey Mulongo. We would like to acknowledge the teams and individuals who shared their views and experience and provided insight, inspiration, ideas and comments.

We would like to send a resounding thank you to Tanya Stathers for her hard work and professionalism and for sharing her vast knowledge and experience while composing the guidelines. We are grateful to the Reaching Agents of Change (RAC) staff and management – Dercio Matale, Elias Munda, Maria Andrade, Kurt Henne, Mary Umoh, Jude Njoku, Ima Chima, Margaret Benjamin, Revelian Ngaiza, Nessie Luambano, Christina Nyhus Dhillon, Gregory Hofknecht, Sonii David, Sarah Thotho and Frank Ojwang for their commitment and invaluable contributions. We also thank the CIP and HKI teams of Robert Mwanga, Sindi Kirimi, Margaret McEwan, Ted Carey, Maria Andrade, Erna Abidin, Jessica Blakenship and Heather Katcher for their suggestions, data and knowledge and for reviewing the various drafts.

The development of the investment guide products was heavily influenced by the RAC OFSP champions, advocates and ambassadors at the national and regional levels, and we value their ideas, questions and highlighting of the challenges faced in the process of advocating for investment in OFSP initiatives and programmes. We owe special thanks to the RAC Regional Advocacy Advisor, Ms Julia Tagwireyi, and the Deputy CAADP Coordinator at the COMESA Secretariat, Dr Nalisheebo Meebelo, whose conversation during the first CAADP workshop in Tanzania in March 2013 sowed the seed for the development of this decision tool. Their discussion identified the strategic role that regional economic communities (RECs) could play in promoting investments in OFSP through CAADP-informed agriculture investment plans. RAC decided to target RECs in its regional advocacy activities because of their potential to influence member states with high prevalence of vitamin A deficiency to include investments in OFSP. To pursue this agenda, it was realized that the RECs would need a toolkit to guide the efforts in engaging member states to include OFSP in their agriculture investment plans.

We would also like to thank the RAC regional champions, whose suggestions during the regional champions'/ambassadors' retreat in February 2014 identified the need to differentiate the products for the different target groups of investors, implementers and policy-makers.

We thank Sara Quinn, Margaret McEwan, Jan Low, Richard Gibson, Ted Carey and Silver Tumwegamire for the photographs used in these guides. The cartoons are from the RAC Training of Trainers manual and were drawn by Movin Were.

These investment guide products have been produced as part of the RAC project. They would not have been possible without the generous support, guidance and encouragement of the Bill & Melinda Gates Foundation, to whom we are very grateful.

This *OFSP Investment Implementation Guide* should be cited as follows:

Stathers, T., Mkumbira, J., Low, J., Tagwireyi, J., Munyua, H., Mbabu, A. and Mulongo, G. (2015). *Orange-fleshed Sweetpotato Investment Implementation Guide*. International Potato Center, Nairobi, Kenya. vi, 57 p.

CONTENTS

ACRONYMS

3AGT	Africa Accelerated Agricultural Growth and Transformation
ARMTI	Agricultural and Rural Management Training Institute, Nigeria
CAADP	Comprehensive Africa Agriculture Development Programme
CBOs	community based organizations
CGP	community group promoters
CIP	International Potato Center
CNGs	community nutrition groups
COMESA	Common Market for Eastern and Southern Africa
DALY	disability-adjusted life year
DVM	decentralized vine multipliers
GDP	gross domestic product
GTIL	Genetic Technologies International Ltd
HHs	households
HKI	Helen Keller International
M&E	monitoring and evaluation
MG	marketing group
MM	mass multiplication
NGO	nongovernmental organization
NRI	Natural Resources Institute
OFSP	orange-fleshed sweetpotato
QDPM	quality declared planting materials
RAC	reaching agents of change
SPKP	Sweetpotato Knowledge Portal
SSA	Sub-Saharan Africa
SUA	Sokoine University of Agriculture, Tanzania
ToT	training of trainers
Triple S	storage, sand, sprouting
UEM	University of Eduardo Mondlane, Mozambique
VAD	vitamin A deficiency
VAS	vitamin A supplementation

1. WHY INVEST IN ORANGE-FLESHED SWEETPOTATO?

Orange-fleshed sweetpotato (OFSP) has a high beta-carotene content, which is of enormous importance in Sub-Saharan Africa (SSA). Due to poor diets and frequent infections, 43 million children under the age of five in SSA are vitamin A deficient, as are large numbers of older children and adults, particularly pregnant women. Once consumed, the beta-carotene in OFSP is converted into vitamin A in our bodies.

Vitamin A is an essential nutrient needed in small amounts for growth and normal functioning of the immune, visual and reproductive systems. Vitamin A deficiency is one of the most damaging forms of undernourishment. It reduces immunity to disease, resulting in higher rates of disease-related death, increased burdening of the already stretched health care systems and indirect costs related to lost productivity and lost economic development, as workers are weakened by this hidden hunger or micronutrient deficiency, together with stunting and inadequate energy intake. Child malnutrition is devastatingly high in many SSA countries.

Undernourished children are at a high risk of impaired cognitive development, which will eventually adversely affect their country's productivity and growth, as these children will be less able than their healthier counterparts to innovate and respond to available opportunities even as adults. Young children, as well as pregnant or lactating women, are at a particularly high risk of vitamin A deficiency, owing to their need for micronutrients to support their rapid growth.

If incorporated into the diet, OFSP varieties can help prevent vitamin A deficiency in children and adults. The OFSP root can be eaten boiled or roasted, or mashed into puree for use in a range of products including breads, chapatis, cakes, juices, porridge etc. In most locations across SSA, an area of just 500 m^2 of OFSP can provide enough vitamin A each year for a family of five. Fresh OFSP roots can be stored whole or cut into small pieces, sun-dried and stored for up to two months as an important food stock. The leaves are widely eaten as a nutritious vegetable in many countries. Additionally, the vines can be fed fresh or as silage to livestock.

Vitamin A deficiency can be addressed in different and complementary ways: through taking supplementary capsules, eating fortified foods, or adopting long-term, sustainable, food-based approaches where locally produced foods rich in vitamin A are actively consumed as part of a balanced and diverse diet (Table 1). However, each of these methods has shortcomings, which highlights the need for an integrated and more holistic approach to addressing vitamin A deficiency.

Table 1 – Options for addressing vitamin A deficiency.

Vitamin A supplementation	Food fortification	Dietary diversification
Provision of vitamin A capsules twice a year to children under five increases child survival and reduces child mortality by about 24%.	Foods such as cooking oils, sugar, flours and infant foods can be fortified with vitamin A and other essential nutrients to reach those who purchase and consume such products.	Many vitamin A rich foods such as orange-fleshed sweetpotato, mangoes, pawpaw, pumpkin, dark green leafy vegetables, eggs, liver and milk are available.
However: • The benefits are short term, lasting two–three months. • Only the under-five's are targeted not the whole population. • Vitamin A supplementation campaigns are largely donor dependent and may not be sustainable in the long term.	*However:* • Access to fortified foods may be limited by availability or purchasing power, particularly in rural areas. • Young children can eat only small quantities of the fortified foods, so fortification needs to be combined with other approaches.	*However:* • There is inadequate awareness about the need for dietary diversity for optimal nutrition, or about vitamin A rich foods that are easy to produce, access and consume by all wealth groups and ages. • Current food crop systems often contain little variety. • Long-term investment in nutrition education is required. • Seasonality needs to be addressed through dietary advice and provision for food storage.

Sweetpotato produces more biomass and nutrients per hectare than any other food crop in the world. In SSA, it typically is grown without fertilizer or irrigation, it can grow from sea level to altitudes of up to 2,500 m and temperatures of 15 °C to 33 °C, it has flexible planting and harvesting times of three to five months, it needs little care, and it matures quickly. Throughout history, sweetpotato has played an important role in saving people from famine. In most African countries, sweetpotato is grown mainly by women and, in addition to its nutritional and food security value, it can enhance women's income where market linkages are established.

Increasingly, farmers across SSA are responding to the decline in cultivable land sizes associated with population growth pressure by growing more root and tuber crops (Figure 1), which give higher yields per unit area than grain crops. Sweetpotato is considered a low labour, low cost and low risk crop that helps families during droughts and shocks and when they are struggling with illness, increased health care requirements and resource losses due to the impacts of HIV/AIDS. Additionally, by 2030 there will be over 759 million urban dwellers in Africa, and this rapid urbanization and the associated food system changes are projected to lead to an increase in the demand for fresh sweetpotato roots and value-added sweetpotato-based processed products.

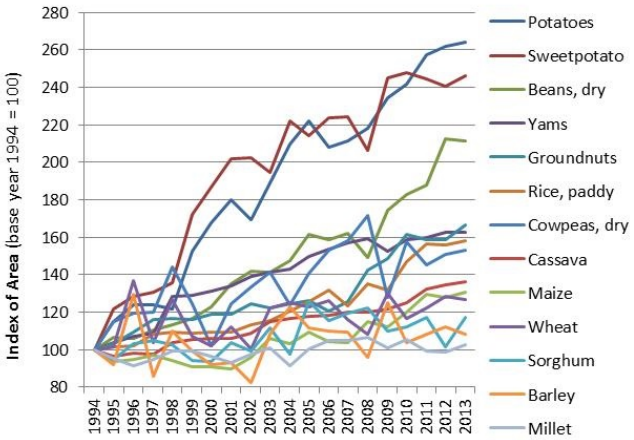


Figure 1 – Growth in cultivated crop area of the main African field crops from 1994 to 2013.
Source: FAOSTAT

This *OFSP Investment Implementation Guide* is targeted at those involved in the implementation of OFSP investment programmes such as local government or NGO field staff. It provides a brief overview of the reasons for investing in pro-poor, nutrition-sensitive agricultural growth and vitamin A deficiency reduction programmes such as the promotion of OFSP. It presents a decision tool for determining where the key opportunities exist in the OFSP value chain. It then unpacks each of the investment areas in detail and presents the activities for achieving its transformation, including details on the required human, financial and physical resources. It assumes such an investment will be undertaken using a multisectoral approach. A related *OFSP Investment Guide* has been developed to support national level technical experts to identify and attract investments and manage pro-poor, nutrition-sensitive OFSP investment programmes through multi-stakeholder approaches. There is also a brief *OFSP Investment Summary* for policy-makers and high level management. These documents are available at http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides/.



2. DEVELOPMENT GOALS, HIDDEN HUNGER AND OFSP

2.1 Opportunities for CAADP-informed national agriculture investment plans in reducing vitamin A deficiency

Most nations across SSA recognize the importance of investing in agriculture for economic growth, and, realistically, they have few other options for tackling mass rural poverty in the short to medium term. However, they are conversely envisioning longer term economies based on complex services and industrial economies. For this to be realized, child malnutrition needs to be addressed now, otherwise the necessary human resources for this transformation will not be available. It might take 20 years for the benefits of addressing child malnutrition to be seen, which highlights the need for unusually astute and visionary leadership that can look beyond short-term planning time frames in order to prepare the stage for their nation's future.

There is a common assumption that all agricultural investment and growth will automatically reduce poverty, malnutrition and food insecurity, but that is not the case. Although agriculture is one of the most effective investment sectors for poverty reduction and development, its effect on poverty occurs only when the investments are specifically pro-poor in targeting. For those looking to back pro-poor, nutrition-sensitive agricultural growth across their country, the promotion of the OFSP enterprise is an obvious win-win investment undertaking.

It is essential to distinguish between a focus on increasing agricultural production and a focus on improving nutrition: more food does not necessarily mean better nutrition. Attention needs to be paid to the quality as well as the quantity of the food produced. A growing economy does not necessarily guarantee improvement in nutrition, although the reverse is true. There is need for nutrition goals to be integrated into agricultural production systems such that the quantity, quality and dietary diversity aspects of the food produced are addressed.

One in three children in SSA is stunted with a body and a brain that have failed to develop properly due to undernutrition. The impacts of malnutrition are felt at the individual and national levels and through not only high child mortality and increased health care requirements but also reduced adult productivity and increased burden of diseases such as heart and kidney disease and diabetes. Estimates suggest that 2–3% of the national income of a country can be lost to malnutrition. For Tanzania, for example, that would equate to up to US$ 1 billion per year, while for Nigeria it would be between US$ 10 billion and US$ 16 billion.

Adults who were malnourished as children earn at least 20% less in pay on average than those who were not. This pervasive, long-term malnutrition erodes the foundations of many national economies by destroying the potential of millions of children. Investing in improving nutrition is investing in the future of a country, and it is hard to see how countries will realize their national development visions without actively tackling child malnutrition. Many nutritional solutions pay for themselves through the boost they give the economy and the impact of the savings on health care, as well-nourished children are less prone to illness.

Many children in SSA have diets that consist almost entirely of starchy staple foods like maize, cassava and rice with few vegetables and little protein. Whilst they might get enough calories, these children miss out on sufficient variety in their diet that would give them enough proteins and vital vitamins and minerals. Promoting an integrated and food-based approach to addressing malnutrition – including the hidden hunger of micronutrient malnutrition – through promoting widely consumed staple crops such as OFSP, which has high levels of beta-carotene, can help ensure the general population, as well as the targeted population of the poor families with young children living in remote rural areas, benefits in the long term. In addition to consumption of biofortified crops, market infrastructure, agroprocessing, crop husbandry and nutritional awareness can be strengthened through training to enable rural communities to produce higher

yields of their nutrient-rich crops for food and nutrition security, sale and production of value-added products.

We cannot afford the irreversible environmental and social consequences that would be attached to focusing solely on raising agricultural productivity but in ways that are neither nutritionally effective nor socioecologically sustainable. There is a need to ensure that the genuine needs and interests of smallholders are at the top of agricultural growth policies and plans.

The Comprehensive Africa Agriculture Development Programme (CAADP) intends to accelerate agricultural growth across Africa and improve food and nutritional security, as well as to strengthen the resilience of the continent's environment. However, in order to reach vulnerable communities and help to reduce the high levels of child malnutrition that act as a long-term capacity barrier to economic growth and development, this will need to be targeted, pro-poor agricultural growth. CAADP highlights the need for integrated and targeted investment in different agriculturally related aspects to help countries to sustainably address the huge burden of child malnutrition through food-based approaches. CAADP's framework can support countries to sustainably address vitamin A deficiency, child malnutrition and food insecurity through integrated OFSP investments within the CAADP pillars, as depicted in Figure 2.

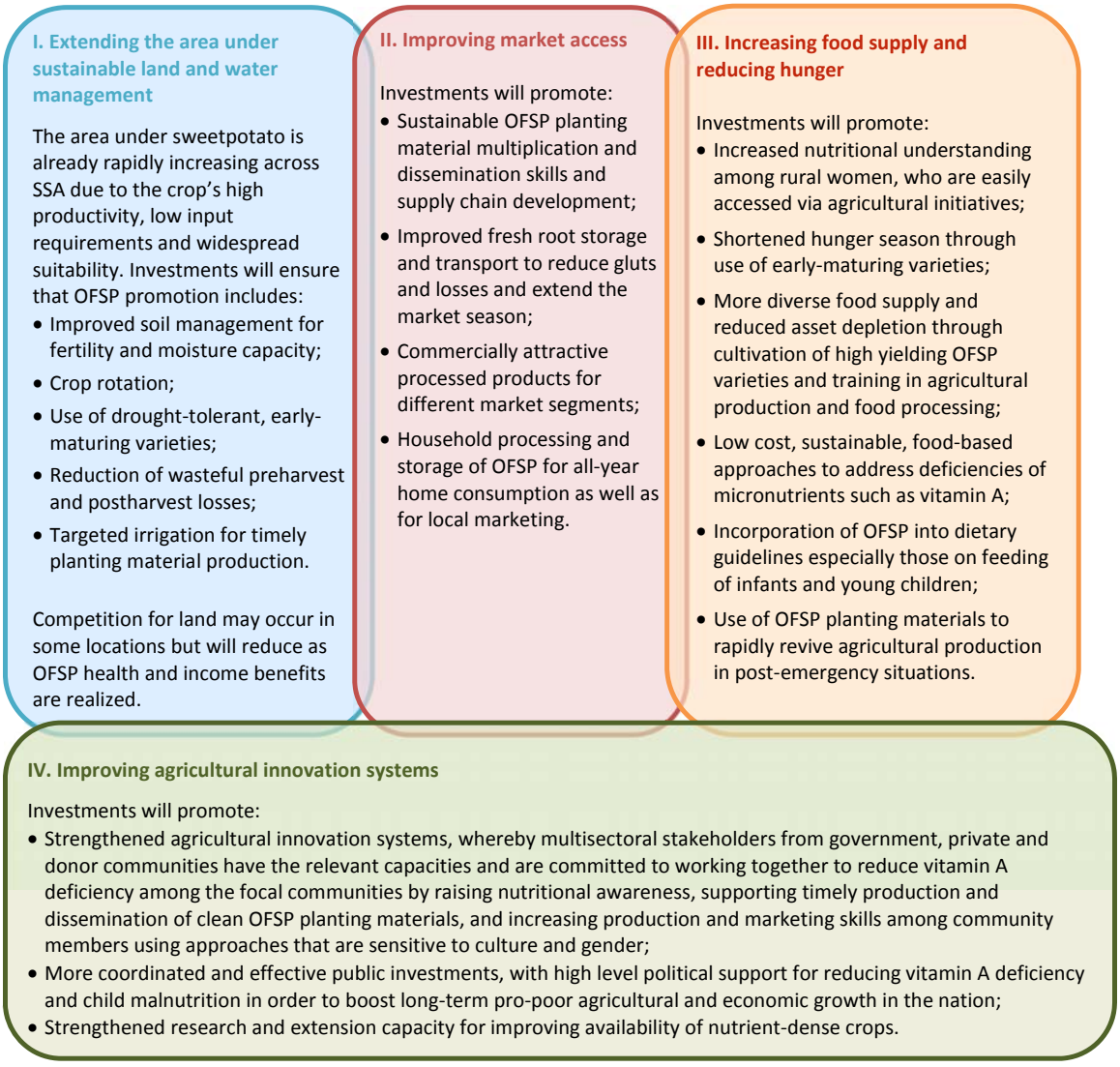


Figure 2 – Reducing vitamin A deficiency through CAADP-informed investment plans.

3. DECISION POINTS ALONG THE OFSP VALUE CHAIN

Opportunities exist all along the OFSP value chain for exploitation of the crop's multifaceted potential. Table 2 is designed to assist investors in determining where their main OFSP decision points and opportunities are. Section 4 explains why each area is important, how it can be transformed and the resources required to do that.

For each 'decision point along the OFSP value chain' identified in the first column in Table 2, select the most accurate 'description of current situation' from column 2. The priority OFSP investment areas are those for which the description of current situation is pink, followed by those where it is purple. If for you the situation is defined by the description in orange, you are already successfully investing in addressing vitamin A deficiency through the promotion of food-based approaches such as OFSP and may now want to focus on scaling out what you are already doing.

Table 2 – Factors for investors to consider in identifying opportunities in the OFSP value chain

Decision points along the OFSP value chain	Description of current situation	Tanzania example	Complete for focal location
Current interventions to address vitamin A deficiency	None or limited vitamin A fortification for sugar, oil or flour		
	Vitamin A capsules coverage of more 60% for children under 5 years	X	
	Widespread, long-term promotion of food-based approaches to addressing vitamin A deficiency (including high dietary diversity index scores), plus vitamin A capsules for children under 5 years old		
Role of sweetpotato in the diet	Not consumed		
	Consumed but not a main staple		
	A main staple and sold in the markets	X	
Availability of OFSP varieties	No OFSP varieties available		
	Fewer than 3 OFSP varieties available		
	3 or more OFSP varieties available	X	
Technical capacity to implement an OFSP programme	No field staff familiar with key OFSP topics		
	Fewer than 50 field staff familiar with key OFSP topics; programme leaders not familiar with multisectoral approaches	X	
	More than 50 extensionists or NGO field staff highly familiar with OFSP and vitamin A, clean planting material production, processing, farmer training, and multisectoral approaches		
Sources of clean OFSP seed/planting materials	No disease-free or 'clean' OFSP planting materials available		
	Trained vine multipliers who understand how to produce healthy looking planting materials	X	
	Tissue cultured plantlets of 2 or more OFSP varieties and protected basic planting material in screen houses		
Multiplication of OFSP planting materials	No trained OFSP vine multipliers		
	1–200 trained decentralized vine multipliers	X	
	More than 200 trained decentralized vine multipliers		
OFSP vine distribution	No OFSP vine distribution		
	OFSP vines distributed to 1 to 10,000 households	X	
	OFSP vines distributed to more than 10,000 households		
Farmers' vine conservation skills	Fewer than 5% of farmers know how to conserve vines	X	
	5–60% of farmers know how to conserve vines		
	More than 60% of sweetpotato farmers know how to conserve vines between seasons		
Farmers' sweetpotato	Low – e.g. late planting, and poor crop and pest and disease management	X	
	Medium – e.g. farmers know how to rogue out diseased plants and space plants properly		

agronomic know-how and skills	High – e.g. timely land and planting material preparation, good crop and pest (especially weevil) and disease management	
Fresh OFSP root marketing	Limited or no marketing of OFSP roots	
	Some marketing of OFSP roots	X
	Strong knowledge, skills and practice of fresh OFSP root marketing, e.g. market information, promotion, packaging, farmer organization	
OFSP product diversification	No use of OFSP in processed products	
	Limited use of OFSP in processed products	X
	OFSP flour or puree being included in several commercial products	
Nutritional awareness, understanding and behaviour change	Target population has low nutritional awareness and typically consumes a diet low in diversity and essential micronutrients	
	Target population has some awareness of the need for a balanced diet	X
	Target population has awareness about and is consuming a balanced diet, and infant and young child feeding guidelines exist and are utilized where they have been introduced	
Monitoring of food-based approaches to addressing vitamin A deficiency	None or low monitoring and evaluation (M&E) of food-based approaches for tackling vitamin A deficiency	X
	Some M&E of food-based approaches for tackling vitamin A deficiency	
	Regular and comprehensive M&E of food-based approaches for tackling vitamin A deficiency	

4. UNPACKING INVESTMENT OPPORTUNITIES ALONG THE OFSP VALUE CHAIN

4.1 Overview of an OFSP investment programme at scale

To make decisions about an investment, we need to understand why the investment is needed, what scale and type of impact it will have and what activities and resources it will require. This OFSP value chain investment programme example has been designed to reach 10,500 direct beneficiary households with young children, organized into community nutrition groups (CNGs) of 30 members, and its in-built spillover activities will allow OFSP planting materials and nutritional information to reach a further 33,000 beneficiary households indirectly within the proposed three-year time span. There is potential for even further spillover after that. The main benefits include improved food security, reduced vitamin A deficiency, improved dietary diversity and nutrition education, sustainable sweetpotato seed systems, increased extension capacity, and improved markets and incomes for those marketing or processing their OFSP roots or vines to add value. The investment programme described here deliberately builds the capacity of all those involved in the OFSP value chain so that these activities will inevitably continue beyond the initial three-year programme. A summary of the resources required for the OFSP investment programme is given in Table 3.

Table 3 – Summary of resources required for the three-year OFSP investment programme

OFSP INVESTMENT PROGRAM BUDGET SUMMARY	Year 1	Year 2	Year 3	TOTAL BUDGET (USD$)
SALARIES - across activities	108,840	114,786	120,525	344,151
COMMON EXPENSES - across activities	31,650	26,710	27,286	85,645
EQUIPMENT - across activities	189,900	-	-	189,900
ACTIVITY COSTS (total for all activities)	370,612	383,273	403,519	1,157,404
Act 1. Understanding the role of sweetpotato in the food system	*15,000*	-	-	*15,000*
Act 2. Availability and acceptability of OFSP varieties	*35,740*	*53,848*	*36,280*	*125,868*
Act 3. Strengthening the capacity of OFSP service providers	*68,390*	*4,017*	*4,139*	*76,546*
Act 4. OFSP vine conservation, multiplication and dissemination	*59,998*	*161,330*	*193,851*	*415,179*
Act 5. Improving sweetpotato production and postharvest management	*3,586*	*10,758*	*14,344*	*28,688*
Act 6. Promoting OFSP to improve health and wealth	*44,398*	*14,100*	*5,070*	*63,568*
Act 7. Nutrition education for behavioural change at community level	*12,420*	*28,260*	*31,680*	*72,360*
Act 8. Strengthening OFSP marketing	*18,460*	*27,840*	*5,940*	*52,240*
Act 9. Processing OFSP	*1,080*	*20,480*	*1,000*	*22,560*
Act 10. Enhancing multi-sectoral collaboration	*2,400*	*600*	*1,800*	*4,800*
Act 11. Monitoring, measuring and sharing the impact of your investment	*109,140*	*62,040*	*109,415*	*280,595*
Sub-total	**701,002**	**524,769**	**551,330**	**1,777,100**
OVERHEADS	70,100	52,477	55,133	177,710
GRAND TOTAL BUDGET	**771,102**	**577,245**	**606,463**	**1,954,810**

From this budget, the investment per household is US$ 45 if direct and indirect beneficiaries are considered or USD$ 185 if only the direct beneficiaries are taken into account.

If the programme is targeting communities living in low population density areas, a higher cost per beneficiary household should be expected with the bigger distance between households, groups or decentralized vine multipliers (DVMs). A recent integrated agriculture–nutrition marketing intervention cost US$ 56 per target beneficiary in the densely populated Uganda and US$ 86 in the less densely populated Mozambique.

The following sections provide an overview of each of the investment areas in the OFSP value change, including the related activities and costs. Personnel and equipment costs (Table 4) will cover all the activities. To help adapt costs to specific contexts, a detailed, interactive Excel budget calculator is provided.

If it is necessary to cut programme costs, marketing and processing activities (4.9 and 4.10) may be removed, but the food and nutrition security focus and scaling up sections must be retained. Vine conservation, multiplication and dissemination are expensive but crucial for the success of the enterprise.

Table 4 – OFSP investment programme costs shared across activities.

OFSP Investment Costs shared across activities		Year 1			Year 2			Year 3			Total
(using Tanzanian 2014 rates)		Rate	Basis	Total	Rate	Basis	Total	Rate	Basis	Total	
PERSONNEL INCLUDING BENEFITS (annual works days = 240)											
Staff	%										
Manager	100%	100	240	24,000	105	240	25,200	110	240	26,460	**75,660**
Finance & Administration	100%	40	240	9,600	42	72	3,024	44	72	3,175	**15,799**
Agronomist	100%	30	240	7,200	32	480	15,120	33	480	15,876	**38,196**
M&E officer	100%	90	240	21,600	95	240	22,680	99	240	23,814	**68,094**
Extension officers (11)	1100%	149	240	35,640	156	240	37,422	164	240	39,293	**112,355**
Drivers (2)	200%	15	720	10,800	16	720	11,340	17	720	11,907	**34,047**
Total: Personnel				**108,840**			**114,786**			**120,525**	**344,151**
TRAVEL/EXPENSES ACROSS ALL ACTIVITIES											
Regional travel	1x5day trip/yr	2,150	1	2,150	2,215	1	2,215	2,281	1	2,281	**6,645**
Vehicle insurance		1,500	2	3,000	1,545	2	3,090	1,591	2	3,183	**9,273**
Motocycle insurance		500	11	5,500	515	11	5,665	530	11	5,835	**17,000**
Vehicle maintenance	thrice a year	1,800	2	3,600	1,854	2	3,708	1,910	2	3,819	**11,127**
Motorcyle maintenance	twice a year	400	11	4,400	412	11	4,532	424	11	4,668	**13,600**
Establishment of extension personnel at village level	Once	500	11	5,500							**5,500**
IT services		300	15	4,500	300	15	4,500	300	15	4,500	**13,500**
Office supplies	Per month	250	12	3,000	250	12	3,000	250	12	3,000	**9,000**
Total: Travel and other costs across all activities				**31,650**			**26,710**			**27,286**	**85,645**
EQUIPMENT											
Vehicle capable of carrying 7 passengers		60,000	1	60,000		0	-	-	-	-	**60,000**
Double cab capable of carrying 5 passengers		40,000	1	40,000		0	-	-	-	-	**40,000**
Motorcycles (1 per extension agent)		4,500	11	49,500		0	-	-	-	-	**49,500**
Computers		900	4	3,600		0	-	-	-	-	**3,600**
Tablets/Phones with GPS capability		400	19	7,600		0	-	-	-	-	**7,600**
Projector		1,200	1	1,200				-			**1,200**
Screenhouse with sandponics capacity		28,000	1	28,000		0	-	-	-	-	**28,000**
Total: Equipment				**189,900**			**-**			**-**	**189,900**

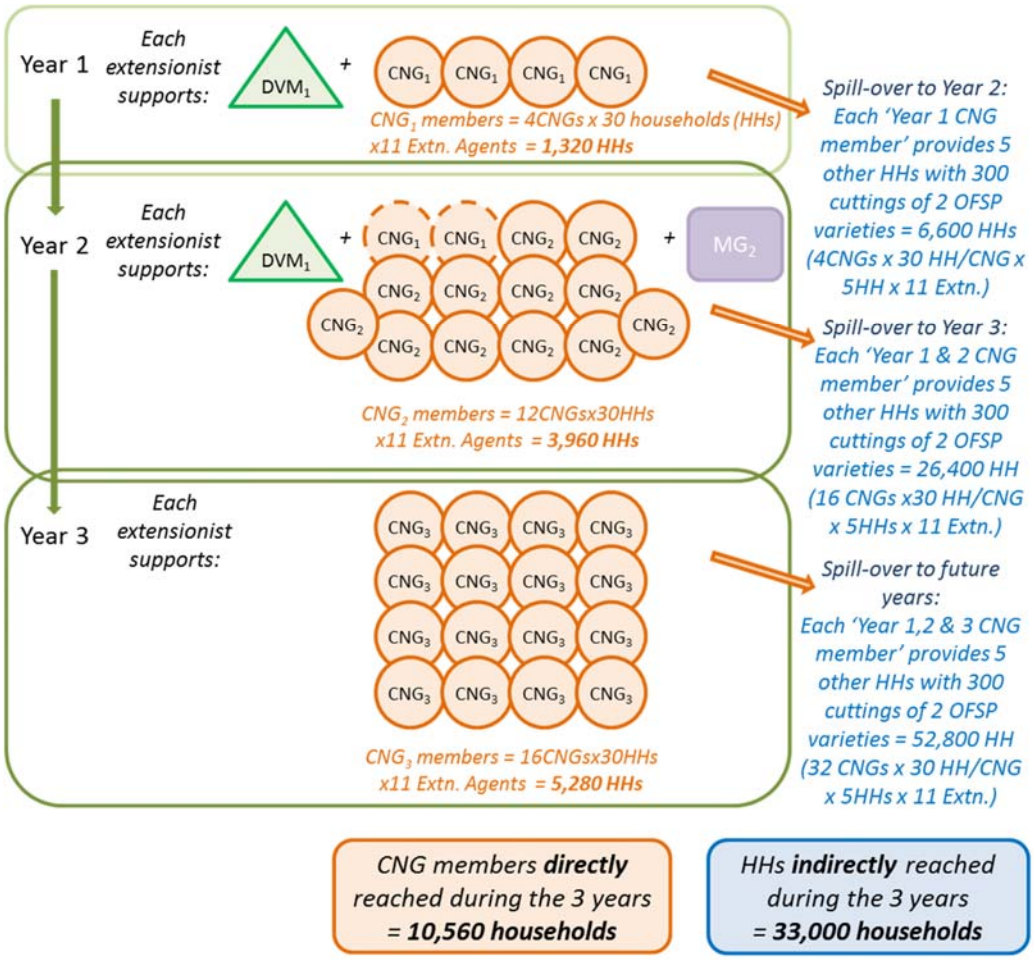
A sketch showing how the OFSP investment programme will reach 43,500 households – 10,500 directly and 33,000 indirectly – within the three years of the plan is provided in Figure 3.

The OFSP investment programme will involve 11 extension agents, each of whom will participate in the 10-day 'Everything You Ever Wanted To Know about Sweetpotato' training course and will be in regular contact with the programme manager at the monthly meetings, where role playing and practising for forthcoming farmer training sessions will occur, as well as provision of feedback on progress of the OFSP investment. Each extension agent will support:

- One DVM enterprise, which will be supplied with two net tunnels in year 1 and another two from year 2 to be used to ensure that planting materials remain disease free during multiplication. The DVM will produce clean planting materials using a rapid multiplication method with irrigation in an open field. These planting materials will then be supplied to each member of the target community's nutrition group (CNG), with increasing numbers of these groups being reached each year. Detailed plans for the multiplication of the planting materials are crucial, as many of the multiplication activities need to start at least seven months before the planting season even in year 1 in order to bulk up sufficient planting materials. An example planting material multiplication plan to reach 10,500 households directly within three years is given in section 4.5.
- Several CNGs (4 in year 1; 14 in year 2, of whom 2 were also supported in year 1; and 16 in year 3). Each CNG has on average 30 members, each of whom will receive 300 cuttings of each of two OFSP varieties along with support and training on a range of agronomic and nutrition topics. Each CNG will select one 'promoter' amongst them who will help organize CNG events and establish a demonstration plot in which at least two OFSP varieties will be multiplied alongside the popular local variety.
- One marketing group (MG) with at least 20 members, each of whom will grow a minimum of 0.25 ha of OFSP roots. Marketing groups will be set up in only areas with good road access so that they will be able to undertake long distance root marketing.

The number of CNGs each extension agent will support will increase each year (see Figure 3). At the start of the new season, there will be a celebratory meeting during which each CNG member (direct beneficiary) will give vines of the two OFSP varieties to five new households (indirect beneficiaries) to assist in scaling out the investment and OFSP nutritional benefits. Further spillover activities after the end of the three-year programme in which each CNG member will

provides OFSP cuttings to five other households would lead to another 52,800 households being reached indirectly.



Key:

DVM1

Decentralised Vine Multiplying Enterprise (DVM):
DVMs will use net tunnels to produce disease-free quality declared OFSP planting materials which are then replicated in the field using rapid multiplication technique and then supplied subsidised to the CNGs. They will be backstopped by an extension agent initially, but are expected to be self-reliant within 2 years.

CNG

Community Nutrition Group (CNG):
Each CNG has 30 members, one member is selected as the 'promoter' (CNGP) who will conventionally multiply OFSP varieties and organise CNG events. Each CNG is backstopped by an extensionist. Each CNG member will receive full training on OFSP and nutrition topics *(e.g. sweetpotato agronomy, seed systems, pest and disease management, harvesting and handling, food preparation, balanced diet, young child feeding)* and 300 cuttings of 2 OFSP varieties produced by the DVMs.

MG

Marketing Group (MG):
Each MG has ≥20 members each of whom grow at least 0.25ha of OFSP roots. Each MG is backstopped by an extensionist. Each MG member will receive full training on OFSP marketing topics.

Figure 3 – Schematic representation of your investment's expansion to ensure 43,000 households are producing and benefitting from vitamin A rich OFSP within three years.

4.2 Understanding the role of sweetpotato in the food system

It is important to understand the role of sweetpotato in the focal food system in order to plan strategic investments based on the opportunities along the OFSP value chain that can simultaneously reduce the burden of vitamin A deficiency while building the capacity to sustainably produce and consume OFSP and generate an income from the crop. This would involve surveys or focus group discussions with farmers – making sure to include men, women, the poor, the wealthy and the different age groups – and key informant interviews with other actors such as traders, extensionists, local leaders, health workers, street food caterers, restaurant owners, and small- and large-scale food processors. These activities will provide information on:

- **Sweetpotato consumption and marketing patterns:**
  - In what forms is sweetpotato consumed within the focal community? By whom, how often, when and in what quantities?
  - Are any parts of the sweetpotato plant marketed within or by the focal community? In what form (fresh or processed, roots, leaves or vines), by whom, where, how often and when, in what quantities and for what value?
- **Trends affecting sweetpotato:**
  - What have the trends over the last 20 years been in sweetpotato consumption and marketing in the focal community, and is everyone affected by them?
  - What are the projected trends for the next 20 years?
  - What factors are driving these trends and is everyone affected in a similar way? If not, how can the differences and reasons be disaggregated?

- **Sweetpotato activity calendar:**
  - When do farmers start preparing their land and how long does it take?
  - Which crops do they plant, how and in what order?
  - Where do they get their sweetpotato planting materials from and do they usually have sufficient planting materials?
  - When does it rain?
  - What varieties of sweetpotato do they plant?
  - When and how do they weed the plots; apply fertilizer to the crop; and harvest, transport to the market, sell, process, or conserve the roots or vines?
  - Who does each of these activities?

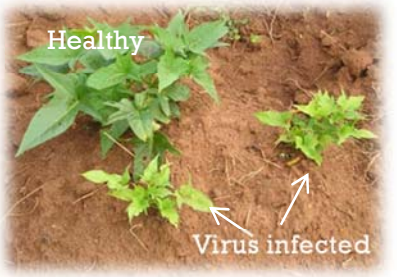
- **Main constraints to production, consumption and marketing of sweetpotato:**
  - What factors constrain production, consumption, and/or marketing of sweetpotato?
  - Do these constraints affect everyone? And if not, why not?
  - What options exist for addressing these constraints, and are the options being applied? If not, why not?
  - What sources of information are available for these sweetpotato constraints, and which are the most useful?

  - What gender differences exist in sweetpotato knowledge, for example on varieties, diseases, pests, planting methods, nutritional attributes and practices such as those associated with vine production or sourcing and labour use?

- **Roles and responsibilities within the sweetpotato value chain:**
  - Who controls the productive resources such as land, water, labour and the labour-saving technologies used in sweetpotato production?
  - Who does each of the farming activities involved in producing sweetpotato, and if men and women are involved, what are the portions of their roles (tip: use the activity calendar)?
  - Who does the decision-making for each of the sweetpotato production activities and in what proportions?
  - Who does the marketing, processing, storage, food stock monitoring, transport, and trading for the large- and small-scale levels for sweetpotato vines, fresh or processed roots or leaves, and who makes the decisions about what should be done at each of these stages?
  - Who owns the income generated from sweetpotato sales and who decides how it should be used?

- **Nutritional behaviour and awareness:**
  - What level of nutritional awareness and which nutritional behaviours exist amongst the different age and sex categories and ethnic groups in the focal community?
  - Who is involved in decision-making on nutrition, for example on the crops to produce, the food to buy, or the feeding of young children?
  - What kind of nutritional messaging has or is being used, who is it targeting and what are its strengths and weaknesses? What other opportunities exist?

- **Other relevant initiatives**:
  - What other relevant initiatives exist at the local or other level? Examples of these are programmes on nutrition and vitamin A deficiency levels and school feeding, relief activities, policy development initiatives, agricultural projects, and food processing.
  - How can OFSP enterprise promotion interact with these initiatives?



Resource requirements

Activity	Year 1	Year 2	Year 3	Total (US$)
Sweetpotato in the food system – 2-week situation analysis	15,000	0	0	**15,000**

NB: A detailed interactive Excel budget sheet is provided at http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides/.

4.3 Availability of OFSP varieties

Natural diversity of sweetpotato

Although sweetpotato is thought to have originated in Central America more than 10,000 years ago, the exchange and movement of its planting materials between farmers and across locations throughout the years have meant that thousands of varieties of sweetpotato now exist across the world. These varieties differ in many ways, including leaf shape and colour, vine structure, root shape, root skin colour, flesh colour, taste, texture, dry matter content, resistance to pests and diseases and yield.

The flesh of sweetpotato roots comes in an amazingly wide range of colours, ranging from white, through yellow, to deep orange and even deep purple. There are differences also in taste, texture and dry matter content. The colours are natural and not the result of genetic modification.

Fortunately, the beta-carotene content of OFSP roots can be estimated visually from the flesh colour. The deeper the orange colour of the flesh, the higher the beta-carotene content and the more the beta-carotene that will be converted into vitamin A (Figure 4).

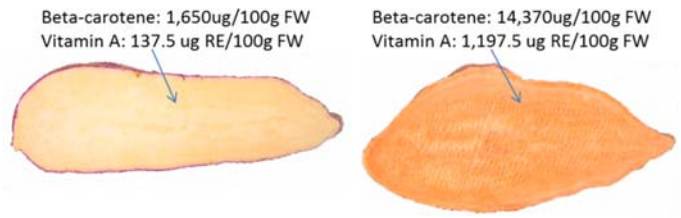


Figure 4 – The link between the orange colour of the flesh of sweetpotato roots and the beta-carotene content.

Helping farmers access OFSP varieties

The varieties that farmers plant are influenced by the varieties they can have access to and what they plan to use the crop for, for example if it is for household food, small local sales, large-scale marketing, processing, animal feed etc., as well as the local pest and disease pressures, agroecological factors, climate, and the length of growing season. Most locations have a few dominant sweetpotato varieties that farmers grow; however, researchers and farmers are constantly developing and evaluating new varieties, and the predominant varieties do change over time.

Farmers obtain new varieties through neighbours, agricultural extension or NGO staff, traders, research stations, and specialized seed producers.

Sweetpotato breeding programmes work closely with farmers and consumers to select new varieties. To breed a new sweetpotato variety typically takes about four years and involves building a crossing block; establishing a seedling nursery, an observation trial, a preliminary yield trial and advanced trials in several locations; and conducting on-farm participatory trials before officially releasing the new variety (Figure 5). However, using disease-free planting materials of popular varieties from neighbouring countries is a good shortcut for acquiring new varieties. These varieties can be studied in advanced trials in several locations, then the most promising varieties are put in multi-locational on-farm trials before they are officially released and promoted.

Figure 5 – Sweetpotato breeding scheme.

Some of the OFSP varieties released recently in some SSA countries are shown in Table 5, along with the local OFSP variety specialists contact details. The CIP support platform (cip-nbo@cgiar.org) also can assist investors in identifying the best-bet OFSP varieties for their specific African agroecology. The *Orange-Fleshed Sweetpotato for Africa Catalogue* (2014) is available on the CIP website.

Table 5 – OFSP varieties available in Sub-Saharan African countries

Country	Released OFSP varieties	Contact person
Mozambique	Tio Joe, Namanga, Bela, Lourdes,Ininda, Irene, Cecilia, Erica, Delvia, Melinda, Amelia, Sumaia, Esther, Jane, Gloria	Jose Ricardo, IIAM Email: j.madiya@yahoo.com.br
Tanzania	Mataya, Kiegea, Ejumula	Everina Lukonge, ARI Ukiriguru Email: elukonge@yahoo.com
Nigeria	King J (Umuspo/1) and Mother's Delight (Umuspo/3)	Jude Njoku, National Root Crops Research Institute Email: j.njoku@cgiar.org
Ghana	Bokye, CRI-Apomuden	Kwadwo Adofo, CSIR Crops Research Institute Email: kinfodda@yahoo.com
Burkina Faso	Tiebele, Bagre, Jewel, BF138, BF139 *(registered in 2014)*	Koussao Somé, INERA Email: koussao@hotmail.com
Malawi	Zondeni, Ana Akwanire, Kadyaubwerere, Mathuthu, Kaphulira, Chipika	Kennedy Masamba, DARS Email: kennedymasamba@yahoo.com
Uganda	SPK004 (Kakamega), Ejumula, NASPOT 8, Vita (NASPOT 9 O), Kabode (NASPOT 10 O), NASPOT 12 O, NASPOT 13 O	Gorrettie Ssemakula, NCCRI Email: gssemakula@naro-ug.org
Kenya	KENSPOT-3, KENSPOT-4, KENSPOT-5, SPK004 (Kakamega), Kabode (NASPOT 10 O), Vita (NASPOT 10 O)	Philip Ndolo, KARI Email: ndolophilip@yahoo.com
Rwanda	97-062 (Gihingamukungu), SPKOO4 (Kakamega), Caceapedo, RW11-2560, RW11-4923 and RW11-2910 (Ndamirabana)	Jean Ndirigue, RAB Email: ndrick3@yahoo.com
Ethiopia	Kulfo, Tulla, Birtukane, Kero, Guntute, Koka-12	Fekadu Gurmu, SARI, Hawassa Email: fekadugurmu@yahoo.com
Zambia	Zambezi, Kalunguwishi, Lukusashi	Martin Chiona, ZARI Email: martinchiona@yahoo.com
South Africa	Bophelo, Impilo, Khano, Serolane, Purple Sunset, Isondlo USA cultivars being distributed: Resisto, Beauregard, W-119	Sunnette Laurie, ARC Email: slaurie@arc.agric.za

Detailed attributes of several of these OFSP varieties are shown in Table 6.

Table 6 – Attributes of some orange-fleshed sweetpotato varieties

	Name	Bela (IIAM-CIP BD004)	Namanga (IIAM-CIP BD002)	Zondeni	Chipika	Kabode (NASPOT 10 O)	Vita (NASPOT 9 O)	CRI-Apomuden	Ejumula	King J (UMUSPO/1)
Variety Info	**CIP No:**	CIP106763.5	CIP106763.3			CIP100200.4	CIP100200.3	CIP440254	CIP443750	Not available
	Released in	Mozambique	Mozambique	Malawi	Malawi	Uganda, Kenya	Uganda, Kenya	Ghana	Tanzania, Uganda, Mozambique	Nigeria
Growth characteristics	**Canopy**	Spreading	Semi-erect	Spreading	Spreading	Semi-erect	Semi-erect	Spreading	Spreading	Erect
	Leaf	Mature & young = green, 5 moderate lobes	Old = green, young = green with purple margins, 5 slight lobes	Light green when mature, purple margins on young leaves, 3–4 lobes	Green	Green = mature, immature leaf = slightly purple, 7 moderate deep leaf lobes	Green = mature, immature leaf = slight purple, 7 deep leaf lobes	Green = mature, immature leaf = purple, no leaf lobes	Green when mature, 3–4 moderately deep lobes	Mature = deep green, immature = green with purple edge
	Flowering	Sparse	Early and profuse	Late and sparse	Sparse	Late and sparse	Late and sparse	Early and moderate	Late and sparse	Very sparse
Major agronomic attributes	**Maturity period**	5 months	5 months	6 months	5 months	4 months	4 months	4 months	4 months	4 months
	Root yield (t/ha)	25.9	19.3	8–16	25–30	16	16.5	20	14.7	>25
	Adaptability	Wide	Wide	High to mid altitudes		Moderate to high rainfall	Moderate to high rainfall	Wide	Does well in low virus zones	Wide
	Resistance to pests	Resistant to weevils	Resistant to weevils	Moderate to weevils	Moderate to weevils	Susceptible to weevils	Susceptible to weevils	Susceptible to weevils	Susceptible to weevils	Moderate to weevils
	Resistance to diseases	Resistant to SPVD	Resistant (1.5 mean score)	Moderate to SPVD	Susceptible to alternaria	Moderate to SPVD and alternaria	Resistant to SPVD, moderate to alternaria	Moderate to SPVD	High to alternaria, low to SPVD	Moderate to alternaria, v. low to SPVD
Root characteristics	**Root shape**	Long elliptic	Long elliptic	Long irregular	Long	Long irregular or curved	Obovate	Long irregular	Long irregular	Long elliptic
	Root skin colour	Cream	Cream	Cream	Pale orange	Purple-red	Purple-red	Purple-red	Cream	Pink
	Dry matter (%)	27.5	27.0	30–32	30	30.5	30.1	21	33	36.3
	Flesh colour	Orange	Intermediate orange	Deep orange	Orange	Deep orange	Deep orange	Intermediate orange	Deep orange	Light orange
	β-carotene (fwb)	8390 µg/100g	8390 µg/100g	9000 µg/100g	3900 µg/100g	11030 µg/100g	11030 µg/100g	2011-5500 µg/100g	7760–14370 µg/100g	700 1650 µg/100 g
Sensory characteristics	**Colour of boiled roots**	Deep orange	Intermediate orange	Deep orange	Pale orange	Deep orange	Deep orange	Orange	Deep orange	Orange
	Texture of boiled roots	Moist to intermediate	Moderate dry mouth feel	Dry and floury mouth feel	Moderate dry	Moderate dry mouth feel	Moderate dry mouth feel	Soft and moist mouth feel	Dry and floury	Moderate dry mouth feel
	Taste	Sweet	Moderately sweet	Moderately sweet	Moderately sweet	Moderately sweet	Moderately sweet	Moderately sweet	Sweet	Moderately sweet

Viruses and other diseases can dramatically reduce sweetpotato yields. A recent trial in Tanzania compared yields of two sweetpotato varieties that had recently been through a cleaning process to remove viruses that they might have had (see Kabode and Polista – cleaned up in Table 7) with the Polista planting materials that farmers were normally planting (see Polista – farmers' own). Cleaning up the planting materials led to a yield increase of 25% for the Polista variety, which converted to a net income benefit of US$ 255/ha. Demonstration trials are usually required to help farmers understand how detrimental virus infection can be to their sweetpotato yields.

Table 7 – Yield and income benefit from use of improved and cleaned-up varieties, Tanzania

Variety	Yield (t/ha)	Yield difference (%)	Gross income (US$/ha)	Planting material cost (US$/ha)	Net income (US$/ha)	Net income benefit (US$/ha)
Kabode – cleaned up	12.9	43.4	2,322	177	2,145	831
Polista – cleaned up	9.7	24.7	1,746	177	1,569	255
Polista – farmers' own	7.3	0.0	1,314	86	1,228	

It is important to ensure that planting materials are disease free. Tissue culture can be used to produce large quantities of clean planting materials. The plantlets from tissue culture can then be hardened-off and grown in screen houses to produce a large quantity of disease-free planting materials for use in variety trials and for dissemination to the trained farmer vine multipliers, who will produce sufficient quantities of clean planting materials for the direct beneficiary households.

Since the performance of the varieties is affected by agroecological situations, there is a need for farmers and their agricultural services providing partners such as extensionists, NGOs and researchers to test the varieties on farms so that they can select those that perform well in their specific locations and meet their intended use plans. This should be done with a representative range of farmers, including both men and women, as some farmers might be more interested in varieties with market potential while others are keener on root or vine yield, or cooking qualities.

How to run on-farm participatory sweetpotato variety trials

To select OFSP varieties with characteristics that farmers and consumers value, these stakeholders need to be involved in the evaluation of varieties. In some locations farmers are involved very early in the breeding process, while in others they are involved in evaluating promising materials in on-farm trials, or what is known as participatory varietal selection.

On-farm participatory varietal selection for sweetpotato helps in testing the performance and acceptability of the varieties under farmers' growing conditions, building farmers' capacity to compare varieties or treatments and disseminating new varieties. The key steps for the participatory varietal selection for sweetpotato are shown below, and further details are available in the *Everything You Ever Wanted to Know about Sweetpotato* ToT manual.

Step 1: Situation analysis	•To learn about sweetpotato in the focal farming and livelihood systems (see 4.2 for the situation analysis process).
Step 2: Identify trial sites & partners	•If you do not have field agents in the location, you will need to identify local partners working in agriculture and nutrition such as NGOs, CBOs and extension agents. •Trial sites should include a range of agroecological and socioeconomic conditions.
Step 3: Identify farmers	•Identify the farmers or farmer groups you will work with. They should come from a representative range of agroecological zones and socioeconomic conditions, be willing to host the trial, be experienced sweetpotato farmers and be fairly easily accessible. It is helpful to sign a contract with them. •The farmers involved should be representative of those growing sweetpotato in the community in regard to gender, wealth etc.
Step 4: Planning trials with the farmers	•Meet to discuss the aims; activities, including trial design; necessary contributions from the farmers such as land, labour, equipment and management oversight, and from the researchers such as vines, field visits and training; and farmers' expectations •Agree on an action plan for what has to be done, by whom, where, how and when, throughout the planting, field testing, harvesting and postharvest periods. •Make sure the meeting is participatory and is held when and where women can attend.
Step 5: Planting the trial	•Do not test more than 8 varieties at a time. •Plot size: about 30 m^2 arranged in 5 rows 6 m long per candidate variety, with 1 m spacing between rows. Ridges should be at least 40 cm high, and the vines should be planted about 30 cm apart so that there are 100 cuttings per plot (see Figure 6 for a trial layout design).

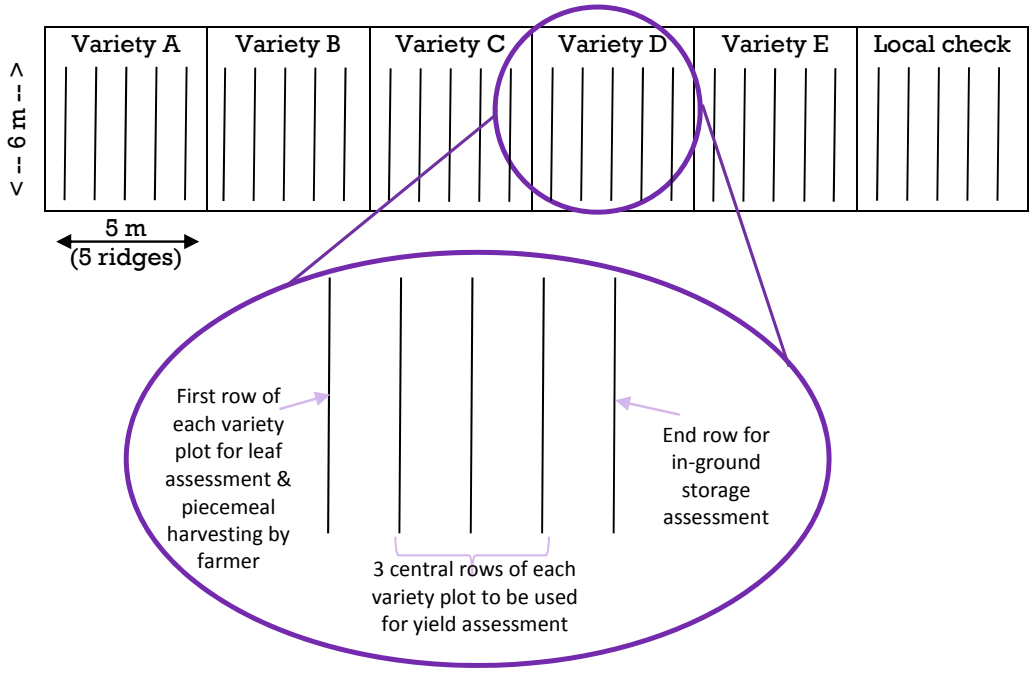


Figure 6 – Example of trial layout showing how the different rows can be used.

Step 6: Monitoring the trial

- Monitor the trial to check that the activities, e.g. planting, gap filling and weeding are done as planned, and to assess the general progress of the trial.
- Monitoring should be done collaboratively, and can be combined with data collection or evaluation visits.
- Keeping records is very important *(*see sample forms in Appendix 3.5 of the ToT manual and on the Sweetpotato Knowledge Portal).

Step 7: Evaluation of the trial

- A range of participatory evaluations can be done during the trial, including:
- Virus incidence assessment at the second weeding (about 6 weeks after planting);
- Leaf taste test evaluation (about 3 months after planting);
- Root quantity assessment (at harvest, which is about 3 to 5 months after planting);
- In-field whole-plant assessment (on various attributes, e.g. planting material production, pest and disease resistance, yielding ability, attractiveness of the root or flesh colour, overall appearance);
- Consumer acceptability assessment (of boiled roots):
- In-ground storability assessment (about 3 months after harvest time).
- (See the *Everything You Ever Wanted to Know about Sweetpotato* ToT manual (section 3.3) for full details and forms)

On-farm participatory trials can be used as variety (and crop husbandry) demonstration trials to promote new OFSP varieties among the wider community. It is important, therefore, that they be well labelled. Field days and other OFSP promotional events can be centred around the demonstration trials. The 'promoter' in each CNG can help organize, oversee and explain the demonstration trial. It is important that traders and vine multipliers, as well as different wealth and age groups of farmers, all be involved in the demonstration trials to maximize the functioning of their OFSP value chain.

Resource requirements

Activity	Year 1	Year 2	Year 3	Total (US$)
Importation of OFSP varieties*	2,650	0	0	**2,650**
Tissue culture plantlets and support	8,040	27,608	0	**35,648**
Demonstration trials	19,150	14,975	15,600	**49,725**
OFSP variety promotion field days and hand-outs	5,900	11,265	20,680	**37,845**
Total	**35,740**	**53,848**	**36,280**	**125,868**

*This budget is based on the importation of best-bet OFSP varieties from nearby countries as opposed to breeding of new varieties, which is a more costly and longer process. The decentralized vine multiplication activities are discussed and included in the budget for section 4.5.

NB: A detailed interactive Excel budget sheet is provided at http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides.

4.4 Strengthening the capacity of OFSP agents of change

Training of trainers on 'Everything You Ever Wanted to Know about Sweetpotato' course

The increasing interest in OFSP and its production led to growing demands for comprehensive training for development workers and farmers on all aspects of the OFSP enterprise.

Between 2011 and 2014, the RAC project supported the development of a 10-day, hands-on training of trainers' course and manual and the annual delivery of the course to build the capacity of public sector extension and NGO personnel to implement projects investing in promoting OFSP. This course recognizes that adults learn best through practical, hands-on experiences that are relevant to their lives, and by sharing and comparing observations with their peers. An overview of the course content is given in Table 8.

RAC's goal was to see *sustained* capacity for training of development workers who in turn would train others about the latest developments in sweetpotato production and utilization in each of the major SSA sub-regions of eastern and central Africa, southern Africa and West Africa. RAC worked with Sokoine University of Agriculture in Tanzania, the University of Eduardo Mondlane in Mozambique and the Agricultural and Rural Management Training Institute in Nigeria to assist them in hosting the 'Everything You Ever Wanted to Know about Sweetpotato' course. To date, 224 OFSP service providers or change agents have been trained on this course, and they have trained over 4,000 others. The goal is to reach as many farmers, traders and OFSP processors as possible. The contact details for the course are provided in section 4.13.

An OFSP investment programme requires knowledgeable, enthusiastic and well-trained field agents to work with each CNG. Where trained OFSP field agents are fortunate enough to be based close to the communities with whom they work, they can facilitate ongoing learning over time.

Good trainers are typically people whose great enthusiasm for and deep understanding of the subject shines through in their activities and who do not dominate the activities but make sure that participants themselves find something relevant about the topic instead of being just passive listeners.

It is recommended that OFSP investors select at least two enthusiastic staff to participate in the ToT course at one of the host centres in Tanzania, Mozambique or Nigeria. On returning to their communities, these trainers will train 12 field workers each on all aspects of the OFSP enterprise, and in this way will build a skilled cadre of committed field agents to work with the communities and other value chain actors to bring about transformation of the OFSP value chain.

Resource requirements

Activity	Year 1	Year 2	Year 3	Total (US$)
Sponsor 2 staff to attend the 'Everything You Ever Wanted to Know about Sweetpotato' ToT course	8,000	0	0	**8,000**
12 Everything You Ever Wanted to Know about OFSP manuals	840	0	0	**840**
Preparation and production of counselling cards and job cards	43,800	0	0	**43,800**
Training of 12 field officers, plus refresher training	13,000	4,017	4,139	**21,156**
Community leader sensitization & training in 11 communities	2,750	0	0	**2,750**
Total	**68,390**	**4,017**	**4,139**	**76,456**

Table 8 – Overview of the topics and intended learning outcomes of the 'Everything You Ever Wanted to Know about Sweetpotato' course

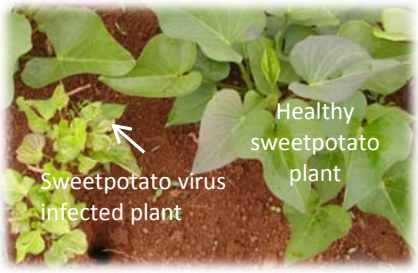
Day	Topics	Intended learning outcomes: Participants will:
1	• Expectations • Uses of sweetpotato • Gender and diversity and sweetpotato	• Understand the course programme • Know about the trends and challenges in sweetpotato production and use • Understand the relevance of gender issues in the different phases of the value chain • Be able to prepare two sweetpotato dishes
2	Different varieties of sweetpotato and their characteristics	• Understand key differences among sweetpotato varieties • Know key characteristics of three or more sweetpotato varieties suitable for their area • Be able to help farmers identify the key OFSP characteristics they want • Understand that varietal preferences differ among people • Be introduced to why care is important during sweetpotato harvesting • Know how to conduct a variety ranking test and a taste test
3	Nutrition and OFSP	• Understand what a balanced diet is and why it is important • Know how OFSP can contribute to reducing vitamin A deficiency • Be able to use local ingredients to make child-friendly, nutritious meals • Understand the importance of gender aspects in household nutrition
4	Selecting, preserving and multiplying sweetpotato planting materials	• Be able to identify, select and conserve clean sweetpotato planting materials • Know about the principles of positive and negative selection and preservation of sweetpotato planting materials • Understand how to calculate vine multiplication rates
5	Sweetpotato pests and diseases and their management	• Be able to find field examples of the key pests and diseases of sweetpotato and describe and show the damage each can cause • Know a range of practical techniques for managing key pests and diseases
6	Sweetpotato production and crop management	• Be able to help farmers set up a field experiment to compare different sweetpotato varieties or management practices • Understand the different stages of the sweetpotato crop cycle and the management requirements for each stage
7	Planning a planting material dissemination programme	• Understand all the key steps and bottlenecks in planning a mass multiplication or for a DVM approach dissemination exercise • Practise designing a dissemination programme to reach 5,000 households • Understand why it is important to monitor and evaluate activities • Practise monitoring the dissemination of planting materials
8	Harvesting, postharvest management, and processing	• Know about the main aspects of sweetpotato harvesting, postharvest management and processing • Understand how OFSP processing and storage affect the beta-carotene content • Understand the importance of involving different groups in sweetpotato processing training and awareness
9	Marketing and entrepreneurship	• Be familiar with the concepts of marketing and market orientation • Understand the five pillars of marketing • Understand the opportunities and challenges in sweetpotato marketing • Explore gender issues for the different stages of the value chain • Be familiar with how to select an appropriate processed product • Know how to calculate marketing margins for fresh roots and processed products
10	Planning to train others on 'Everything You Ever Wanted to Know about Sweetpotato' course	• Understand and will have developed the draft learning outcomes and approaches, training materials and draft logistics plans for the sweetpotato training courses they will be delivering • Be able to deliver a course on 'Everything You Ever Wanted to Know about Sweetpotato'




4.5 OFSP vine conservation, multiplication and dissemination

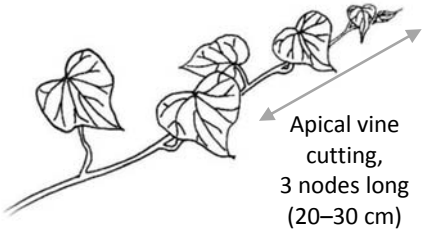
Selecting healthy planting materials

Farmers use vines as planting materials for sweetpotato; but sweetpotato vines can be infected with viruses or infested with insect pests, which will subsequently reduce yields, and if used as planting materials they will act as sources of infection or infestation in the newly planted crop. It is very important, therefore, that only clean planting materials be used.



Clean planting materials can be obtained by:

- Roguing out (removing) any plant showing virus symptoms such as stunting, chlorosis, misshapen or curled leaves, purple or yellow spots or rings on leaves, poor root production etc.;
- Using vines from plants that are less than four months old;
- Ensuring only the tips (the top 20–30 cm) of the vine of healthy looking plants are used as planting material. The tips recover easily from cutting and planting shock, establish faster than the lower parts of the vine and are more likely to be free of sweetpotato weevil or stemborer damage.



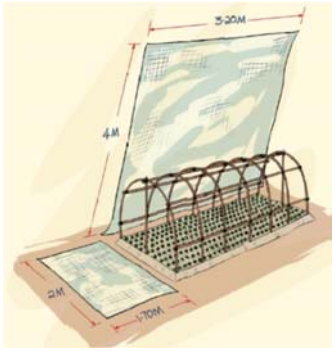
The selection of the top part (tips) of the vines from plants without visual symptoms of disease (especially virus disease) such as stunting, chlorosis or curled leaves helps reduce disease pressure. However, sometimes the virus becomes so pervasive within a variety or area that clean planting materials can be produced only through tissue culture.

Tissue culture

This a specialist process by which tiny pieces such as nodes or buds are cut from a sweetpotato plant that has been determined as virus free. These tiny pieces are surface sterilized and then grown into miniature sweetpotato plantlets in a nutrient medium in a tube. Nodes can be cut from these plantlets and used to produce more plantlets. To survive planting out in the field, the plantlets need to be carefully hardened-off and acclimatized in a lab and then in a nursery.

Tissue culture is beginning to be used widely for large-scale multiplication of clean planting materials. Tissue cultured sweetpotato plantlets are available from laboratories such as Genetic Technologies International Ltd (GTIL) in Nairobi, and cost about US$ 350 per 1,000 hardened plantlets, exclusive of transport and taxes.

Use of net tunnels



These structures can be used to keep planting materials clean and uninfected. They also help accelerate the production of planting materials. A net tunnel is similar in structure to a greenhouse but is covered with a fine net instead of plastic sheeting. The net prevents aphids or whiteflies, which spread sweetpotato viruses, from reaching the planting materials and infecting them with viruses. Net tunnels are fairly simple to construct. They require netting material, flexible wooden poles and binding twine, and cost about US$ 150 for a 3 m long x 1.8 m wide x 1.4 m high net tunnel. Details can be found in Appendix 5.2 of the ToT manual and on the Sweetpotato Knowledge Portal.

The better yields from the clean or virus-free planting material compared with the farmers' normal planting material will drive demand for clean planting materials.

Conserving planting materials through the dry season

Sweetpotato farming is typically rain fed, so there is need to preserve planting materials between seasons. This can be challenging in areas where the dry season is prolonged, causing the dying of sweetpotato vines due to lack of moisture, or they may be eaten up by livestock. In such cases farmers will not have access to sweetpotato planting materials from their previous field crop. The lack of clean planting materials at the onset of the rains is a major bottleneck for sweetpotato enterprises. Farmers can be trained in the following methods to address that constraint:

- **Dry season conservation of planting materials**. At harvest, healthy planting materials from the younger and middle parts of the vine are selected. They are then grown in swampy areas, around water points, under shade, or near homesteads, where they can be monitored and protected from livestock damage.

- **Dry season preservation of sweetpotato roots using the Triple S (storage, sand, sprouting) system**

At harvest, undamaged roots are selected and placed in a basin amongst layers of dry sand.

About 6–8 weeks before the rains are expected, the now sprouting roots are planted in a garden near the homestead and watered every few days.

The vigorous sprouting of the roots produces large amounts of planting material, which can be cut and planted as the rains start. Just 40 roots can generate about 1,500 cuttings.

Rapid multiplication of planting materials

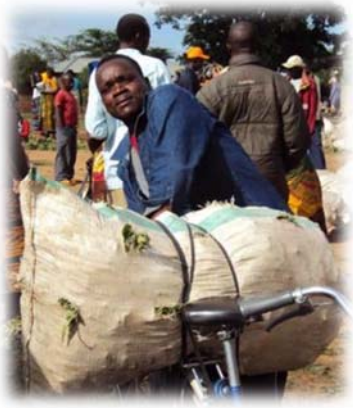
To rapidly increase the supply of planting materials, defoliated healthy cuttings of vines of three nodes in length (about 20 cm long) can be planted at a tight spacing of 50 cuttings per m^2, or 20 x 10 cm, in a fertile seedbed that can be easily watered and protected from livestock and intense sun. The resulting vines can be harvested after just six to eight weeks and a second yield a few weeks later. While the multiplication rate of sweetpotato differs by variety, 50 cuttings can typically produce 1,500–2,100 cuttings within a four-month period using this rapid multiplication method.

Use loose soil mixed with fertilizer, compost or decomposed farmyard manure to prepare the seedbeds, which should be raised about 20 cm above the ground level. If the land is sloping, site the seedbeds across the slopes to reduce damage from water run-off and erosion. Lightly irrigate the seedbeds before planting.

Plant the three-node long cuttings upright or slanting, at a spacing of 10 cm x 20 cm and with two nodes buried in the soil. Water the nursery bed in the early morning and late afternoon. If it is very hot, lightly shade the nursery seedbed.

Check the nursery bed regularly for diseased plants and rogue out any with virus symptoms. Also remove any weeds.

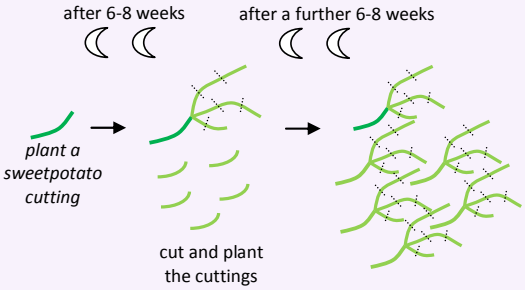
The first vine harvest can occur six to eight weeks after planting and should be undertaken during a cool part of the day. Cuttings three nodes long can be taken starting from the tips of the vines. Avoid taking cuttings from close to the base of the vine, as they are more likely to be infested with weevils. A second vine harvest can come a few weeks later. The first cuttings may be planted out in a rapid multiplication bed adjacent to the seedbed so that the quantity of planting material obtained after another six to eight weeks is amplified.



Cuttings should be kept in the shade and carefully packed in pierced sacks to allow air movement. Do not over-pack your cuttings or you will damage them. Label the sacks and bunches of cuttings clearly to help farmers identify the varieties they will be testing. The label should provide the name of the variety, contacts of the multiplier and the date of harvest. Ideally, the details of the variety's characteristics should be printed on the back of the label. Cuttings are often sold or distributed in lots of 200, which weighs about 4 kg. Cuttings should be transported carefully to avoid squashing or overheating. They should be transported soon after harvest using open trucks. Early morning and late afternoon are preferred times to help reduce rotting and drying out of the cuttings. The cuttings should be planted as soon as possible, which means logistics need to be in place beforehand to ensure that the recipients of the materials are given advance warning of the arrival date so that they prepare their fields in time. If a delay is likely before they are planted, the cuttings should be placed in the shade with their bases covered with a wet cloth, or in a shady trench with their bases buried in moist soil. Removing most of the leaves except those at the very tip also can help keep the cuttings viable.

To be able to determine how much planting material one can produce and to plan for it, it is important to know the multiplication rate of the variety you are dealing with. By keeping records of the number of cuttings you obtain from one square metre of each variety at each harvest, you can calculate the multiplication rate for a four-month period, i.e. two harvests (see Figure 7). Multiplication rates do vary by variety and are affected by temperature, agroecological factors and the management scheme. Proper fertilization can double vine multiplication rates.

1 sweetpotato cutting can produce 30–50 cuttings of 3 nodes length after 4 months (Note: This is based on the assumption that the cuttings will be harvested 6–8 weeks after planting, the harvested cuttings will then be planted, and finally both the initial and the second lot of cuttings will be harvested after a further 6–8 weeks. This means that there will be 2 cycles in 4 months).



If you start with 50 cuttings per square metre and you obtain 250–300 cuttings from that area after 2 months, and then you plant the new cuttings, you will obtain 1,500–2,100 cuttings 3 nodes long after 4 months from your now expanded area of 6–7 m^2.

Figure 7 – Explaining planting material multiplication rates.

Large-scale planting material dissemination approaches

To have significant impact on improving yields and incomes of small-scale farming households and reducing vitamin A deficiency, a large-scale planting material multiplication and dissemination strategy needs to be developed and used. This strategy will be context specific and needs to be carefully thought through. There is a wide range of options for both planting material multiplication and dissemination. One key decision is whether the dissemination strategy should use a 'single-shot' or an 'ongoing access' approach.

A 'single-shot' dissemination approach

- Is one-off distribution of planting materials to the target community for integration and subsequent maintence in their faming systems;
- Is often the approach chosen following an emergency or for the dissemination of a new variety;
- Can work well where the dry season is short and where the varieties being distributed have resistance to viruses;
- Usually it involves giving the planting materials to farmers at subsidized prices or for free.

An 'ongoing access' dissemination approach

- Involves annual or repeated distribution of planting materials to the target community;
- May be necessary in areas with a prolonged dry season and where access to planting materials is a constraint, or where the varieties being disseminated are susceptible to viruses, and a regular injection of clean planting materials can help maintain yields;
- May start out with distribution of highly subsidized planting materials and then gradually become more commercial as the varieties become better known by the beneficiaries and as locally based DVMs produce them.

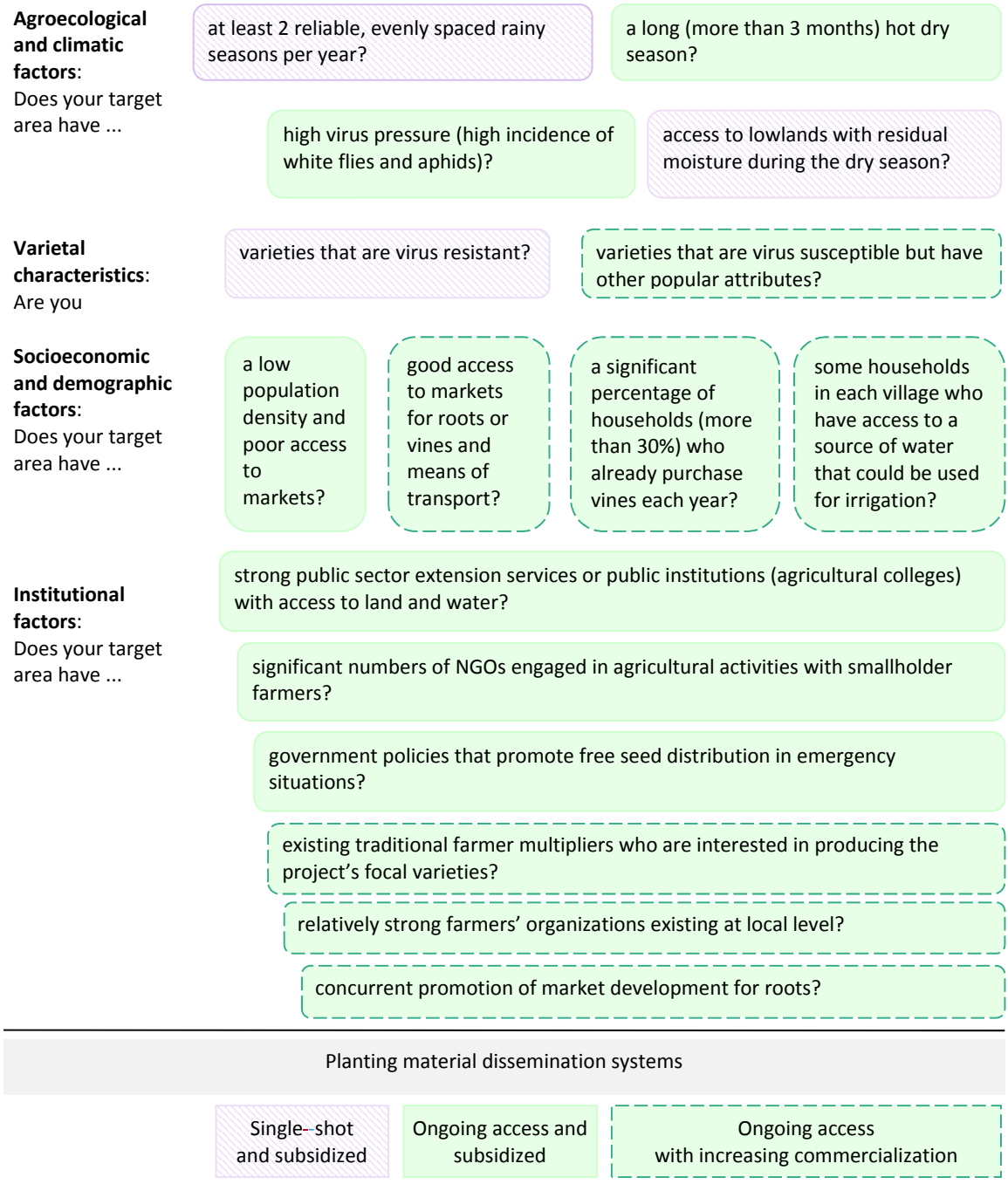
The key factors in deciding which planting material multiplication and dissemination strategies to use are the length of the dry season, farmers' access to land with residual moisture, virus pressure and virus resistance of the varieties to be promoted, population density, market access and demand, farmers' purchasing power, institutional capacity, and existing vine multipliers and farmers' organizations. A helpful decision framework is presented in Figure 8.

In addition to the planting material dissemination approach, investors also need to decide:

- How many and what type of beneficiaries they want to reach and in what locations;
- Which intermediaries to work with;
- What human and financial resources are required;
- Whether the long-term sustainability of the seed system is a priority.

Investors might wish to test different strategies to decide which to continue with or whether to use more than one of them. It is unlikely that a commercialized dissemination strategy will work at the outset, but it can be sustainably developed over time, with voucher-based targeted subsidies being used initially.

Wherever there is to be delivery of planting materials, there needs to be a well-organized system to ensure that the planting materials arrive when the farmers want them; the recipients are aware of the delivery time and are prepared to receive them with their land already prepared; and the planting materials are cut, packed, clearly labelled to prevent varietal mix-ups, and carefully transported without delays.



Note: For each key agroecological, varietal, socioeconomic or institutional factor, identify the boxes that best fit your situation and note their colour and border pattern. The purple/hash box indicates that a single-shot and subsidized dissemination approach would be possible. The green box indicates that an ongoing access dissemination approach would be more suitable, and the green boxes with a broken border suggest that an increasing degree of commercialization would be possible, aiming towards a self-sustaining sweetpotato seed dissemination system.

Figure 8 – Factors influencing the sweetpotato planting material dissemination strategy used.

Centralized or decentralized OFSP vine multiplication and dissemination?

Large quantities of sweetpotato planting materials can be produced using either a centralized mass multiplication (MM) and dissemination system or a number of trained DVMs.

Centralized mass multiplication	•Typically this is closely managed by researchers and usually has irrigation facilities to ensure that the planting materials are not wiped out during dry spells. •Requires strong logistical coordination among the recipients, the transporters, and the harvesters and packers to prevent the drying up and loss of viability of the planting materials or their arriving at locations where they were not expected.
Trained decentralized vine multipliers (DVMs)	•These are usually farmers with access to irrigation water who have received training to develop or boost their vine multiplication skills and knowledge or to increase the range of varieties they are producing. •Typically they provide planting materials to farmer group members. Their planting materials should be inspected before any are harvested to ensure that they are free of pests and diseases. •They will be able to continue to produce clean planting materials at the community level after the project has ended, so their operations need to become commercially viable as soon as is possible. •When used as demonstration plots where the new or cleaned-up varieties are grown, their plots become powerful visuals for raising awareness and demand amongst the local community. •Planting materials can remain in the ground until the recipients have prepared their fields and come to purchase or present their vouchers to collect them. •They need to be supported through providing farmers with clear information about where they are located and the varieties they produce, when the varieties will be ready for collection and what they will cost.

In Tanzania, DVMs were selected based on several criteria:

- Be resident in the target area and willing to produce and protect 750 m^2 of vines;
- Have prior experience with growing sweetpotato and have access to water during the dry season;
- Be recognized by the community as honest;
- Be able to read and write and be willing to keep records;
- Be easily accessible to the community and be located at least 10 km from any other DVM;
- Be willing to have a demonstration plot to compare the new varieties with the local varieties.

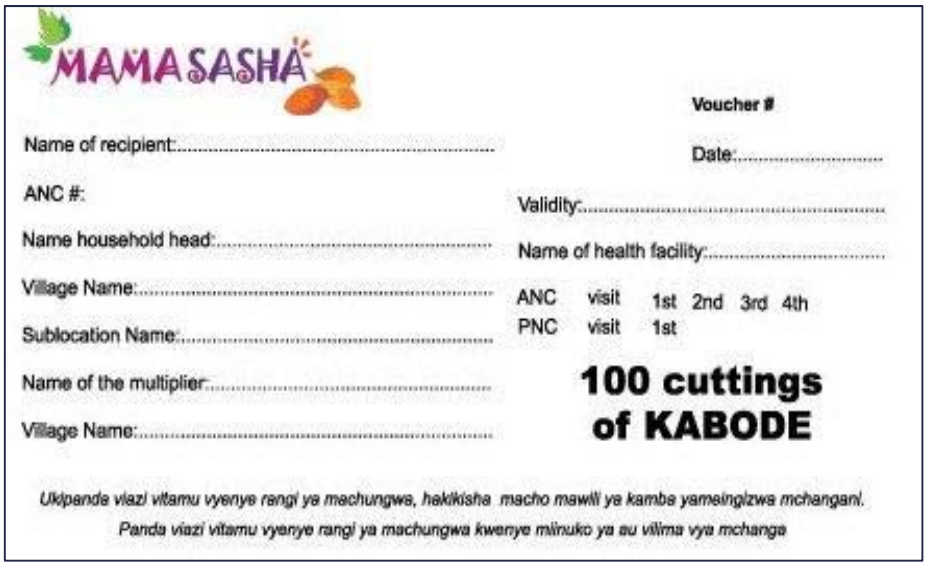
To ensure that women and poorer people are not excluded by these criteria, DVMs may include active farmer groups.

Seed systems are likely to be more sustainable if they are run commercially. However, for this to work, farmers need to be willing to pay for sweetpotato planting materials, which requires their valuing access to clean, high yielding planting materials of nutritious varieties. Farmers are more willing to pay when new sweetpotato varieties are being made available; sweetpotato is their main crop; there is a prolonged dry season; the nutritional benefits of sweetpotato, especially OFSP, are recognized; they are aware of the yield benefits of early planting and use of disease-free planting materials; and there is market demand for sweetpotato roots. Well-labelled demonstration plots can be influential in enabling local communities to monitor and evaluate the performance of new varieties in their own situation, and in raising awareness about the new varieties and disseminating them.

Investors need to understand how the sweetpotato seed system links to other parts of the value chain to help ensure that demand pulls quality materials out of the seed system, as opposed to their being pushed by the public sector, NGO actors or project-linked and unsustainable incentives. A seed system is affected by technical, social, financial and institutional factors (see Figure 9).

Figure 9 – Aspects of the enabling environment that influence scaling out of seed systems.

Voucher systems can be an effective tool for targeting specific beneficiaries at the start of the planting material dissemination initiative and for getting farmers to try new varieties. The voucher can be a simple printed form that entitles someone to receive planting materials either for free or at a subsidized price. Vouchers should be printed in several colours and have a special mark, which also can form part of an awareness campaign, so that they cannot be easily photocopied. More complicated vouchers can be used to collect information about the person receiving the planting materials, which can help in monitoring how that planting material is used by the recipient and how it performs. Voucher systems can be costly to run and need to be well organized. However, they can be very useful in targeting certain groups, such as women at health clinics, school children etc.



Advanced planning

Detailed, long-term advanced planning is required to ensure your planting material multiplication strategy produces sufficient planting materials in time for the onset of the rains. Find out when the sweetpotato farming activities typically occur and then work backwards from the planting date to determine when the multiplication and dissemination activities need to occur. Building up sufficient quantities of planting materials takes time, and for new varieties you might need to start at least seven months in advance of the dissemination period.

In addition to the planting date, you will need to know how many households you want to target, with how many cuttings and of which varieties; what the multiplication rates of the selected varieties are (note that these vary depending on the soil type, irrigation schedule, climate and field management); where virus-free planting materials can be obtained; whether you are going to use just centralized mass multiplication or also will have decentralized multiplication, and what the training and resource needs are; where the multiplication sites will be located; how well your funding is aligned with the agricultural calendar; and how much you would need to charge for the cuttings for your enterprise to be commercially viable.

For example, if you wish to target 10,000 households in November 2015 with 300 cuttings each of variety A, which has a multiplication rate of 15 in a 4-month period (e.g. for every 1 cutting planted, 15 can be harvested 4 months later), and you are starting with about 900 cuttings, the time frame for variety A in Table 9 would be relevant for you. However, if you also have another variety that you wish to distribute with a different multiplication rate (see variety B in Table 9) or you are starting with a much larger number of cuttings of one variety (see variety C in Table 9), you will need to do additional planning calculations and then incorporate them all into your work plan.

Table 9 – Example of multiplication calculations and timings for three varieties

	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	Oct 2015	Nov 2015
Target no. of households & timing													**10,000**
No. of cuttings of variety A *Variety A multiplication rate per 4 months*	900 *15*				13,500 *15*				202,500 *15*				3,037,500
No. of cuttings of variety B *Variety B Multiplication rate per 4 months*					1,875 *40*				75,000 *40*				3,000,000
No. of cuttings of variety C *Variety C multiplication rate per 4 months*					7,500 *20*				150,000 *20*				3,000,000

Once you have determined the time frame for producing the number of cuttings you require, you will need to decide whether you want a centralized or decentralized approach, and then you can determine how many farmer DVMs you will need to train and work with and what land size they will need to put under vine multiplication. Note that if vine multipliers wish to harvest roots as well as vines, they will need to plant cuttings at a wider spacing (e.g. 30 cm between plants and 1 m between ridges) than if they will harvest only vines.

If your OFSP investment programme is using a DVM approach, the planting material production plans in Table 10 will help you to reach 10,500 households directly and another 33,000 households indirectly within a three-year time frame. This planting material production plan can be used in an interactive way at http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides/. To use the plan effectively you will need to have the following information in advance:

- target number of households
- number of cuttings and varieties required per household
- number of multipliers (DVMs and CNG promoters) and size of their multiplication sites
- multiplication rates of the different varieties using the main multiplication methods

To maximize the impact of such planting material production activities, most projects require the direct beneficiary households that receive vines of the new OFSP varieties to subsequently provide cuttings from each of the varieties to about five other households each year. In this way the new varieties also will reach a much larger number of indirect beneficiary households, for example 10,000 direct beneficiary households plus 50,000 indirect beneficiary households. After two to three years, the DVMs will be well established and will be able to advertise their planting materials over the radio and to commercially supply them to the local community.

The suggested activities required are shown in the resource requirements section below. The training activities listed are necessary for vine conservation, multiplication and dissemination, as well as improved root production. They integrate with the training activities mentioned in the subsequent sections of this document.

Resource requirements

Reaching 43,000 households through decentralized vine multiplication

The following costs are based on the assumption that 10,500 households will be reached directly with 300 cuttings of two OFSP varieties, and a further 33,000 households will be reached indirectly using DVMs in a three-year OFSP investment programme. The training needs to be aligned with the agricultural calendar, and thorough advanced planning will be required to ensure that sufficient planting materials are available.

Activity	Year 1	Year 2	Year 3	Total (US$)
If required, partner identification for dissemination (travel costs)	3,000	0	0	**3,000**
Identification, contracting and training of DVMs	2,000	9,000	6,600	**17,600**
Provide and install irrigation equipment for DVMs (50% cost share)	1,000	4,500	0	**5,500**
Procure and establish 4 net tunnels, signs, labels and string per DVM	4,800	3,800	2,250	**10,850**
Train 4 QDPM inspection agents and 2 inspection visits/yr/DVM	3,440	3,520	3,520	**10,480**
Transport of vines from primary site to DVM and 6 monitoring visits	680	3,540	2,640	**6,860**
Community group promoters (CGP) identification and group formation	11,220	33,660	44,880	**89,760**
Establishing demonstration sites at CGP farms	8,800	26,400	35,200	**70,400**
Dissemination day for community nutrition group members	5,940	18,216	24,816	**48,972**
Dissemination day for marketing group members, and data entry	780	3,350	300	**4,430**
1 training visit to CNG and MG on quality planting material, virus detection, weevil management and planting	1,840	5,720	7,480	**15,040**
2 training visits to CNG on vine conservation and Triple S approach (incl. 2 basins/group and brochure for those in semi-arid areas)	4,178	12,664	16,885	**33,727**
Vine sharing ad promotion day for wider community	11,000	33,000	44,000	**88,000**
Certificates for CNGs and MGs completing sweetpotato training	1,320	3,960	5,280	**10,560**
Total	**59,998**	**161,330**	**193,851**	**415,179**

NB: A detailed interactive Excel budget sheet is provided at http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides/.

Brief step by step guide to using the planting material multiplication plan tool

1. The number of direct beneficiary households (HHs) is calculated by multiplying the number of extension agents by the number of community nutrition group (CNG) members as shown in Figure 3. For example, year 1 = 11 extensionists x 4 CNGs each with 30 members = 1,320 HHs.
2. If each HH is to receive 300 cuttings of 2 OFSP varieties = 1,320 x (300 x 2) = 792,000 cuttings.
3. If each of the 11 extension agents is supporting 1 DVM who has 2 net tunnels that are each planted with 360 cuttings, then 11 DVMs x (360 x 2) = 7,920 cuttings will be required – *these can be produced by a primary level seed multiplier such as a research station.*
4. If the varieties when grown in net tunnels have a multiplication rate (MR) of 8 within 2.5 months (2 vine harvests), then the 11 DVMs will be able to produce a total of 11 x (360 x 2 x 8) = 63,360 cuttings. With some losses catered for, this will result in about 62,568 cuttings being available after a production period of 2.5 months.
5. If these cuttings are then planted out in an open field using a rapid multiplication technique, and they have a multiplication rate of 15 within 4 months (2 vine harvests), then the 11 DVMs will be able to produce a total of 11 x (5,688 cuttings x 15) = 938,520 cuttings. With some losses taken into account, this will result in about 926,789 cuttings being made available after a further 4-months.
6. These calculation steps can be repeated for years 2 and 3. The DVMs will by then need 4 net tunnels each, and the year 1 CNGs will also be involved in multiplying the OFSP in their demonstration fields.

Table 10 – OFSP planting material multiplication plan for reaching 10,500 households in three years *(year 1 below and years 2 and 3 on subsequent page)*

			Year 1							
DEMAND	**Direct beneficiary households (HHs)**		**1,320** HHs							
	Total no. of cuttings required @300 cuttings of each variety/ HH:		**792,000** cuttings							
	No. of cuttings per variety per HH		300							
	of OFSP Variety A		396,000							
	of OFSP Variety B		396,000							
	Multiplier	**Method**	**Cuttings per unit**	**No. of units**	**Multiplication rate (MR)**	**No. of multipliers**	**No. cuttings harvested**	**Wastage factor**	**No. cuttings available**	**Time taken**
SUPPLY	**Research station (primary multiplier)**: will need to produce sufficient disease-free pathogen tested planting materials to supply the DVMs with clean cuttings for their net tunnels.	1,400 tissue cultured plantlets hardened off, and used to produce clean pre-basic seed cuttings in the screen house. These cuttings are used to supply the DVMs net tunnels							7,920	3.5 months
	DVM enterprise (secondary multipliers): Each DVM enterprise will have 2 net tunnels AND will also do open field RMT. Each extensionist supports 1 DVM enterprise, and there are 11 extensionists	2 net tunnels/ enterprise - 2 rattoons (each net tunnel is 1 unit).	360	2	8	11	63,360	0.0125	62,568	2.5 months
		RMT in open field using an initial area of 0.02ha and the cuttings produced in net tunnel, after first vine harvest they will plant them out and harvest them all 6-8 weeks later	5,688	1	15	11	938,520	0.0125	926,789	4 months
	Community nutrition group promoters (tertiary multipliers and demonstration site): Using conventional multiplication in open field	Conventional multiplication in open field using an area of 0.05ha/ CNG promoter at a plant density of 33,300 per ha	-	-	-	-	-	-	-	-
	No. of cuttings produced for CNG members in time for that year's planting								**926,789**	

NB: An Excel version of this OFSP planting material multiplication plan is available at http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides/.

			Year 2								Year 3							
DEMAND	Direct beneficiary households (HHs)		3,960 HHs								5,280 HHs							
	Total no. of cuttings required @300 cuttings of each variety/ HH:		**2,376,000** cuttings								**3,168,000** cuttings							
	No. of cuttings per variety per HH		300								300							
	of OFSP Variety A		1,188,000								1,584,000							
	of OFSP Variety B		1,188,000								1,584,000							
	Multiplier	**Method**	**Cuttings per unit**	**No. of units**	**Multiplication rate (MR)**	**No. of multipliers**	**No. cuttings harvested**	**Wastage factor**	**No. cuttings available**	**Time taken**	**Cuttings per unit**	**No. of units**	**Multiplication rate (MR)**	**No. of multipliers**	**No. cuttings**	**Wastage factor**	**No. cuttings**	**Time taken**
SUPPLY	**Research station (primary multiplier)**: will need to produce sufficient disease-free pathogen tested planting materials to supply the DVMs with clean cuttings for their net tunnels.	Tissue cultured plantlets hardened off, and used to produce clean pre-basic seed cuttings in the screen house. These cuttings are used to supply the DVMs net tunnels							15,840	4 months							15,840	4 months
	DVM enterprise (secondary multipliers): Each DVM enterprise will have 2 net tunnels AND will also do open field RMT. Each extensionist supports 1 DVM enterprise, and there are 11 extensionists	4 net tunnels/ enterprise - 2 rattoons (each net tunnel is 1 unit).	360	4	8	11	126,720	0.0125	125,136	2.5 months	360	4	8	11	126,720	0.0125	125,136	2.5 months
		RMT in open field using an initial area of 0.02ha and the cuttings produced in net tunnel, after first vine harvest they will plant them out and harvest them all 6-8 weeks later	11,376	1	15	11	1,877,040	0.0125	1,853,577	4 months	11,376	1	15	11	1,877,040	0.0125	1,853,577	4 months
	Community nutrition group promoters (tertiary multipliers and demonstration site): Using conventional multiplication in open field	Conventional multiplication in open field using an area of 0.05ha/ CNG promoter at a plant density of 33,300 per ha	1,720	1	7	44	529,760	0	523,138	3 months	1,685	1	6	132	1,334,520	0	1,317,839	3 months
	No. of cuttings produced for CNG members in time for that years planting								**2,376,715**								**3,171,416**	

4.6 Improving sweetpotato production and postharvest management

To optimize investments made at various points in the sweetpotato value chain by reducing constraints and maximizing yields and income earning opportunities, farmers need to be skilled in sweetpotato crop management. This requires training service providers and farmers on the appropriate farming practices such as those described below.

- **Conserving and multiplying healthy vines**: Sufficient quantities of disease-free sweetpotato vines are needed for planting at the onset of the rains. This is the most critical step to getting sweetpotato production moving (see section 4.5).

- **Land preparation**:
  - Sweetpotato does best in deep moderately fertile, sandy loam soils, although it can grow in many types of soil.
  - Sweetpotato is usually grown on mounds or ridges to ensure adequate drainage and soil aeration are provided.
  - Mound and ridge preparation are labour intensive, but oxen can be used to produce ridges. Where there are labour shortages, sweetpotato can be planted on flat beds, although this results in lower yields.
  - Farmers rarely apply fertilizer to their sweetpotato crop but it often benefits from residual farmyard manure, compost, ash or fertilizer applied to crops it is rotated with such as maize.
  - New sweetpotato fields should be separated from recently harvested or existing fields to help prevent cross-infestation from weevils and/or viruses.
  - Sweetpotato does well when rotated with cereals or legumes, but should not follow root and tuber crops such as cassava, since their nutrient requirements are similar. Crop rotation and fallows help reduce the build-up of pests and diseases.
  - Gender awareness is required in land-use control and decision-making, and both men and women should be consulted prior to setting up sweetpotato field activities.

- **Planting**:
  - Planting sweetpotato cuttings on mounds and ridges ensures adequate drainage and makes harvesting easier, especially if it is done in a piecemeal fashion.
  - Vine cuttings 3–5 nodes long (about 20–30 cm) should be planted at a spacing of 25 cm between plants and 60–100 cm between ridges, or 3 vines per mound. This spacing allows about 33,300 cuttings/ha.
  - Close spacing results in smaller root sizes.
  - The cuttings should be placed in holes along the top of the ridge, either upright or at a slant, with at least two nodes buried under the soil and the vine tip left above ground. The soil around the cutting should then be pushed down so that there is contact between the nodes and the soil. Use just one cutting per planting hole. Gaps when cuttings fail to establish can be filled later.
  - Planting should be done during the cooler parts of the day, preferably late afternoon.
  - In areas with a short rainy season, sweetpotato should be planted as early as possible. Many farmers prefer to stagger the planting of their sweetpotato crop to ensure a longer supply of fresh roots and to avoid a glut at harvest; to spread the risk of crop failure from dry spells; and to spread the planting material and labour needs over a longer period. However, sweetpotato planted late in the season may be exposed to very dry conditions that might result in high weevil damage, as the soil cracks and exposes the roots.

- **Intercropping**: Intercropping is often used where land pressure is high and labour for constructing ridges is limited. The intercropping design (crop types, spacing and timing) should minimize the competition for light and nutrients between the two or more crops. Farmers intercrop pigeon pea, maize, beans, soybeans, peas, cassava, sugarcane or fast-growing agroforestry trees and shrubs with sweetpotato.

- **Weeding and hilling up**: As with all crops, a sweetpotato crop will not do well in plots infested with weeds. Weeds may compete for light, nutrients and water, and so they should be removed and fed to livestock or used as mulch or for making compost. Many farmers regularly lift the maturing vines off the soil to prevent them from forming roots where they touch moist soil. Soil should also be heaped up around the base of the plant (hilling up) to fill the cracks caused by the expanding storage roots to protect the roots from exposure to the sun or weevils. This is often done in combination with weeding and with piecemeal harvesting.

- **Virus management**: The two main sweetpotato viruses are transmitted by either aphids or whiteflies. These insects cannot fly very far so they tend to spread the viruses to plants that are close to one another.
- If planting materials are infected with viruses, they may be transported very long distances and that way the virus can be spread widely.
- Symptoms from virus attack include plant stunting, chlorosis, misshapen leaves and reduced root yield. Virus disease risk and damage can be reduced by:
  - Always using planting materials cut from healthy looking plants;
  - Removing and burning or feeding to livestock any diseased plants as soon as they appear;
  - Planting sweetpotato varieties that are resistant to viruses;
  - Avoiding planting a new sweetpotato crop where you grew sweetpotato the previous season;
  - Planting your new sweetpotato crop away from old sweetpotato crops.

- **Weevil management**: The sweetpotato weevil (*Cylas* sp.) is the main pest of sweetpotato. The weevil lays eggs inside the vines or exposed roots. On hatching, the larvae feed and tunnel through the vine or root, creating tunnels that give the root a bitter taste and reduce its market value. To reduce losses from weevils, farmers should integrate into their farming system pest-management methods such as the following:
  - Hilling up the soil around the roots so that weevils cannot access the roots via cracks;
  - Sanitizing the field, i.e. removing and destroying any old vines or roots;
  - Using clean planting materials from the tips of vines;
  - Harvesting the roots before the soil becomes so dry that it cracks, providing easy entry for weevils;
  - Rotating crops so that there is no continuous source of food for weevils;
  - Separating sweetpotato plots using barrier crops or space to reduce weevil transmission;
  - Encouraging predatory natural enemies such as ants, earwigs, ground beetles and spiders to move through the crop;
  - Mulching to reduce soil cracking;
  - Flooding the field after harvest for at least 48 hours to drown all the weevils in the soil.

- **Harvesting:** Some sweetpotato varieties may be ready for harvesting within three months of planting, but others may take up to eight months. Piecemeal harvesting describes the process whereby a few roots on a plant are dug up and cooked or sold while the rest of the roots are re-covered and left to get larger. This is common with sweetpotato and is a way of providing the household with options for food and small-scale marketing. By growing several different varieties and staggering their planting dates, farmers can harvest the sweetpotato crop over a long period. However, during the prolonged dry seasons found in many parts of SSA, there will still be long periods when no fresh sweetpotato roots can be harvested. If left in the ground for long, sweetpotato roots typically get heavily attacked by weevils. Harvesting is typically done manually with a sharp stick or a hoe. Surface wounds can reduce the value of the roots and expose them to disease. Women generally do the harvesting of sweetpotato for household consumption needs. Men and hired labourers are involved when large quantities are being harvested for marketing.

- **Storage of fresh sweetpotato**: If fresh sweetpotato roots are available outside the main harvest season they will fetch much better market prices. However, few acceptable methods exist for storing fresh sweetpotato roots. Traditionally, some communities store mounds of fresh sweetpotato roots in pits or piles lined with grass and/or ash and covered with soil. Only top quality roots must be stored, as damaged roots spread disease or pests to the other stored roots. Research is going on on storage of fresh roots between layers of sand as is a done in the Triple S system, on the use of evaporative or low energy cooled structures, and on the effect of storage on the beta-carotene content.

- **Storage of dried sweetpotato**: Sweetpotato roots can be sliced, sun-dried and stored as food stock for use later in stews or porridges or for sale in local markets. Processing of OFSP can reduce the beta-carotene levels, but this loss will be minimized if the pieces are turned regularly, are dried in a thin layer of less than 4 kg/m^2, are protected from rain and are not over-dried. Beta-carotene losses occur also during storage. To reduce this loss, storage should be limited to just two months and the product should be stored in a cool room and in closed/opaque containers and, ideally, vacuum packed. As with all dried commodities, sacks containing sweetpotato should be stored off the ground, protected from moisture and regularly monitored for pest attack or rotting.

Resource requirements

Activity	Year 1	Year 2	Year 3	Total (US$)
2 training visits to CNG demonstrating in-ground skin toughening, careful harvesting and fresh root storage, plus poster (NB: other crop management training is included in an earlier budget)	3,586	10,758	14,344	**28,688**

NB: A detailed interactive Excel budget sheet is provided at http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides/.

4.7 Promoting OFSP to improve health and wealth

Why promote OFSP

Regular consumption of OFSP can reduce vitamin A deficiency. Production of OFSP can provide small-scale farmers with new income earning opportunities, and processors of all scales can incorporate OFSP into popular food and beverage products to make them more nutritious.

The promotion of OFSP also provides an important public good, as it increases the nutritional awareness of the whole population about the need for dietary diversity and for consumption of different foods – which can include a wide range of the many indigenous, nutrient-dense fruits and vegetables – in order to meet our multitude of nutrient requirements. Raising nutritional awareness, together with OFSP fresh root and product promotion campaigns, can play an important role in increasing consumer demand for OFSP and other nutritious food crops.

Micronutrient deficiencies such as vitamin A deficiency are very hard to detect and often go unrecognized until they become severe. This hidden hunger aspect of these deficiencies makes it extremely difficult to raise consumer awareness or concern or promote behaviour change targeting them. However, it can be done. Following an OFSP promotion campaign in Mozambique, three quarters of sweetpotato consumers said they preferred OFSP to white-fleshed sweetpotato. Further, OFSP promotion activities over two years in Uganda and Mozambique led to increases in consumption of the variety of at least 66% among women and children.

With 43 million children under the age of five years in SSA and large numbers of older children and adults, particularly pregnant women, suffering from vitamin A deficiency, we have a responsibility to address this deficiency through the promotion of sustainable, food-based approaches that highlight the importance of dietary diversity and the need to increase the range of food crops people produce and consume, while incorporating OFSP.

How to promote OFSP

Step 1: Understand the existing nutritional knowledge and behaviours and the farming and business systems	•When promoting OFSP, the target group will include food processors (who can substitute OFSP puree or flour for wheat or other ingredients), traders and different types of farmers. Intermediaries could include extension, health and NGO workers, the media, local leaders, school teachers, traders and processors. •A thorough situation analysis (see section 4.2) will explore the target communities' farming systems, the role of sweetpotato in their household food and income generation, and the nutritional information pathways and practices used by different groups.
Step 2: Create awareness about the importance of vitamin A	•Building on the target groups' existing nutrition understanding and use of various information pathways, different strategies can be developed and rolled out to raise awareness on the importance of vitamin A and on the high vitamin A content in foods such as OFSP, pumpkin, pawpaw, mango, carrot, liver and milk.
Step 3: Design and implement behaviour-change strategies for the different target groups	•The behaviour change strategies might focus on any or a mix of topics, including improving young children's feeding practices, diversifying household diets, improving marketing chains for sweetpotato roots and/or leaves and products, substituting OFSP puree for wheat flour in a number of processed food products sold, and farmer training on OFSP production, utilization and marketing. •Tailored promotional messages and approaches for creating demand for OFSP and other vitamin A rich foods can then be crafted, tested and refined. •Different messages and approaches will be required for the different target groups. •Several promotional approaches can be used to reinforce key messages. It is important to monitor the success of the different approaches and to re-develop them as necessary.

Examples of effective OFSP promotion activities

- Radio/TV programmes or jingles, billboards, community theatre, songs with sticking messages that last, posters and promotional materials on vitamin A and OFSP production and use;
- Use of the orange colour for brand images, for example for market stalls selling OFSP, OFSP product labels, variety demonstration plots, product tasting event items, and trained OFSP extension staff outfits;
- Slogans painted on vehicles, caps, T-shirts and wraps worn by women;
- Stakeholder meetings with local leaders or health service professionals;
- Group nutrition sessions, cooking demonstrations and counselling sessions with parents of malnourished children;
- Demonstration plots, field days, practical farmer training courses and advertising campaigns providing access to new OFSP products and planting materials but at subsidized prices;
- Information sessions for traders and processors on the nutritional value of OFSP and ways it can be used in popular dishes and processed products;
- Integration of OFSP information, planting material vouchers and food-based nutrition training into child health day events when vitamin A capsules are being distributed. This can help promote more sustainable nutritional behaviour for the whole family, all of whom require vitamin A, along with other micronutrients, as part of a healthy diet;
- Training tools/aids for extensionists and community health workers or promoters.

Resource requirements

Activity	Year 1	Year 2	Year 3	Total (US$)
Radio/TV programmes, theatre or song: design and translation for advertising dissemination days	1,200	3,300	3,300	**7,800**
Design and production of banners and extensionists' T-shirts	1,298	1,000	770	**3,068**
Painting and decorating vehicles and motorcycles	5,900	0	0	**5,900**
Painting and decorating market stalls	0	8,800	0	**8,800**
Attending 2 agricultural fairs or other promotion events/yr	1,000	1,000	1,000	**3,000**
Producing promotional cloth (kitenge or capulanas) to sell at cost	35,000	0	0	**35,000**
Total	**44,398**	**14,100**	**5,070**	**63,568**

4.8 Nutrition education for behaviour change

Eating a balanced diet

Our choice of foods is dependent on the food taste, availability, affordability and convenience, and our culture, socioeconomic status and level of hunger. To stay healthy we need to eat a mixture of foods of appropriate quantity, quality and combination. Our bodies need foods that give us energy, promote growth, repair tissues, store energy and protect us from diseases (see Figure 10).

Vitamins and minerals are needed in only small amounts and are therefore called micronutrients. But micronutrients play vital functions in the body and are essential for normal metabolism, growth and physical well-being. Nutritional requirements, including those for vitamin A, vary by age, sex, health status and the load of work we perform.

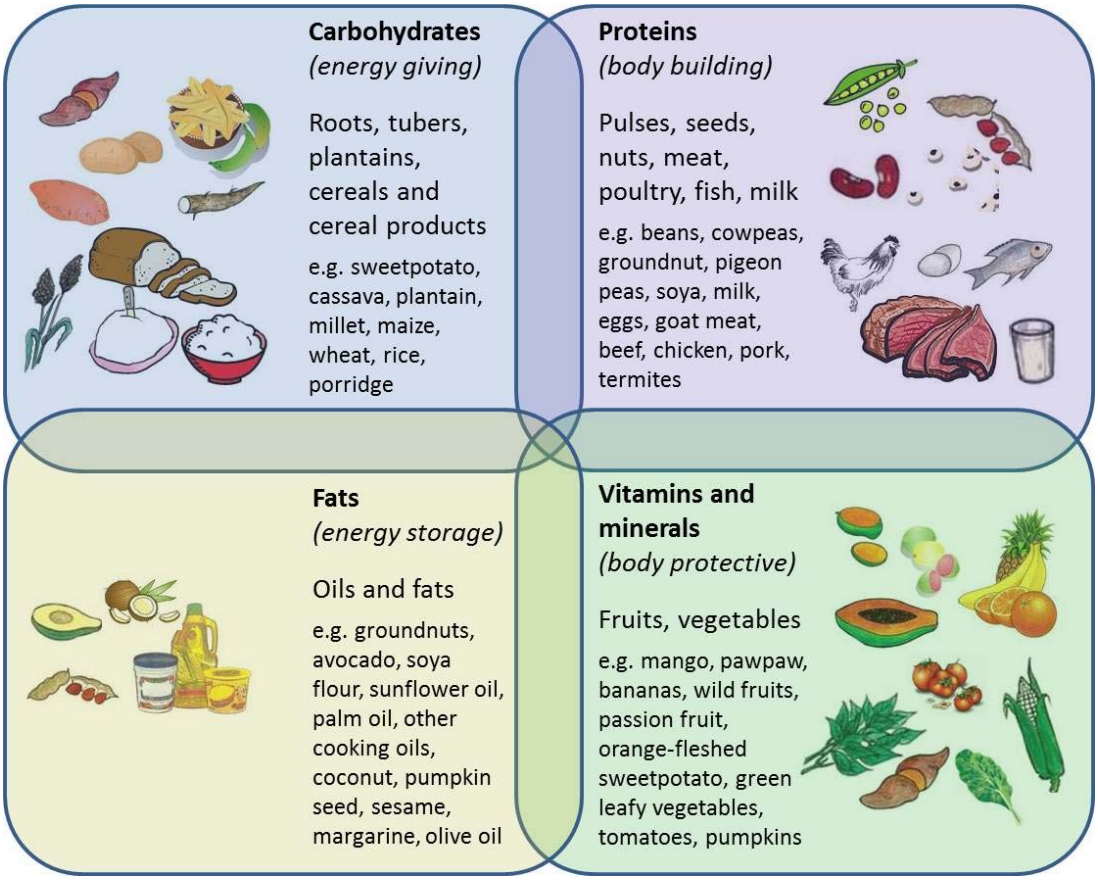


Figure 10 – Examples of foods that are good sources of nutrients.

Malnutrition and micronutrient deficiency or hidden hunger

Economic growth and human development require well-nourished populations that can learn new skills, think critically and contribute to their communities. If we do not consume a diverse and balanced diet or if we are unwell we can suffer from malnutrition and deficiencies in macronutrients or micronutrients.

Some 35% of African children under five years of age are chronically malnourished and stunted. Nearly half of all deaths among children aged under five years are attributable to undernutrition. Every US$ 1 invested in nutrition returns US$ 30 in increased health, schooling and productivity.

Micronutrient deficiency refers to a lack of vitamins and/or minerals. Deficiencies in micronutrients such as vitamin A, iron, iodine, zinc and folate are detrimental to growth, immunity and overall health. Micronutrient deficiencies are referred to as hidden hunger because often they present no visible warning signs and people affected by them may not be aware of the deficiency. But they have disastrous consequences.

The consistency of a food type has implications for its nutrient density, which is the amount of micronutrients in a particular food in relation to its total energy and in relation to the body's requirements. A cup of thick porridge will have more nutrients than a cup of thin, watery porridge. The combination of the ingredients used to make a particular food also will determine the nutrient content. High nutrient density meals are particularly important for groups of people who typically eat small portions such as young children, the elderly and people who are ill.

Vitamin A

Vitamin A is needed by our bodies in small amounts for growth and normal functioning of the immune, visual and reproductive systems. Vitamin A deficiency is one of the most pernicious forms of undernourishment. It reduces immunity to disease, resulting in higher rates of disease-related death, increased burdening of the already stretched health care systems and indirect costs related to lost productivity and lost economic development, as workers are weakened by this hidden hunger. Young children, as well as pregnant or lactating women, are at a particularly high risk of vitamin A deficiency due to their need for micronutrients to support their rapid growth.

Vitamin A deficiency can be addressed in different and complementary ways: through taking supplementary capsules, eating fortified foods and adopting long-term, sustainable, food-based approaches where locally produced foods rich in vitamin A are actively consumed as part of a balanced and diverse diet. The benefits and shortcomings of each of these approaches are described in section 1, and highlight the need for an integrated approach to addressing vitamin A deficiency.

Vitamin A is found in some fruits and vegetables such as OFSP, pumpkin, pawpaw, mangoes, carrots, red pepper, red palm oil, fruits of the African locust tree, butternut squash, spinach and amaranth leaves, breadfruit and pumpkin leaves (see Table 11). Typically the deeper the colour of the fruit, vegetable or root, the higher the concentration of vitamin A. Besides the plant sources, there are some rich animal vitamin A sources including liver, whole milk, egg yolks, fish and fish oils, as well as some artificially vitamin A fortified products such as margarine and oil. In order to maximize the benefit from vitamin A rich foods, it is important to eat them together with fats, which help the body absorb and use the vitamin.

If incorporated into the diet, OFSP can eliminate vitamin A deficiency in children and adults. The OFSP root can be boiled or roasted and eaten or mashed into puree for use in a range of products including breads, chapatis, cakes, juices, porridge etc. (see 4.10 for OFSP recipes). Just one medium-size root or a handful (150 g) of OFSP pieces will meet a child's daily needs for vitamin A. In most of SSA, a field area of 500 m^2 of OFSP can provide enough vitamin A each year for a family of five. The roots can also be cut into small pieces, sun-dried and stored as an important food stock, although care needs to be taken to maintain the beta-carotene levels. In addition to providing vitamin A and energy, OFSP roots have high levels of vitamins C and E, several B vitamins, iron, zinc, potassium and fibre. Its good levels of fibre mean that OFSP has a moderate glycaemic index. It also is gluten free. Across SSA, OFSP is one of the cheapest sources of vitamin A.

Table 11 – Nutrient content of 100 g edible portions of vitamin A rich foods

Food	Water	Energy_Kcal	Protein	Lipid_Total	Carbohydrate	Fibre_TD	Calcium	Iron	Magnesium	Phosphorus	Potassium	Zinc	Vitamin C	Thiamine	Riboflavin	Niacin	Vitamin B6	Folate_Total	Vitamin A (RAE)	Vitamin K
Unit	gm	kcal	gm	gm	gm	gm	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	ug	ug	ug
Pumpkin, raw	91.6	26	1.0	0.1	6.5	0.5	21	0.8	12	44	340	0.32	9	0.05	0.11	0.6	0.06	16	369	1.1
Squash, cooked	91.1	30	1.5	0.4	6.5	2.9	10	0.3	13	14	214	0.1	6.5	0.04	0.03	0.3	0.10	10	200	
Yellow fleshed SP, cooked	80.1	76	1.4	0.1	17.7	2.5	27	0.7	18	32	230	0.2	12.8	0.06	0.05	0.5	0.17	6	162	2.1
OFSP, cooked	80.1	76	1.4	0.1	17.7	2.5	27	0.7	18	32	230	0.2	12.8	0.06	0.05	0.5	0.17	6	788	2.1
Carrots, cooked	90.2	35	0.8	0.2	8.2	3	30	0.3	10	30	235	0.2	3.6	0.07	0.04	0.6	0.15	2	845	14
Amaranthus leaf, cooked	91.5	21	2.1	0.2	4.1		209	2.3	55	72	641	0.88	41.1	0.02	0.13	0.6	0.18	57	139	
Pumpkin leaves, cooked	92.5	21	2.7	0.2	3.4	2.7	43	3.2	38	79	438	0.2	1	0.07	0.14	0.8	0.20	25	80	108
SP leaves, cooked	88.7	34	2.3	0.3	7.3	1.9	24	0.6	61	60	477	0.26	1.5	0.11	0.27	1.0	0.16	49	46	109
Mango, raw	81.7	65	0.5	0.3	17.0	1.8	10	0.1	9	11	156	0.04	27.7	0.06	0.06	0.6	0.13	14	38	4.2
Papaya, raw	88.8	39	0.6	0.1	9.8	1.8	24	0.1	10	5	257	0.07	61.8	0.03	0.03	0.3	0.02	38	55	2.6
Milk, whole fat	88.3	60	3.2	3.3	4.5	0	101	0.0	10	84	133	0.38	0	0.04	0.18	0.1	0.04	5	28	0.2
Egg, hard boiled	74.6	155	12.6	10.6	1.1	0	50	1.2	10	172	126	1.05	0	0.07	0.51	0.1	0.12	44	169	0.3
Chicken, stewed	53.1	285	26.9	18.9	0.0	0	13	1.4	20	180	182	1.77	0	0.09	0.24	5.8	0.25	5	39	
Lamb liver, cooked	56.7	220	30.6	8.8	2.5	0	8	8.3	22	420	221	7.89	4	0.23	4.03	12.2	0.49	73	7491	

OFSP = orange-fleshed sweetpotato, SP = sweetpotato
Source: USDA, 2003

Nutritional behaviour change

The consumption of OFSP roots and other vitamin A rich foods can reduce the high levels of vitamin A deficiency across SSA. However, for this to happen, investments are needed to raise nutritional awareness and understanding and bring about behaviour change that sees people eating a diverse and balanced diet as opposed to one predominantly composed of just starchy carbohydrates.

Nutritional awareness raising approaches will need to be adapted for specific consumer groups, whether they are grandmothers, traders, food processors, male or female farmers, teenagers, local leaders, school teachers, school cooks etc., and to build on and integrate the target populations' nutritional beliefs and food systems.

The promotion of solutions to micronutrient malnutrition is particularly challenging because micronutrient deficiencies are often hard to detect and can go unnoticed until the deficiency is severe. If people do not realize they have a problem, they will be less likely to take up the behaviours promoted as solutions to that problem. Therefore, there is a need to start with creating demand for vitamin A rich foods as part of a focus on improved nutrition.

Creating awareness about:

- the importance of a diverse and **balanced diet** and the different food groups
- the **importance of vitamin A**
- the **high vitamin A content in OFSP**, pawpaw, mango, carrots, spinach, liver, egg yolk, milk

The activities might include antenatal nutrition sessions; radio or TV programmes; community info-seminars, posters, drama performance; and primary and secondary school level modules on the importance of vitamin A for all age groups; the need for a balanced diet and the main food groups; the value of OFSP and how to grow it; good children's feeding practices; and other foods rich in vitamin A.

Designing and implementing programmes that will **enable actual nutritional behaviour change**, typically relating to:

- improving **young children's feeding practices**
- **diversifying the overall diet** at the household level
- improving **marketing chains** for OFSP roots, leaves and products

These might include:

- Stakeholder meetings with community leaders and health service personnel to discuss key campaign messages;
- Group nutrition sessions led by trained extension or community health workers with various community members, including those who influence nutritional behaviour such as fathers, grandmothers, school cooks, traders and local leaders, as opposed to just mothers;
- Cooking demonstrations with an emphasis on utilizing locally available foods and integrating OFSP varieties;
- One-to-one counselling sessions with mothers of malnourished children;
- Integrating OFSP into national infant and young children's feeding guidelines, as well as national nutrition guidelines;
- OFSP demonstration plots and farmer training days;
- Advertising campaigns that subsidize access to OFSP planting materials and OFSP products

Resource requirements

Activity	Year 1	Year 2	Year 3	Total (US$)
Local nurses working on mother & child nutrition – 1 day workshop	4,500	4,500	0	**9,000**
Community nutrition group training (CNG) on vitamin A rich foods – ½ day	1,760	5,280	7,040	**14,080**
CNG training on balanced diet and diet diversification – ½ day	1,760	5,280	7,040	**14,080**
CNG training on nutrition during pregnancy, breastfeeding and young children's feeding principles – ½ day	1,760	5,280	7,040	**14,080**
CNG training on young children's feeding including cooking demo – ½ day	2,640	7,920	10,560	**21,120**
Total	**12,420**	**28,260**	**31,680**	**72,360**

NB: A detailed interactive Excel budget sheet is provided at http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides/.

4.9 Strengthening OFSP marketing

Fresh root marketing

Fresh sweetpotato roots are traded in urban markets most of the year. Given the highly seasonal nature of the crop, traders achieve this by sequentially purchasing fresh roots from different geographical areas to create a fairly continuous year-round supply.

The bulkiness of the sweetpotato roots, their short shelf life and their relatively low profitability are responsible for the short supply chains. Large-scale wholesale traders move sweetpotato in trucks and often have agents in the field who locate the sweetpotato and make sure it is bulked up in a convenient location before the truck arrives. Small-scale traders move sweetpotato by bicycle, motorbike or public transport. In many SSA countries retailing of sweetpotato roots in the market and interaction with customers are mainly done by women, while the men travel to rural areas to obtain the roots.

Where road and market linkages are limited, farmers perceive fresh sweetpotato root marketing as problematic. Markets are often far away, meaning that transport costs will be high, given the bulky nature of the crop, and that farmers are often forced to take whatever farm-gate price the sole trader buying from their area will offer. Rural markets typically are oversupplied during the harvest season, resulting in gluts and large price variations. The cost implications and tax requirements for transporters and urban markets in East Africa force sweetpotato handlers to jam them into large extended bags that are difficult to carry, which results in bruising and damaging of a lot of the roots they contain. This lowers the quality of the roots and shortens their shelf life.

Farmers usually rely on traders or neighbours for market price information, although the use of mobile phones for this is increasing. Sweetpotato market prices are rarely available at the national level.

Sweetpotato marketing investments typically will be found where the crop is consumed as a primary staple. The consumption levels for the crop are very high in Burundi and Rwanda, with per capita consumption of 80 kg per year. For Angola, Madagascar, Mozambique, Sierra Leone, Tanzania and Uganda per capita consumption is 35–70 kg, and for Cameroon, Ethiopia, Kenya, Guinea, Malawi, Mali, Nigeria and Zambia it is just 10–30 kg. But rapid urbanization, population growth, shrinking farm sizes, climate change and variable staple food prices are likely to drive increased consumption of sweetpotato across many SSA countries.

Rural consumers in Kenya were found to use the sweetpotato root size, colour, taste, skin texture, price, shape, fibre content, health and freshness as the main purchasing decision criteria. Medium and small roots are easier to cook, package and share amongst people. Urban consumers were more likely to choose sweetpotato roots based on the skin colour and area or region where they were grown, then size (preferring medium size), damage level, shape and freshness.

Transformation of the sweetpotato value chain could be brought about through:

- Successful promotion of the nutritional benefits of consuming OFSP;
- Use of processed OFSP products or sweetpotato as animal feed;
- Extending the period of the year when fresh sweetpotato roots are available;
- Improving relationships and trust among value chain players;
- Improving farmers' and traders' postharvest handling and marketing skills.

Market orientation: meeting the customers' needs

Given the diversity of markets across SSA, market improvement strategies will need to be context specific. Training traders about the nutritional benefits of OFSP and its potential as an important component in processed nutritious products can help to develop OFSP markets.

A value chain analysis will identify the weak links in the sweetpotato value chain and opportunities for strengthening them. Such an exercise typically involves analysing prices, volume data, operations and relations at each point in the value chain, taking into account the relevant cost factors such as labour, inputs, transportation, taxes etc. and returns on the produce marketed. This information is then used in scenarios where the volumes sold and prices realized from improvements in production yields, product quality, postharvest improvements, processing, market diversification etc. are increased. Following this, the opportunities for upgrading the activities and improving the returns at different points in the chain are studied, such as the use of clean seed, staggered planting dates, improved pest and disease management, postharvest handling, packaging, transport, storage, market information, farmers' marketing and logistics skills (including group marketing and aggregation), product diversification, linkage to processors, nutrition awareness creation, and service providers' capacity.

Marketing OFSP processed products

Many of the marketing constraints for OFSP fresh roots are relevant also for processed OFSP products' value chains. But those intending to market processed OFSP products in addition need to:

- Identify their target groups of customers;
- Find out about current and potential OFSP product opportunities for those target groups;
- Develop and test OFSP products, asking questions such as, Is it cost-effective to substitute some wheat flour with sweetpotato flour or puree? Do consumers like the appearance and taste?
- Develop relationships with other actors in the value chain;
- Determine the pricing, promotion and distribution methods for their OFSP products;
- Monitor the market to retain customers and to develop new products in response to customers' feedback and the competition environment.

A growing number of processed OFSP products are being marketed in SSA, including flour, bread loaves, biscuits, mandazi (doughnuts), crisps, chapatis, crackles and chips.

OFSP Golden Power Biscuits – Sales income of US$ 341,000 in one factory in 2 years

The key supply issues limiting OFSP processing include the unreliability of root supply; the high labour requirements to wash, peel and cut up the roots for chip making; the poor quality of dried chips associated with poor drying techniques; and organizational and market development constraints.

Some drying, storage and preparation techniques reduce the beta-carotene content in OFSP, which affects its nutritional value as a processed product. But if 25% or more of the wheat flour in a product is replaced with a medium- to dark-intensity OFSP in puree or flour form, the resulting product will have significant amounts of pro-vitamin A. In Rwanda, substitution of wheat flour with OFSP puree by a large-scale processor decreased production costs by 7–15%.

While a huge range of delicious processed products can be made from sweetpotato, it is important to carefully figure out which of these products makes commercial sense in your specific context and whether OFSP puree or flour should be used. It takes 4–5 kg of fresh roots to make 1 kg of sweetpotato flour and 1.25 kg of fresh roots to make 1 kg of puree, so it usually makes economic sense to use puree if a reliable source of fresh OFSP roots exists for most months.

Experience from Mozambique, Rwanda, Uganda and Kenya suggests that training efforts on processed products should focus on people already engaged in selling such products or in businesses like restaurants that serve the products. As these people integrate OFSP into their commercial products, demand for fresh roots and high yielding varieties will increase rapidly, helping OFSP farmers, many of whom are women, to earn better incomes from expanding OFSP root sales. Contact details of those involved in scaling up commercially marketed processed products through the SUSTAIN (scaling-up sweetpotato through agriculture and nutrition) initiative in these countries are given in 4.13.

Marketing sweetpotato superfoods in Rwanda

Recipes were developed and test-marketed for four OFSP products: biscuits, mandazi, bread and queen cakes.

Urwibutso (SINA) Enterprise then began purchasing OFSP roots from local farmers, most of whom were women, who had obtained high yielding, clean OFSP planting materials and crop management training from the project. The factory processed the roots into puree and produced biscuits and mandazi. Attractive packaging was developed for the popular Akarabo Golden Power Biscuits, in which OFSP puree replaced 43% of the wheat flour.

The products sold well, and in 2012/13 SINA Enterprises made factory sales of US$ 146,490 (gross) from the OFSP Golden Power Biscuits and mandazi. This increased to US$ 195,384 in 2013/14.

Resource requirements

Strengthening OFSP marketing

Activity	Year 1	Year 2	Year 3	Total (US$)
Rapid market assessment – value chain functioning/entry points	5,000	0	0	**5,000**
Price monitoring (weekly)	220	220	220	**660**
Training of extension staff on market assessment findings	9,000	0	0	**12,000**
Identification of traders (wholesale and retail) and 2 days' training	720	6,480	0	**7,200**
Market group (MG) formation – 3 visits	240	1,080	0	**1,320**
MG training on (1) sweetpotato marketing as a business, (2) enhancing yields to generate surplus, (3) group dynamics, negotiation, record keeping, (4) harvesting, grading & storage, and (5) designing promotion strategy	640	2,880	0	**3,520**
2 joint MG negotiations with traders (pre- and post-training)	2,000	9,900	0	**11,900**
MG promotion materials & events, including radio adverts	400	6,200	4,400	**11,000**
Supervisory visits	240	1,080	1,320	**2,640**
Total	**18,460**	**27,840**	**5,940**	**52,240**

4.10 Processing OFSP

How to process OFSP

OFSP roots are usually consumed cooked. Traditionally they are boiled, steamed or roasted. The roots may also be chipped into small pieces, sun-dried, stored and later milled into flour or rehydrated in a stew.

Boiling Steaming Roasting Drying

The leaves of OFSP can be used to prepare highly nutritious relishes.

In addition to its consumption as human food, sweetpotato is also used widely in many countries as animal feed. The wilted or dried vines may be chopped up and fed to goats, pigs, cows, chickens or rabbits. The roots are more typically fed to pigs and broilers, but it is best to dry or boil them before using them as animal feed. Unlike the vines, the roots do not have a high protein content so supplementation with fish meal or soybeans is usually needed. Some farmers chop up the roots and dry them as chips and cut and dry the vines as hay to preserve for feeding the animals later. The vines can also be fermented or made into silage.

How to retain beta-carotene content of OFSP during processing

Micronutrients such as beta-carotene, the precursor of vitamin A, can be lost during OFSP preparation by washing or destroyed by cooking, sun exposure or long-term storage (Figure 11). The processes that cause beta-carotene losses in OFSP roots, arranged from the least to the most detrimental, are roasting, boiling, frying, steaming and sun-drying.

Actions that help retain the beta-carotene content of OFSP during processing include:

- **Quick processing**: Do not over-boil, over-steam, over-roast or over-dry your OFSP.
- **Leaving the skin on during processing**: Remove the peel after cooking or drying.
- **Short storage period:** Dried OFSP starts to lose its beta-carotene after one month of storage. If dried OFSP needs to be stored, it should be kept in a cool and dry place and in opaque packaging so that sunlight does destroy the beta-carotene.

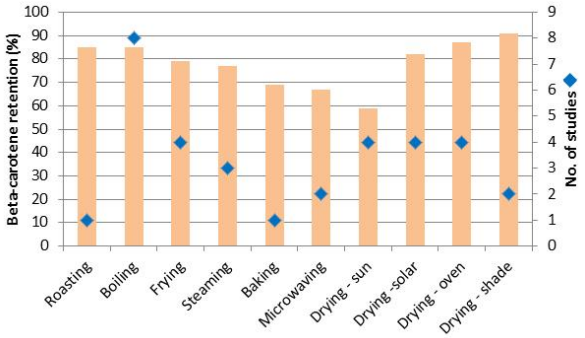


Figure 11 – Influence of different OFSP processing techniques on beta-carotene retention

Commercial value addition for OFSP

In addition to traditional preparation methods, there are multiple novel ways of preparing OFSP that increase its value. Three primary OFSP products can be used as ingredients for a range of popular value-added products.

Fresh, grated sweetpotato

Grate the fresh roots

Boiled and mashed sweetpotato often referred to as puree

Boil then mash fresh roots

Sweetpotato flour

Chip fresh roots, dry them and then mill them into flour. You can store the chips for at most 1 month if necessary.

These products can be incorporated into bread, mandazi, chapatis, cakes etc., replacing some of the wheat flour. Consuming just one OFSP chapati provides a child 100% of the daily vitamin A requirement.

OFSP can also be mixed with the flours of millet, cassava, roasted soybean, roasted maize or amaranthus and used to produce a nutritious porridge.

Mandazi from OFSP and wheat flours at a 30:70 ratio

Porridge from OFSP, soybean and maize flours at a 30:35:35 ratio

Chapati from OFSP and wheat flours at a 30:70 ratio

Relish made from sweetpotato leaves

It is more complex and time consuming to make sweetpotato flour than grated or pureed sweetpotato, and the beta-carotene can be more easily lost during flour preparation, particularly if the ingredients are stored for more than a month. But sweetpotato flour produces a lighter product that is easier to transport and store and that can be used easily to partially replace 25–50% of the wheat flour in many recipes. Use of sweetpotato puree, on the other hand, requires changing the proportions of the other ingredients. Most consumers prefer the taste and appearance of products containing sweetpotato puree over those with only wheat flour. Pastry products are being made commercially using sweetpotato puree to replace some of the wheat flour, with the puree making up to 30% for bread, up to 40% for mandazi and up to 45% for biscuits. Profit levels are determined by the relative costs of sweetpotato roots or flour to wheat flour and the degree of substitution. Most new products will require promotion to develop a market demand, and most processors will require packaging and marketing support for their OFSP products at first.

Consumer preference tests

Currently, the OFSP products with the most commercial potential being produced in SSA are:

- fried products such as chips, crisps, chapatis and doughnuts
- baked products such as breads and biscuits
- juice

In Rwanda, the sweetpotato Superfoods project has worked with large-scale processors to produce OFSP biscuits, mandazi, bread, queen cakes, juice and improved packaging. Replacing some of the wheat flour in the recipes with OFSP puree led to 15%, 12% and 7% decreases in the per unit production costs for doughnuts, biscuits and bread, respectively. The product development required a long lead time involving product, sensory and packaging tests, in addition to supporting the production end of the value chain. However, within just two years (2012–2014) one factory earned a gross income of US$ 341,000 from the sale of OFSP-based products. Two farmers' cooperatives producing OFSP mandazi were also developed.

Orange-fleshed sweetpotato biscuits and mandazi being produced in a factory in Rwanda, and nicely packaged sweetpotato products being promoted at a trade fair.

China and Japan are making many commercial sweetpotato products such as noodles, breakfast cereals, crackers, dumplings, crisps, candy, baby food and packaged boiled roots. In the USA, OFSP is regularly processed into ready to cook French fries (chips).

Breakfast cereal made from sweetpotato and cornflakes, sweetpotato crackers, snacks and French fries

Using OFSP to improve household nutrition

For rural households, emphasis should be put on including OFSP in the existing diet at least several times a week. Sweetpotato can be easily added to a stew or made into a really healthy sweetpotato and groundnut dish. Roasted or boiled OFSP roots should be promoted as a simple breakfast food or school snack for children, since it is much more nutritious and filling than bread. Boiled, fried or roasted sweetpotato can be incorporated into the household's weekly menu. Diversifying how it is prepared often increases its consumption. The young and tender leaves can be eaten as a vegetable, prepared in the same way most African leafy vegetables are. Better-off households can be encouraged to use sweetpotato in bakery products.

Sweetpotato can be one of the first complementary weaning foods infants receive at six months of age, helping to fill their small stomachs with a thick, nutritious porridge. Weaning porridges should be thick and should contain carbohydrates and fats for energy, vitamins and minerals as protective foods, and proteins for body building. OFSP provides both energy and vitamins, and children enjoy the naturally sweet flavour of OFSP and fruits.

Selected OFSP recipes

Sweetpotato mandazi

Ingredients

½ cup sweetpotato mash or sweetpotato flour (30%)
2 cups wheat flour (70%)
2 tablespoons sugar
A pinch of salt
2 cups cooking oil
1 tablespoon baking powder
Adequate lukewarm water

Procedure

1. Put the sweetpotato mash in a mixing bowl and sift in the dry ingredients.
2. Add water and mix into a dough.
3. Knead the dough well while adding 2 tablespoons of oil.
4. On a floured surface, roll the dough to about 1 cm thickness.
5. Cut the dough into desired sizes and shapes.
6. Deep fry the mandazi, turning them till they are golden brown.
7. Remove the mandazi from the oil, drain off the oil and serve them warm or cold.

Sweetpotato porridge

Ingredients

1 heaped tablespoon sweetpotato flour
4 heaped tablespoons millet, sorghum, cassava or maize flour
1 heaped tablespoon soya flour
1 small lemon
2 tablespoons sugar
6 cups water

Procedure

1. Bring 5 cups of water to boil.
2. Mix the cereal/root crop flours with the soya flour and make a paste with the remaining cup of water.
3. Pour the paste into the boiling water and keep stirring to prevent lumps forming.
4. Squeeze the juice of the lemon into a cup while the pot continues to boil for 20 minutes.
5. The cooked product should jell.
6. Remove from fire and add the lemon juice and sugar.
7. Cool, then serve warm. Milk can be added if desired.

Other popular porridge composite flour formulations are:

- Sweetpotato, maize, soybean (30:35:35)
- Sweetpotato, maize, amaranthus (30:35:35)
- Sweetpotato, maize,groundnut (25:50:25)
- Sweetpotato, millet, soybean (35:30:35)
- Sweetpotato, millet, amaranthus (35:30:35)
- Sweetpotato, millet, groundnut (30:40:30)
- Sweetpotato, soybean (50:50)

Chapati

Ingredients

1 cup grated, boiled and mashed sweetpotato or sweetpotato flour
2 cups wheat flour
1 cup soya flour
1 teaspoon salt
Adequate lukewarm water
½ cup oil

Procedure

1. Mix the dry ingredients together in a bowl.
2. Add the grated sweetpotato and mix.
3. Add 1 tablespoon of oil and mix well.
4. Add the lukewarm water to the mixture in the bowl and knead till a stiff smooth paste is formed.
5. Divide the dough into 8–10 equal balls.
6. On a lightly floured surface roll 1 ball at a time.
7. Fold each ball at a time to form a strip.
8. Coil each strip to form a circle and put aside for 20 minutes.
9. On a floured surface, roll out each coiled circle into a thin, circular sheet.
10. Grease a shallow frying pan.
11. Fry each circular sheet on both sides till golden brown, make sure both sides are greased.
12. The resulting chapati can be served with stew, sauce or tea.

Sweetpotato as animal feed

Sweetpotato is used as animal feed. The wilted vines may be chopped up and fed to goats, pigs, cows, chickens or rabbits. The roots are usually fed to pigs and broilers after being dried or boiled. The roots do not have as much protein content as the vines, so supplementation with fish meal or soybeans is usually done. Some farmers chop up the roots and dry them as chips while others cut up the vines and dry them as hay to preserve as animal feed. The vines can also be fermented or made into silage.

Vines are most commonly fed to livestock fresh during the harvest season, but they can also be dried into hay or made into silage for feed stock to be used later in the year.

When vines are produced for feed, the sweetpotato cuttings can be planted on flat fields at a spacing of 30–40 cm between plants and 40–50 cm between rows. Vines can be harvested 30–45 days after planting and every 15–25 days after that. The longest branches should be cut, leaving 10 cm for re-sprouting. It is easier to cut the vines into small pieces when freshly harvested than when they are dry. Fermented vines have a high protein content. Often vines are mixed with rice bran and salt and fermented for10 days before being fed to pigs.

Ensiling allows purchasing of vines during the harvest period when they are cheap and using them during times when feed is limited. Fermentation converts nitrogen into protein, increasing the nutritional value. Vines chopped into pieces 2–5 cm long can be covered with a layer of salt and placed in polythene bags or pressed firmly down into a tank or a pit lined with banana leaves or polythene sheeting and covered. Additives that supply carbohydrates such as sweetpotato roots, molasses or fresh sugarcane juice should be included, at rates of about 2–5 kg molasses or sugarcane juice per 100 kg of silage or 10–20% by weight of sweetpotato roots. Good quality sweetpotato vine silage will be brownish yellow and will have a pleasant aroma. If compacting is done well, it will take about one month to get good quality silage. Instructions for using an improved sweetpotato silage tube can be found on the Sweetpotato Knowledge Portal.

Roots are not yet as commonly used for feeding pigs in Africa as in Asia. Pigs will consume low value sweetpotato components and provide highly desired meat or other marketable commodities, while at the same time providing manure. The roots can also be used in feeds for broiler chickens and rabbits and could replace maize in many feeds. In China dry pellet feeds that have sweetpotato as the main ingredient are being developed.

The roots of some sweetpotato varieties contain chemicals that inhibit the digestive enzyme trypsin, which can negatively affect nutrient absorption. However, cooking or slicing and drying the sweetpotato roots before feeding them to animals solves this problem. Varieties with low moisture content or high dry matter content do not cause bloating in pigs. Roots, unlike vines, have very low levels of protein and so rice bran, fish meal, soybeans, sweetpotato or cassava leaves, or commercial protein supplements should be added to the root feed.

Resource requirements

Processing OFSP

As mentioned above, past projects have found that training of individuals already involved in food processing is more successful in the long term than training complete novices. Training a few local processors who already produce foods such as mandazi, as well as staff from one larger bakery, on how they could substitute OFSP for wheat flour in their products can help kick-start OFSP processing and fresh root demand. It will be necessary to support all these processors for some time to help establish the value chains such as those for product and packaging development and supplies, and to carry out consumer acceptance studies. It may be necessary to share the costs for the large-scale puree processing equipment.

Activity	Year 1	Year 2	Year 3	Total (US$)
Identify 3–5 local mandazi/snack makers, 1-day training on substituting wheat flour with OFSP, promotional signs and aprons	1,080	4,380	0	**5,460**
Identify 1 medium-size bakery interested in using OFSP, TA on products refinement & packaging, subsidize puree processing equipment	0	12,300	0	**12,300**
Consumer study to assess product acceptability	0	2,000	0	**2,000**
Nutritional analysis of products	0	800	0	**800**
Promotional materials and events	0	1,000	1,000	**2,000**
Total	**1,080**	**20,480**	**1,000**	**22,560**

4.11 Enhancing multisectoral collaboration

Whilst many of the OFSP investment opportunities highlighted in this guide might appear to be about promoting technological change, they all are embedded within a larger and complex system. For the sustainable and meaningful changes required to reduce the high vitamin A deficiency levels, the change processes need to be decentralized, participatory, multi-stakeholder and empowering.

Malnutrition is a complex and multifaceted problem, which a single organization is unlikely to be able to address. To reduce malnutrition, there needs to be increased interaction and collaboration between those in the health sector and other relevant actors (Figure 12). Multisectoral collaboration can include relationships among sectors at the same government level, among agencies at different government levels and among different types of stakeholders such as NGOs, the private sector and government ministries. Political commitment at the highest level of government can be hugely influential in increasing the success of multisectoral actions.

Effective collaboration requires partners wanting to work together on strategies they have jointly developed to reflect their needs, conditions and contexts. Inclusive processes with a strong focus on results and evidence-based decision-making are required. These entail a shared vision, institutional incentives and an understanding of how others gauge the costs and benefits of participation. It is unrealistic to imagine such collaboration can happen after a one-off workshop; it takes time to build the shared understanding, vision, strategy, personal relationships and trust to make it sustainable and functional. The management styles and approaches of the individuals involved play a large role in whether multisectoral processes are successful.

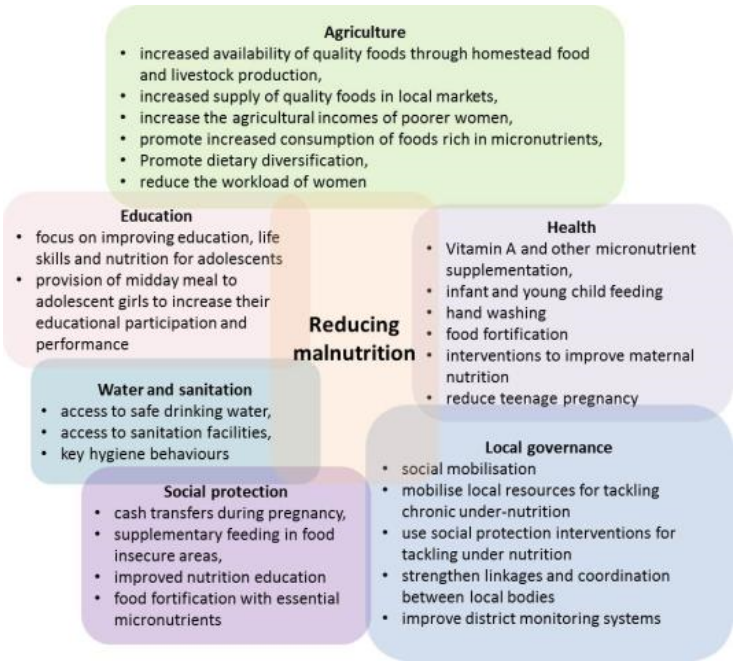


Figure 12 – Multisectoral roles in reducing malnutrition.

Given the diversity of farming environments and rates and types of changes occurring, there is a need to enhance localized innovation through collective learning approaches, as no single knowledge source is adequate in addressing malnutrition. While nutrition-*specific* interventions such as micronutrient supplementation and nutrition behaviour change packages can largely be scaled up through the health sector, nutrition-*sensitive* interventions require other approaches, as they are largely aimed at the underlying factors of causality, which are at the community or family level and are nearly all in the domain of non-health sectors.

Multisector plans often can be very broad and may propose too many measures and actions for each sector without a focus or prioritization, which can cause implementation problems down-stream. Strategic entry points should be identified and prioritized in each sector for real impact.

Resource requirements

Activity	Year 1	Year 2	Year 3	Total (US$)
Planning/sharing meeting (12 pers. x 3 days)	1,800	0	0	**1,800**
Implementation activities and visits	600	600	600	**1,800**
Lesson learning/refining workshop (12 pers. x 2 days)	0	0	1,200	**1,200**
Total	**2,400**	**600**	**1,800**	**4,800**

4.12 Monitoring, measuring and sharing the impact of your investment

To determine whether your OFSP investments are making a difference and to whom, in what ways, at what scale and over what time frame, you will need to monitor and evaluate your activities.

Monitoring, which is the systematic collection, analysis and use of information, will help you check whether or not your work schedules are proceeding according to your plans and assist you in documenting the processes. Evaluation will enable periodic assessment of the extent to which your investment has achieved its planned goals and objectives. As you design your OFSP investment plan, identify the logical linkages connecting your inputs, activities, outcomes, outputs and impacts (see Figure 13).

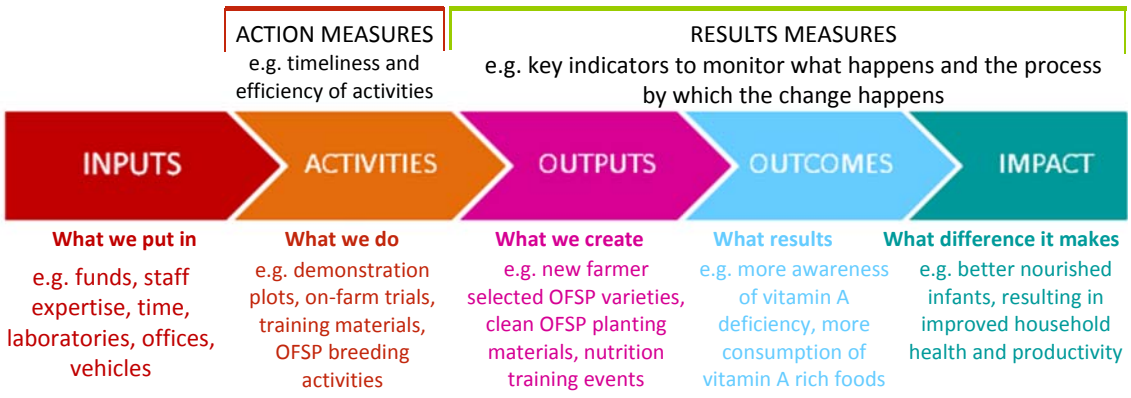


Figure 13 – Different aspects of an investment's logic which need monitoring and evaluating

Identify the information you will need to collect in order to prove that your investments have led to the anticipated impacts. Determine how you will obtain that information and who will collect, enter and analyse it.

What indicators can you identify that will enable you to measure the progress in achieving your investment plan's goals? These might include the number of households growing or obtaining OFSP and other kinds of sweetpotato, the area under OFSP crop, OFSP planting material sales, OFSP root sales, the number of extensionists and/or farmers trained on various aspects of OFSP, the frequency of consumption of OFSP and other vitamin A rich foods by young children, the understanding of the nutritional benefits of OFSP, and the vitamin A deficiency levels.

It is important to figure out how much it will cost to collect data for each indicator. It is better to collect good data on a few indicators than poor data on everything. It is often advisable to focus on a few key indicators; however, you need to recognize that changes affecting your indicators might be associated with other factors and not just your project's activities.

A wide range of M&E approaches, techniques and tools exist. These include combinations of recorded observations; review of diaries (written, oral or video versions), multi-stakeholder workshops; sample surveys; structured questionnaires; systematic review of official statistics; logic models; interviews; focus groups; case studies; and recording or analysis of important incidents. You may also be able to review existing reports, minutes and attendance registers or financial statements as sources of monitoring and evaluation data or as sources of evidence for their verification. These tools help you collect data on indicators.

Depending on the intended use of the information, you might decide that it would be more meaningful to collect quantitative (how much or how many) or qualitative (descriptive information, e.g. what people know or believe about something, how people feel about something, why and how things are done the way they are) data or a mixture of the two types. The project also needs to decide on the degree of beneficiary and partner participation and ownership in the M&E process that would be most meaningful.

It is useful to collect the information before and after the investment to be able to assess the change that has occurred. An example of a baseline survey form used to collect data prior to or at the start of an OFSP promotion project is presented in Appendix 12 of the ToT manual, and is available in Excel on the Sweetpotato Knowledge Portal under RAC ToT course. However, ongoing monitoring throughout the investment's life will enable you to see if it is going according to plan. It is important to incorporate review or reflection opportunities, as changes often need to be made to the initial plans.

Many monitoring forms and tools already exist for sweetpotato. Section 12.5 of the ToT manual and the Sweetpotato Knowledge Portal (under RAC ToT course) have examples of tools for monitoring the following:

- The dissemination of sweetpotato planting materials from a mass multiplication process (Tool 12.5.1 in ToT Manual)
- The dissemination of sweetpotato planting material from a voucher system (Form A), which provides for collection of details on who received the planting material vouchers, follow-up visits to verify whether the planting materials were planted (Form B) and whether the spread of the planting materials to other farmers or households has occurred (Form C) (Tool 12.5.2)
- The performance of disseminated planting material (Tool 12.5.3)
- The use of disseminated planting material (Tool 12.5.4)
- Who has received sweetpotato training and what they plan to do as a result of it (Tool 12.5.5)

Monitor to find out where the planting materials were planted, how they are performing and the ways in which they are being used by different members of the household

Resource requirements

Activity	Year 1	Year 2	Year 3	Total (US$)
Technical assistance and workshop to develop impact pathway and design M&E system with team	13,600	0	0	**13,600**
Training of partners in M&E systems	3,500	0	0	**3,500**
Fuel and per diem costs for manager and monitoring officer	20,640	20,640	20,640	**61,920**
Baseline study	30,000	0	0	**30,000**
Monthly staff review meetings & refresh training (2 d/m, 15 persons)	32,400	32,400	32,400	**97,200**
Mid-term gender review & stakeholder meetings at district level	0	8,000	0	**8,000**
End-line study	0	0	35,000	**35,000**
Technical support in M&E study analysis and writing up	9,000	0	9,375	**18,375**
Stakeholder dissemination meetings (at national & district levels)	0	0	10,000	**10,000**
Best practice briefs	0	1,000	2,000	**3,000**
Total	**109,140**	**62,040**	**109,415**	**280,595**

4.13 OFSP advisory services

If you have questions on the material in this *OFSP Investment Implementation Guide* that you would like to discuss with an OFSP specialist, contact the people in the list below.

	Investment questions	**ToT course on 'Everything You Ever Wanted to Know about Sweetpotato'**
Tanzania	Dr Nessie Luambano Sugarcane Research Institute, Sweetpotato Program – Kibaha Email: nluambano@yahoo.com Margaret Benjamin Helen Keller International (HKI) – Tanzania Email: mbenjamin@hki.org	Dr Anna Temu Dept of Agric. Economics and Agribusiness Sokoine University of Agriculture (SUA) Email: aatemu@gmail.com Dr Joyce Lyimo Macha, Associate Professor Institute of Continuing Education Sokoine University of Agriculture (SUA) Email: joylimac2@yahoo.com
Mozambique	Dr Maria Isabel Andrade CIP – Mozambique Email: M.andrade@cgiar.org Helen Keller International (HKI) – Mozambique Email: info@hki.org	Dr Angela Loforte Remane, Fac. of Agronomy and Forestry Engineering University of Eduardo Mondlane (UEM) Email: angelaloforte63@gmail.com Elias Munda CIP – Mozambique Email: e.munda@cgiar.org
Nigeria	Dr Jude Njoku National Root Crops Research Institute (NRCRI) Email: j.njoku@cgiar.org Dr Phorbee Olapeju CIP – Nigeria Email: o.phorbee@cgiar.org	Mr Anthony Njoku Agricultural and Rural Management Training Institute (ARMTI) Email: njokuzo@yahoo.com Dr Jude Njoku National Root Crops Research Institute Email: j.njoku@cgiar.org
Burkina Faso	Dr Koussao Some P.A. INERA – Kamboinse Email: koussao@hotmail.com Dr Ted Carey CIP – Ghana Email: e.carey@cgiar.org	Mr Son Adama Centre Agricole Polyvalent de Matourkou Bobo Dioulasso Email: adamason59@yahoo.fr Dr Ted Carey CIP – Ghana Email: e.carey@cgiar.org
Ghana	Dr Ted Carey CIP – Ghana Email: e.carey@cgiar.org Kwadwo Adofo CSIR-CRI – Ghana Email: kinfodda@yahoo.com	Victoria Tsekpo Ministry of Food and Agriculture (MOFA) Email: victsekpo@yahoo.com Dr Ted Carey CIP – Ghana Email: e.carey@cgiar.org
SSA region	Dr Jan Low International Potato Center (CIP) Email: j.low@cgiar.org Dr Simon Heck International Potato Center (CIP) Email: s.heck@cgiar.org Email: cip-nbo@cgiar.org	Dr Adiel Mbabu International Potato Center (CIP) Email: a.mbabu@cgiar.org Dr Hilda Munyua International Potato Center (CIP) Email: h.munyua@cgiar.org Email: cip-nbo@cgiar.org

In case of problems with the web links, please contact: Luka Wanjohi, CIP at L.Wanjohi@cgiar.org

5. CLOSING SUMMARY

Forty-three million children under the age of five in SSA are vitamin A deficient, as are large numbers of older children and adults, particularly pregnant women. Vitamin A deficiency reduces immunity to disease, resulting in higher rates of disease-related death, increased burdening of the already stretched health care systems and indirect costs related to lost productivity and lost economic development.

Vitamin A deficiency can be addressed in different and complementary ways: through taking supplementary capsules, eating fortified foods and adopting long-term, sustainable food-based approaches where locally produced foods rich in vitamin A are actively consumed as part of a balanced and diverse diet. However, each of these methods has shortcomings, which highlights the need for an integrated and holistic approach to addressing vitamin A deficiency.

If incorporated into the diet, OFSP varieties, with their high beta-carotene content, can help prevent vitamin A deficiency in children and adults. OFSP production also improves household food security and income-generating opportunities. The OFSP root can be boiled or roasted, or mashed into puree for use in a range of products, including breads, chapatis, cakes, juices, porridge etc. In most locations across SSA an area of just 500 m^2 of OFSP can provide enough vitamin A each year for a family of five.

This *OFSP Investment Implementation Guide* provides a brief overview of the reasons for investing in pro-poor, nutrition-sensitive agricultural growth and vitamin A deficiency reduction programmes such as the promotion of OFSP. A decision tool for identifying where the key investment opportunities exist along the OFSP value chain is presented. Each of these investment areas is then unpacked to provide background information as to why it is important and what activities can be successful in transforming it, including details on the human, financial and physical resources required to do so. This guide is targeted at those involved in the implementation of OFSP investment programmes such as local government or NGO field staff. We hope it will help guide and inspire those people. If you have further questions please contact the OFSP advisory services providers shown in section 4.13.

Two other OFSP investment products have also been developed: the *OFSP Investment Guide* to support national level technical experts through multi-stakeholder approaches to identify and attract investments and manage pro-poor, nutrition-sensitive OFSP investment programmes, and a brief *OFSP Investment Summary* for policy-makers and high level managers. They all are available at http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides/.

REFERENCES

AU. 2014. AU Assembly of the Union 23rd Ordinary Session, 26–27 June 2014, Malabo, Equatorial Guinea, Malabo declaration on Accelerated agricultural growth and transformation for shared prosperity and improved livelihoods – Doc Assembly/ AU/2(XXIII).

Berhanu, K. 2013. CAADP Ethiopia: a new start? *Futures Agricultures* 60:1–28.

Fan, S. 2014. Digging deeper – hunger, undernutrition and poverty linkages. IFPRI blogs (http://www.ifpri.org/blog/digging-deeper-hunger-undernutrition-and-poverty-linkages).

FAO. 2011. *The State of Food and Agriculture: Women in Agriculture, Closing the Gender Gap for Development*. FAO, Rome. 160 p. (http://www.fao.org/docrep/013/i2050e/i2050e.pdf).

FAO. 2012. Sustainable nutrition security: restoring the bridge between agriculture and health. FAO, Rome. 36 p.

FAO, IFAD, WFP. 2014. The state of food insecurity in the world: strengthening the enabling environment for food security and nutrition. FAO, Rome. 57 p.

FAOSTAT. 2014. (http://faostat3.fao.org/ home/index.html).

Farm Concern International. 2004. Orange fleshed sweetpotato promotional research: creating a suitable market environment for orange-fleshed sweetpotato and nutrient-rich baby foods. Farm Concern International, Nairobi. 38 p.

Federal Ministry of Health, Ethiopia et al. undated. The cost of hunger in Ethiopia: implications for growth and transformation of Ethiopia. AU/NEPAD/UNECA/WFP. 24 p.

Ferris, S., Robbins, P., Best, R., Seville, D., Buxton, A., Shriver, J., Wei, E. 2014. Linking smallholder farmers to markets and the implications for extension and advisory services. MEAS Brief 4. 10 p.

Golooba-Mutebi, F. 2014. Political economy of agricultural policy in Africa: has CAADP made a different? A Rwanda case study. *Futures Agricultures* 78:1–16.

Government of Nepal. 2012. Multi-sector nutritional plan: for accelerating the reduction of maternal and child under-nutrition in Nepal. Kathmandu, Nepal. 163 p.

HarvestPlus. 2012. Disseminating orange-fleshed sweetpotato: findings from a HarvestPlus project in Mozambique and Uganda. HarvestPlus, Washington, DC. 20 p.

Hoddinott, J., Rosegrant, M., Torero, M. 2012. Hunger and malnutrition: investments to reduce hunger and malnutrition. IFPRI, Washington, DC. 69 p.

Horton, S., Begin, F., Greig, A., Lakshman, A. 2008. Best practice paper: micronutrient supplements for child survival (vitamin a and zinc). Copenhagen Consensus Centre Working Paper, October 2008. 26 p.

IFPRI. 2011. Working multisectorally in nutrition: principles, practices, and case studies. In: Garret J., Natalicchio M., eds. Washington, DC, USA. 229 p.

Keding, G.B., Msuya, J.M., Maass, B.L., Krawinkel, M.B. 2012. Relating dietary diversity and food variety scores to vegetable production and socio-economic status of women in rural Tanzania. *Food Security* 4:129–140.

Kimenyi, M.S., Routman, B., Westbury, A. 2013. CAADP at 10: Progress towards agricultural prosperity. Africa Growth Initiative at Brookings. 21 p.

Lartey, A. 2013. Nutrition in Sub-Saharan Africa: Setting the stage for a post-2015 take-off. *IDS Bulletin* 44(5–6):49–54.

Low, J., Lynam, J., Lemaga, B., Crissman, C., Barker, I., Thiele, G., Namanda, S., Wheatley, C., Andrade, M. 2009. Chapter 16 Sweetpotato in Sub-Saharan Africa. In: Loebenstein, G., Thottappilly, G., eds. *The Sweetpotato*. Springer. pp 359–390.

Mason, J., Greiner, T., Shrimpton, R., Sanders, D., Yukich, J. 2014. Vitamin A policies need rethinking. *International Journal of Epidemiology*, doi: 10.1093/ije/dyu194

McEwan, M., Lusheshanija, D. et al. 2013. SASHA Marando Bora component. Report on second cycle of QDPM inspections: August and November 2012. CIP, Kenya.

Namanda, S., Mwanga, R., Mulumba, S. 2012. Performance of seven sweetpotato varieties in demonstration plots in the Lake Zone, northern Tanzania. CIP, Kampala. 6 p.

Pinstrup-Andersen, P. 2010. *The African Food System and its Interaction with Human Health and Nutrition.* Cornell University Press, New York. 357 p.

Rajendran, S., Afari-Sefa, V., Bekunda, M., Dominick, I., Lukumay, P.J. 2014. Does crop diversity contribute to dietary diversity? Evidence from integration of vegetables into maize-based farming systems in Tanzania. Discussion paper for presentation at the 88th Annual Conference of the Agricultural Economics Society, AgroParisTech, Paris. 18 p.

Rice, A., West, K., Black, R. 2004. Vitamin A deficiency. In: Ezzati, M., Lopez, A.D., Murray, C.J.L., eds. *Comparative Quantification of Health Risks, Global and Regional Burdens of Disease Attributable to Selected Major Risk Factors.* Geneva, WHO.

Robinson, E., Nyagaya, M., Benson, V. 2014. Ensuring that food fortification will reach the poor in Tanzania. IDS Policy Brief 72. 4 p.

Robinson, E., Temu, A., Waized, B., Ndyetabula, D., Humphrey, J., Henson, S. 2014. Policy options to enhance markets for nutrient-dense foods in Tanzania. IDS Evidence Report 90: Reducing Hunger and Undernutrition. 60 p.

SCF (Save the Children Fund). 2012. A life free from hunger: tackling child malnutrition. London, UK. 116 p.

Stathers, T., Low, J., Mwanga, R., Carey, T., David, S., Gibson, R., Namanda, S., et al. 2013. *Everything You Ever Wanted to Know About Sweetpotato: Reaching Agents of Change*. ToT Manual. CIP, Nairobi, Kenya. X, 390 p.

SUN (Scaling Up Nutrition), 2014. An introduction to the scaling up nutrition movement. 12 p. (http://scalingupnutrition.org/wp-content/uploads/2014/04/Orange_Internal_InOutline_ENG_20140415_web.pdf).

Thankurta, P.G., Chaturvedi, S. 2012. Food and nutrition justice: How to make is more newsworthy. *IDS Bulletin* 43:58–64.

Twaweza. 2010. Malnutrition: can Tanzania afford to ignore 43,000 dead children and Tshs 700 billion in lost incomes every year? 12 p.

UNICEF, 2014. Global child malnutrition datasets. (http://data.unicef.org/nutrition/malnutrition).

UNICEF/WHO/World Bank. 2012. Regional trends in child malnutrition prevalence. (http://dataviz.worldbank.org/t/DECDG/views/JointMalnutritionDataDashboard2/RegionalPrevalenceWHO/JuanFeng/UNView).

United Republic of Tanzania. undated. Creating an enabling agricultural policy environment: Tanzania. Brief No 1.Strategic investment priorities for agricultural growth and poverty reduction. Brief No 2. Financing agricultural sector development in Tanzania. Brief No 3. Achieving food and nutrition security in Tanzania. Brief No 4. Improving market access and value addition for sustainable agricultural development: Tanzania. Brief No 5.Institutional strengthening in the agricultural sector: Tanzania. Brief No 6.

USDA, 2003. USDA National Nutrient Database for Standard Reference, Release 16.

von Grebmber, K., Saltzman, A., Birol, E., Wiesman, D., Prasai, N., Yin, S., Yohannes, Y., Menon, P., Thompson, J., Sonntag, A. 2014. *2014 Global Hunger Index: The Challenge of Hidden Hunger.* Welt Hunger Hilfe, Bonn, IFPRI, Washington DC, Concern, Dublin, 56 p.

Weigand, C. 2011. Wheat import projections towards 2050. US Wheat Associates, USA. 14 pp

WHO. 2009. Global prevalence of vitamin A deficiency in populations at risk 1995–2005. WHO global database on Vitamin A deficiency. World Health Organization, Geneva. 68 p.

WHO. 2013. Global Database on child growth and malnutrition.

World Bank. 2010. *Scaling Up Nutrition: What Will it Cost?* Washington, DC. 136 p. (https://openknowledge.worldbank.org/handle/10986/2685).

World Bank. (undated). Nutrition at a glance – country profiles for Tanzania, Mozambique, Nigeria, Burkina Faso, Ghana.

World Bank. *World Development Indicators 2014.* Washington, DC. doi:10.1596/978-1-4648-0163-1.

Xiaoyun, L., Lixia, T., Xiuli, X., Gubo, Q., Haimin, W. 2013. What can Africa learn from China's experience in agricultural development? *IDS Bulletin* 44(4):31–41.

CENTRO INTERNACIONAL DE LA PAPA
CIP
A member of the CGIAR Consortium

The International Potato Center (known by its Spanish acronym CIP) is a research-for-development organization with a focus on potato, sweetpotato, and Andean roots and tubers. CIP is dedicated to delivering sustainable science-based solutions to the pressing world issues of hunger, poverty, gender equity, climate change and the preservation of our Earth's fragile biodiversity and natural resources.

www.cipotato.org

CGIAR
Science for a food-secure future

CIP is a member of CGIAR.
CGIAR is a global agriculture research partnership for a food-secure future. Its science is carried out by the 15 research centers who are members of the CGIAR Consortium in collaboration with hundreds of partner organizations.

www.cgiar.org