



# Orange-fleshed Sweetpotato (OFSP) INVESTMENT GUIDE



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## **Orange-fleshed Sweetpotato Investment Guide**

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## 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 the region 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 research 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 that are adequately resourced and are able to realize 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, 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 utilization of OFSP in SSA. Discussions with regional advocates and champions identified a strategic role that regional economic communities and their member states could play in promoting investments in OFSP through agriculture investment plans informed by the Comprehensive Africa Agriculture Development Programme (CAADP). However, potential investors often raised questions regarding what it would take to invest, how much to invest and how to invest in order to improve food and nutritional 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, which it presented to the RAC champions and advocates for comments. Later, RAC engaged a high calibre consultant to help repackage the information gathered and produce targeted investment guide products.

This package of investment guides comprises three products – an investment guide, an implementation guide and a summary (each with PowerPoint presentations 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 of starting investments from scratch. However, some countries may not need to invest in some of the steps costed in the guide such as human resources or any other element if they already have it in adequate levels.

This *OFSP Investment Guide* targets national level technical experts in public, private and development institutions, the *OFSP Investment Implementation Guide* targets those involved in the implementation of OFSP investment programmes such as local government or NGO field staff, while 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 financial support to combat vitamin A deficiency in SSA. The OFSP investment guide products are produced as part of the RAC project funded by the Bill & Melinda Gates Foundation.

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We 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 guides. 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 support. We also acknowledge the International Potato Center and Helen Keller International teams, comprising Robert Mwangi, Sindi Kirimi, Margaret McEwan, Ted Carey, Maria Andrade, Erna Abidin, Jessica Blakenship and Heather Katcher, for their suggestions, data, sharing their knowledge and 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 Secretariat of the Common Market for Eastern and Southern Africa (COMESA), Dr Nalishebo 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 investment in OFSP through agriculture investment plans informed by CAADP. 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 investment in OFSP in their agriculture development plans. It was realized that to pursue that agenda, RECs would need a toolkit to guide their efforts in engaging member states in discussions on the need to include OFSP in their agriculture investment plans.

We thank the RAC regional champions, whose suggestions during the regional champions and ambassadors' retreat in February 2014 highlighted the need to differentiate the products for the different target groups: investors, implementers and policy-makers.

We recognize 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 are a part of the RAC project. They would not have been produced without the generous support, guidance and encouragement of the Bill & Melinda Gates Foundation, to whom we are very grateful.

This investment guide product 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 Guide*. International Potato Center, Nairobi, Kenya. x, 39 p.

## CONTENTS

Acronyms and abbreviations .....	vi
Executive summary.....	vii
Why invest in orange-fleshed sweetpotato (OFSP)?.....	vii
Development goals, hidden hunger and OFSP .....	viii
1. Why invest in orange-fleshed sweetpotato?.....	1
2. Development goals, hidden hunger and OFSP.....	4
2.1 Opportunities for CAADP-informed national agriculture investment plans in reducing vitamin A deficiency .....	4
3. Decision points along the OFSP value chain.....	7
4. Unpacking investment opportunities along the OFSP value chain .....	9
4.1 Overview of an OFSP investment programme at scale.....	9
4.2 Understanding the role of sweetpotato in the food system .....	12
4.3 Availability of OFSP varieties .....	13
4.4 Strengthening the capacity of OFSP service providers .....	15
4.5 OFSP vine conservation, multiplication and dissemination.....	16
4.6 Improving sweetpotato production and postharvest management.....	22
4.7 Promoting OFSP to improve health and wealth .....	24
4.8 Nutrition education for behaviour change .....	26
4.9 Strengthening OFSP marketing .....	29
4.10 Processing OFSP .....	32
4.11 Enhancing multisectoral collaboration.....	34
4.12 Monitoring, measuring and sharing the impact of your investment.....	35
4.13 OFSP advisory services.....	36
5. Closing summary .....	37
References .....	38

## ACRONYMS AND ABBREVIATIONS

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

## EXECUTIVE SUMMARY

### Why invest in orange-fleshed sweetpotato (OFSP)?

Forty-three million children under the age of five across Sub-Saharan Africa (SSA) are vitamin A deficient, as are large numbers of older children and adults, particularly pregnant women. Vitamin A deficiency is one of the most damaging forms of undernourishment. It reduces immunity to disease, resulting in higher incidence of disease-related death, increased burdening of the already stretched health care systems, and indirect costs related to lost productivity and lost economic development. Undernourished children are at a high risk of impaired mental development, which will eventually adversely affect their country's productivity and growth, as such children will be less innovative or able to respond opportunities even as adults than their healthy counterparts. A poor diet and frequent infections lead to vitamin A deficiency. Those at a particularly high risk of vitamin A deficiency are young children, owing to their body's rapid growth, and pregnant or lactating women, who have special micronutrient requirements.



Vitamin A deficiency can be addressed in different and complementary ways: taking supplement 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. Each of these strategies has advantages and shortcomings, which highlights the need for an integrated approach to addressing vitamin A deficiency.

#### Options for addressing vitamin A deficiency

Vitamin A supplementation	Food fortification	Dietary diversification
<p>Provision of vitamin A capsules twice a year to children under five increases child survival and reduces child mortality by about 24%.</p> <p><i>However,</i></p> <ul style="list-style-type: none"> <li>• The benefits are short term and last two–three months.</li> <li>• Only the under-five's are targeted not the whole the population.</li> <li>• Vitamin A supplementation campaigns are largely donor dependent and may not be sustainable in the long term.</li> </ul>	<p>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.</p> <p><i>However:</i></p> <ul style="list-style-type: none"> <li>• Access to fortified foods may be limited by availability and purchasing power, particularly in rural areas.</li> <li>• Young children can eat only small quantities of the fortified foods, so this approach needs to be combined with other interventions.</li> </ul>	<p>Many vitamin A rich foods are available, such as OFSP, mangoes, pawpaw, pumpkin, dark green leafy vegetables, eggs, liver and milk.</p> <p><i>However:</i></p> <ul style="list-style-type: none"> <li>• There is inadequate awareness about the need for dietary diversity for optimal nutrition, and about vitamin A rich foods that are easy to produce, access and consume by all wealth groups and ages.</li> <li>• Current food crop systems often contain little variety.</li> <li>• Long-term investment in nutrition education is required.</li> <li>• Seasonality needs addressing through dietary advice and providing for food storage.</li> </ul>

Orange-fleshed sweetpotato (OFSP) is not only a high energy food but it also contains high levels of beta-carotene, which is converted into vitamin A in our bodies. OFSP is a healthy, delicious and affordable food that can be enjoyed in numerous forms. The roots can be eaten after boiling or roasting or mashed into a puree for use in a range of nutritious products including breads, chapatis, cakes, juices, porridge etc. Sweetpotato is a low input, low risk crop that is grown widely across SSA. Throughout history, it has played an important role in saving people from famine. Sweetpotato produces more biomass and nutrients per hectare than any other food crop in the world. In most locations across SSA, an area of just 500 m<sup>2</sup> of OFSP crop can provide enough vitamin A for a family of five each year. Across Africa, sweetpotato is grown mainly by women, and where market linkages are established it can enhance women's incomes, in addition to serving its nutritional and food security roles.



## Development goals, hidden hunger and OFSP

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 terms. 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.

One out of 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 individual and national levels through not only high child mortality and increased health care requirements but also reduced adult productivity and disease burden. Estimates suggest that 2–3% of the national income of a country can be lost to malnutrition. This for Tanzania, for example, equates to about US\$ 1 billion per year and for Nigeria to between US\$ 10 billion and US\$ 16 billion.

Most countries in SSA are actively promoting agricultural growth; however, it is essential to distinguish between a focus on increased agricultural production and a focus on improved 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 and to teaching those preparing food about the importance of a balanced, diverse diet and methods for retaining nutrients during food processing.

Many children in SSA have diets that consist almost entirely of starchy staple foods. Whilst they may get enough calories, these children miss out on sufficient variety in their diet that would give them enough protein and vital vitamins and minerals. Promoting an integrated and food-based approach to addressing malnutrition – including the ‘hidden hunger’ of micronutrient malnutrition – through the consumption of locally grown, nutrient-rich crops such as OFSP can help ensure sustainable and wide-reaching benefits. In addition to promoting consumption of such crops, crop husbandry, market infrastructure, agroprocessing and nutritional awareness can be strengthened to enable communities to produce higher yields of their nutrient-rich crops for food and nutrition security, sale and processing for value addition. Such pro-poor, nutrition-sensitive agricultural investments fit comfortably within frameworks such as the Comprehensive Africa Agriculture Development Programme (CAADP), as shown in Table 2 and Figure 3 of this guide.



## Investing in OFSP promotion to sustainably improve the food and nutrition security of over 40,000 households

Opportunities exist throughout the OFSP value chain for increased exploitation of this crop’s multifaceted potential. A decision tool has been developed to assist investors in identifying their investment opportunities (see section 3).

In this OFSP Investment guide we highlight the key investment areas along the OFSP value chain (sections 4.2–4.12), discussing the reasons that each area is important, the kinds of activities involved in transforming each area, and the resources involved in doing so. The resource requirements are based on an OFSP value chain investment programme designed to reach 10,500 beneficiary households directly, with an additional 33,000 households reached indirectly. The food and nutrition security of the direct beneficiary households will be achieved through practical agricultural and nutrition training, advocacy, high yielding OFSP planting materials, OFSP promotion, and development of sustainable seed systems to enable the communities to continue accessing disease-free, high yielding OFSP planting materials. In-built spillover activities will allow OFSP planting materials and nutritional information to reach 33,000 indirect beneficiary households within the three-year time span.

The main benefits to all these households will include improved food and nutrition 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 adding value to their OFSP roots or vines through processing. The OFSP investment programme deliberately builds the capacity of all those involved along the value chain so that the transformations continue beyond the initial three-year programme. A summary of the resources required for the programme is given in the Table below. More detailed breakdowns of each of the budget lines are provided in the investment guide. Existing programmes that already include an agronomist, a monitoring and evaluation expert, extensionists, an administrator, drivers and a manager may be able to reduce the salary costs shown below. An interactive Excel budget calculator that will enable investors to determine their context-specific costs as necessary is available at <http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides/>.

**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
<b>Sub-total</b>	<b>701,002</b>	<b>524,769</b>	<b>551,330</b>	<b>1,777,100</b>
OVERHEADS	70,100	52,477	55,133	177,710
<b>GRAND TOTAL BUDGET</b>	<b>771,102</b>	<b>577,245</b>	<b>606,463</b>	<b>1,954,810</b>

These highly cost-effective OFSP interventions cost just US\$ 45 per household if both direct and indirect beneficiaries are considered or US\$ 185 per direct beneficiary household. Programmes targeting communities that live in low population density areas should be expected to have a higher cost per beneficiary household with the longer distances to be covered between households, groups or decentralized vine multipliers.



This OFSP investment guide aims to unpack the investment opportunities in the OFSP value chain and offer a decision tool for determining where the key opportunities are and the activities for transforming them, including details on the human, financial and physical resources required. This guide is targeted at national level technical experts in public, private and development institutions, to support them through multisectoral and multi-stakeholder actions to identify and attract investments and implement pro-poor, nutrition-sensitive agricultural growth programmes to reduce vitamin A deficiency. The related *OFSP Investment Summary* was developed for policy-makers, and the *OFSP Investment Implementation Guide* to support those implementing OFSP investment programmes, providing them details on the activities required to transform OFSP value chains. The three documents are available at <http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides/>.



## 1. WHY INVEST IN ORANGE-FLESHED SWEETPOTATO?

Orange-fleshed sweetpotato (OFSP) has 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. 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 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', or micronutrient deficiency, together with stunting and inadequate energy intake. Child malnutrition is devastatingly high in many SSA countries, including in some of the countries with relatively high per capita incomes (Figure 1).

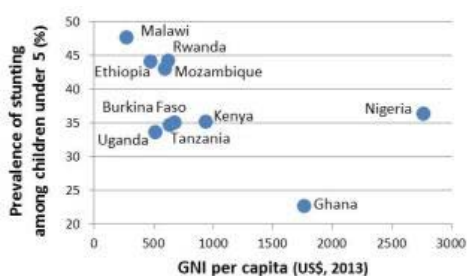


Figure 1 - Child malnutrition rates and incomes within SSA countries.

Source: WHO database; World Development Indicators

Undernourished children are at a high risk of impaired cognitive development, which will eventually adversely affect their country's productivity and growth, as, unlike healthy children, they will not be as innovative or responsive to opportunities even as adults. 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.

If incorporated into the diet, OFSP can help prevent vitamin A deficiency in children and



The bird's song woke Jude. He turned over and tried to block out the morning light. His little sister, Miriam, was ill again and her crying and thrashing around had kept him awake most of the night. He heard his mother begin to sweep the yard, and waited for her to tell him he would be late for school.

He soon joined the other children dressed in their uniforms as they headed out towards the road they would follow to school. After the large rocks, more children from the next village joined them. After walking for about 10 minutes, Paulo, his friend ran up to join him. Soon they were engrossed in an animated talk about the different trucks passing on their way to collect timber or deliver crates of soft drinks. Although Paulo was a year younger, he was already taller and stronger than Jude, who had been kept back a year at school after failing his exams. Jude struggled to keep up with Paulo's walking pace.

By the time the bell rang for morning break, Jude was struggling to stay awake. Slouched across his desk, he watched Paulo outside score a goal and then race over to his school bag and pull out his snack. Jude gazed enviously as Paulo broke open the roasted sweetpotato roots and took a bite of their delicious soft golden flesh.

Paulo's mother was a well-respected local farmer, and a few years beforehand had started growing a new type of sweetpotato. It was orange inside and the children loved it. Paulo brought it to school for his snack nearly every day. When the other children visited Paulo's house, his mother would serve them a mug of delicious hot sweetpotato porridge or fresh sweetpotato 'mandazis', the doughnuts that she also sold in the nearby market. Paulo's mother told them the orange-fleshed sweetpotato was full of goodness which would keep them healthy and help them concentrate better at school.

A few weeks back, at the start of the rains, Paulo's mother had given Jude some of the vines of the orange sweetpotato. Jude had helped his mother carefully plant them out on ridges in the field behind their house.



The plants were growing well, and Jude was looking forward to tasting their orange-fleshed roots, to having the energy to score goals, to being alert enough to answer the maths questions, and to helping his mother sell some of the extra orange-fleshed sweetpotato roots.

adults. The OFSP root is eaten after boiling or roasting or is mashed into a 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<sup>2</sup> of OFSP crop can provide enough vitamin A for a family of five each year. Fresh OFSP roots can be stored whole or cut into small pieces, then sun-dried and stored for up to two months as an important food stock. The leaves are eaten widely in many countries as a nutritious vegetable. Additionally, the vines can be fed fresh or as silage to livestock.

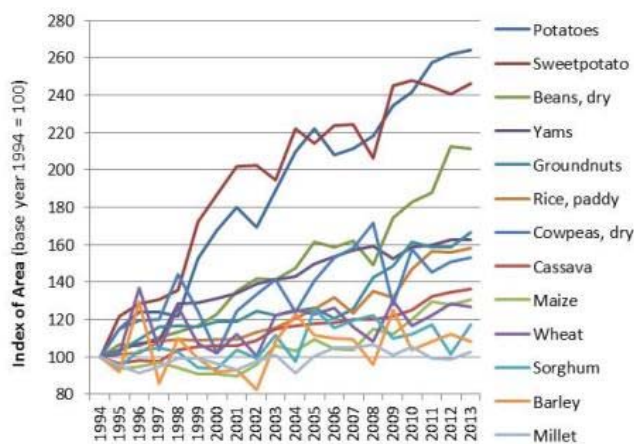
Vitamin A deficiency can be addressed in different and complementary ways: through taking supplementary capsules, eating fortified foods, or adopting long-term, sustainable, food-based approaches where locally produced foods rich in vitamin A are actively consumed as part of a balanced and diverse diet.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

**Table 1. Options for addressing vitamin A deficiency**

Vitamin A supplementation	Food fortification	Dietary diversification
<p>Provision of vitamin A capsules twice a year to children under five years increases child survival and reduces child mortality by about 24%.</p> <p><i>However:</i></p> <ul style="list-style-type: none"> <li>• The benefits are short term, lasting two–three months.</li> <li>• Only the under-five’s are targeted not the whole population.</li> <li>• Vitamin A supplementation campaigns are largely donor dependent and may not be sustainable in the long term.</li> </ul>	<p>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.</p> <p><i>However:</i></p> <ul style="list-style-type: none"> <li>• Access to fortified foods may be limited by availability and purchasing power, particularly in rural areas.</li> <li>• Young children can eat only small quantities of the fortified foods, so this approach needs to be combined with other interventions.</li> </ul>	<p>Many vitamin A rich foods such as orange-fleshed sweetpotato, mangoes, pawpaw, pumpkin, dark green leafy vegetables, eggs, liver and milk are available.</p> <p><i>However:</i></p> <ul style="list-style-type: none"> <li>• There is inadequate awareness about the need for dietary diversity for optimal nutrition and about vitamin A rich foods that are easy to produce, access and consume by all wealth groups and ages.</li> <li>• Current food crop systems often contain little variety.</li> <li>• Long-term investment in nutrition education is required.</li> <li>• Seasonality needs to be addressed through dietary advice and providing for food storage.</li> </ul>

Throughout history, sweetpotato has played an important role in saving people from famine. Sweetpotato produces more biomass and nutrients per hectare than any other food crop in the world. In SSA, it is typically grown without fertilizer or irrigation, can grow from sea level to altitudes of up to 2500 m and temperatures of 15–33 °C, has flexible planting and harvesting times ranging from three to five months, needs little care, and matures quickly. In most African countries, sweetpotato is grown mainly by women, and so in addition to its nutritional and food security value, it can enhance women’s incomes where market linkages are established.

Increasingly, farmers across SSA are responding to the decline in cultivable land size due to increasing population pressure by growing more root and tuber crops (Figure 2), which give higher yields per unit area than grain crops.



**Figure 2 – Growth in cultivated crop area of the main African field crops from 1994 to 2013.**

Source: FAOSTAT.

Sweetpotato is considered a low labour, low cost and low risk crop that helps families during droughts and shocks, when input prices are high, and when families are struggling with illness and 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 the low cost, locally grown, filling and tasty fresh sweetpotato roots and for value-added, sweetpotato-based processed products, such as nutritious breads, biscuits and juices.

Pro-poor, nutrition-sensitive agricultural investments are required to bring about the necessary reductions in child malnutrition that are essential in achieving long-term economic growth and transformation in SSA. The promotion of OFSP enterprise as part of a food-based approach to addressing malnutrition is an obvious win-win investment undertaking.

This OFSP investment guide aims to unpack the investment opportunities along the OFSP value chain, serving as a decision tool for determining where the key opportunities are and the activities for exploiting them, including details on the human, financial and physical resources required. This guide is targeted at national level technical experts in public, private and development institutions to support them through multisectoral and multi-stakeholder actions to identify and attract investments and implement pro-poor, nutrition-sensitive agricultural growth and vitamin A deficiency reduction programmes. The *OFSP Investment Summary* is targeted at policy-makers, while the *OFSP Investment Implementation Guide* aims to support those implementing OFSP programmes by providing extensive detail on the activities required to transform OFSP value chains. They 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

One in three children in SSA is stunted with a body and a brain that have failed to develop properly as a result of undernutrition. The impacts of this malnutrition are felt at individual and national levels through not only high child mortality and increased health care requirements but also reduced adult productivity and the high disease burden associated with such illnesses 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, this would equate to up to US\$ 1 billion per year, while for Nigeria that would be up to US\$ 16 billion.

Adults who were malnourished as children earn incomes that on average are at least 20% lower than those of counterparts who were not malnourished. This pervasive and long-term malnutrition surreptitiously 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 savings on health care, as well-nourished children are more likely to grow into high achieving adults and are less prone to disease and illness.

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 and medium terms. However, these nations 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 may take 20 years for the benefits of the efforts to address child malnutrition to be seen, highlighting 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.

Many people assume 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, such results occur 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 OFSP enterprise is an obvious win-win investment agenda. The Comprehensive Africa Agriculture Development Programme (CAADP) highlights the need for integrated and targeted investment in different agriculture-related interventions in order to reduce vitamin A deficiency and increase agricultural productivity and the related incomes. The promotion of sustainable OFSP enterprises along with other food-based approaches will address that objective.

It is essential to distinguish between a focus on increased agricultural production and a focus on improved 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 and to teaching those who prepare food about the importance of balanced, diverse diets and the methods for retaining nutrients when food is prepared. Growth in an economy does not necessarily guarantee improvement in nutrition, although the reverse is true: improving nutrition does have a positive impact on economic growth and development. Nutrition goals need to be integrated into agricultural production systems' strategies so that the quantity, quality and dietary diversity aspects of food production are addressed.



**More food  
does not  
necessarily  
mean better  
nutrition.**

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 these children may get enough calories, they 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 address malnutrition – including the hidden hunger of micronutrient malnutrition – through biofortification

(breeding crops for high levels of nutrients) of widely consumed staple crops such as OFSP can help ensure that the general population, as well as the targeted population of the poor families in remote rural areas, benefits in the long term. In addition to fostering consumption of nutrient-rich crops, crop husbandry, market infrastructure, agroprocessing and nutritional awareness can be strengthened to enable rural communities to produce higher yields of these crops for food and nutrition security, sale and processing for value addition.

We cannot afford the irreversible environmental and social consequences that would be attached to focusing solely on raising agricultural productivity 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 the agricultural growth policies and plans.

CAADP intends to accelerate agricultural growth across Africa and improve food and nutrition security, as well as to strengthen the resilience of the continent’s environment. However, in order to reach vulnerable communities and to reduce the high levels of child malnutrition that act as a long-term barrier to capacity creation for future economic growth and development, this will need to be targeted, pro-poor agricultural growth. The CAADP framework can support countries to sustainably address vitamin A deficiency, child malnutrition and food insecurity through integrated OFSP investments within the CAADP pillars, as per the suggestions in Figure 3.



Figure 3 – Reducing vitamin A deficiency through CAADP-informed investment plans.



**Table 2 – Synergies between orange-fleshed sweetpotato investments and achievement of the June 2014 Malabo Declaration for Africa Accelerated Agricultural Growth and Transformation (3AGT)**

<b>Malabo Declaration commitments and their synergies with orange-fleshed sweetpotato (OFSP) investments</b>
<p><b>Commitment to enhancing investment finance in agriculture</b></p> <ul style="list-style-type: none"> <li>• Uphold 10% of public expenditure to agriculture target – sweetpotato production is rapidly increasing across Africa due to the crop’s high productivity and wide suitability, decreasing farm sizes and urbanization. Investment in this often overlooked staple food crop will produce high returns.</li> <li>• Support conditions for facilitation of private investment in agri-business – food processors (large and small scale) using OFSP puree or flour in producing nutritious and affordable foods at scale.</li> <li>• Operationalization of the African Investment Bank – disbursing finance to nutrition-sensitive agricultural projects such as OFSP training, seed system development, OFSP processing and marketing.</li> </ul>
<p><b>Commitment to ending hunger in Africa by 2025 (zero hunger)</b></p> <ul style="list-style-type: none"> <li>• Double agricultural productivity – disease-free planting materials and new varieties can triple yields. Some 50–70% of agricultural labour is done by women, and OFSP generally is a women’s crop.</li> <li>• Create conditions for access to quality inputs – capacity building of sweetpotato vine multipliers.</li> <li>• Supply appropriate knowledge, information and skills – intensive agricultural and nutrition training of field agents and farmers, including women and the youth.</li> <li>• Halve current postharvest loss levels – improved OFSP root curing, handling, transport, storage and processing.</li> <li>• Target priority locations and groups – low input crop, grown over a wide range of agroecologies.</li> <li>• Encourage consumption of locally produced food – locally grown nutritious OFSP foods.</li> <li>• Reduce child stunting to 10% – through advocating for the production and consumption of a diversified diet with adequate macro- and micronutrients and practical nutrition education.</li> </ul>
<p><b>Commitment to halve poverty by 2025 through inclusive agricultural growth and transformation</b></p> <ul style="list-style-type: none"> <li>• Sustain annual agricultural GDP growth of 6% – improved nutrition and economic productivity.</li> <li>• Strengthen public–private partnerships for 5 value chains linked to smallholder agriculture – large-scale as well as small- to medium-scale food processing, fresh root marketing and seed system opportunities.</li> <li>• Create agricultural job opportunities for 30% of youth – marketing and processing, rural and urban.</li> <li>• Preferential participation for women and youth in agri-business opportunities – root marketing and processing opportunities at different scales, disease-free planting material production.</li> </ul>
<p><b>Commitment to boosting intra-African trade in agricultural commodities and services</b></p> <ul style="list-style-type: none"> <li>• Triple intra-African trade in agricultural commodities by 2025 – data collection on the role of informal cross-border sweetpotato trade in the regional food security and economic development.</li> <li>• Create conditions to increase and facilitate investment in markets and trade infrastructure – improved market information, linkages and quality requirements.</li> <li>• Strengthen platforms for multi-actor interactions – multisectoral, nutrition-sensitive agriculture.</li> </ul>
<p><b>Commitment to enhancing resilience of livelihoods and production systems to climate variability and other related risks</b></p> <ul style="list-style-type: none"> <li>• Build the climate resilience of farming systems – early maturing, drought-tolerant crop that can be grown by all on poor soils to reduce climate-related food insecurity.</li> <li>• Mainstream resilience in policies and investment plans – drought-tolerant, early-maturing, nutrient-rich crop; strengthened adaptive capacity via multi-stakeholder, hands-on learning and experimentation, and targeting women and the youth in vulnerable areas with multisectoral initiatives.</li> </ul>
<p><b>Commitment to mutual accountability to actions and results</b></p> <ul style="list-style-type: none"> <li>• Strengthen knowledge and data management capacities to support evidence-based planning, implementation, monitoring and evaluation – lesson learning and monitoring and evaluation training and implementation.</li> <li>• Biennial review process monitoring and reporting – indicators from OFSP promotion that can be used for monitoring other nutrition-sensitive agricultural initiatives.</li> </ul>

### 3. DECISION POINTS ALONG THE OFSP VALUE CHAIN

Opportunities exist all along the orange-fleshed sweetpotato (OFSP) value chain for exploitation of the crop’s multifaceted potential. The chart in Figure 4 is designed to assist investors in identifying where their main OFSP decision points and opportunities are. Section 4 of this guide explains why each area is important, how it can be addressed and what resources are required to do so.

For each ‘decision point along the OFSP value chain’ identified in the first column in Table 3, select the most accurate ‘description of your current situation’. Priority OFSP investment areas are those where the description of current situation is pink, followed by those where it is purple. If your situation fits the orange description, you are already successfully investing in addressing vitamin A deficiency through the promotion of food-based approaches such as OFSP, and may want to focus on scaling out what you are already doing.

**Table 3 – Factors for investors to consider in identifying opportunities in the orange-fleshed sweetpotato value chain**

Decision points along the OFSP value chain	Description of current situation	Tanzania example	Complete for focal location
Current interventions to address VAD	None or limited vitamin A fortification for sugar, oil or flour		
	Vitamin A capsules coverage of more than 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		
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 materials production, OFSP 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, poor crop and pest and disease management	X	

agronomic know-how and skills	Medium – e.g. farmers know how to rogue out diseased plants and space plants properly	
	High – e.g. timely land and planting material preparation; good crop, 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 already being included in several commercial products	
Nutritional awareness, understanding and behavioural 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 of food-based approaches for tackling vitamin A deficiency	X
	Some monitoring and evaluation of food-based approaches for tackling vitamin A deficiency	
	Regular and comprehensive monitoring and evaluation 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 orange-fleshed sweetpotato (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, with in-built spillover activities that will allow OFSP planting materials and nutritional information to reach a further 33,000 beneficiary households indirectly within the proposed three-year time span. The main benefits include improved food security, reduced vitamin A deficiency, improved dietary diversity and nutrition, sustainable sweetpotato seed systems, increased extension capacity, and improved markets and incomes for those marketing or processing their OFSP roots or vines for value addition. The investment programme described 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 4.

Table 4 – Summary of resources required for the 3-year orange-fleshed sweetpotato 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
<i>Act 1. Understanding the role of sweetpotato in the food system</i>	15,000	-	-	15,000
<i>Act 2. Availability and acceptability of OFSP varieties</i>	35,740	53,848	36,280	125,868
<i>Act 3. Strengthening the capacity of OFSP service providers</i>	68,390	4,017	4,139	76,546
<i>Act 4. OFSP vine conservation, multiplication and dissemination</i>	59,998	161,330	193,851	415,179
<i>Act 5. Improving sweetpotato production and postharvest management</i>	3,586	10,758	14,344	28,688
<i>Act 6. Promoting OFSP to improve health and wealth</i>	44,398	14,100	5,070	63,568
<i>Act 7. Nutrition education for behavioural change at community level</i>	12,420	28,260	31,680	72,360
<i>Act 8. Strengthening OFSP marketing</i>	18,460	27,840	5,940	52,240
<i>Act 9. Processing OFSP</i>	1,080	20,480	1,000	22,560
<i>Act 10. Enhancing multi-sectoral collaboration</i>	2,400	600	1,800	4,800
<i>Act 11. Monitoring, measuring and sharing the impact of your investment</i>	109,140	62,040	109,415	280,595
<b>Sub-total</b>	<b>701,002</b>	<b>524,769</b>	<b>551,330</b>	<b>1,777,100</b>
OVERHEADS	70,100	52,477	55,133	177,710
<b>GRAND TOTAL BUDGET</b>	<b>771,102</b>	<b>577,245</b>	<b>606,463</b>	<b>1,954,810</b>

This budget converts to an investment of US\$ 45 per household if direct and indirect beneficiaries are considered, or US\$ 185 per household if only 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 longer distance to be covered between households, groups or decentralized vine multipliers (DVMs). A recent integrated agriculture–nutrition marketing intervention cost US\$ 56 per target beneficiary in densely populated Uganda and US\$ 86 in the less densely populated Mozambique. For Uganda, this converted to US\$ 15–20 per disability-adjusted life year (DALY), making it a highly cost-effective health intervention.

The following sections provide an overview of each of the investment areas, including the activities and costs involved. Personnel and equipment costs (Table 5) will cover all the activities. To help adapt the costs or activities to specific contexts, a detailed interactive [Excel OFSP investment budget calculator](#) is provided online.

If necessary, programme costs could be reduced by removing the marketing and processing activities (4.9 and 4.10) but retaining the food and nutrition security focus. Vine conservation, multiplication and dissemination are expensive but crucial for the success of the enterprise.

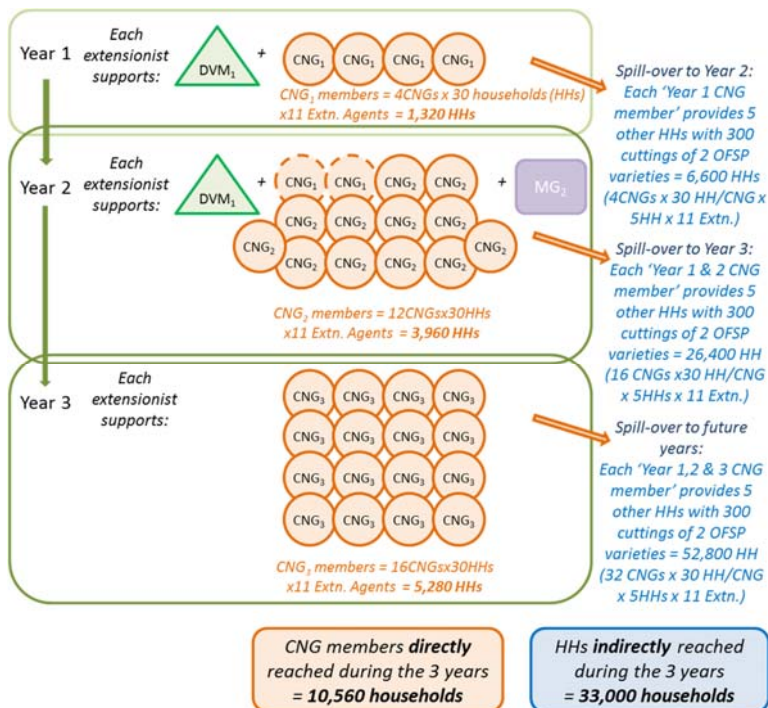
**Table 5 – Orange-fleshed sweetpotato investment programme costs shared across activities**

OFSP Investment Costs shared across activities (using Tanzanian 2014 rates)	Year 1			Year 2			Year 3			Total	
	Rate	Basis	Total	Rate	Basis	Total	Rate	Basis	Total		
<b>PERSONNEL INCLUDING BENEFITS (annual works days = 240)</b>											
<b>Staff</b>	%										
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
<b>Total: Personnel</b>			<b>108,840</b>			<b>114,786</b>			<b>120,525</b>	<b>344,151</b>	
<b>TRAVEL/EXPENSES ACROSS ALL ACTIVITIES</b>											
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
Motorcycle 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
Motorcycle 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
<b>Total: Travel and other costs across all activities</b>			<b>31,650</b>			<b>26,710</b>			<b>27,286</b>	<b>85,645</b>	
<b>EQUIPMENT</b>											
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
<b>Total: Equipment</b>			<b>189,900</b>			<b>-</b>			<b>-</b>	<b>189,900</b>	

Figure 4 shows how the OFSP investment programme will reach 43,500 households (HHs) – 10,500 of them directly and 33,000 indirectly – within the three years of the plan.

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 attend monthly programme meetings where they will take part in role playing and practising for the farmer training sessions that they will run, as well as giving feedback on the programme’s progress. 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 that will be used to ensure that planting materials remain disease free during multiplication. The DVM will multiply these clean planting materials using a rapid multiplication method with irrigation in an open field. The planting materials will then be supplied to each member of the target community’s nutrition group (CNG), with these groups increasing in number 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 is provided in section 4.5.
- Several CNGs (4 in year 1, 14 in year 2 [2 of whom were supported in year 1 and require further help], and 16 in year 3). On average, each CNG has 30 members, each of whom will receive 300 cuttings of each of 2 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 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 who will grow a minimum of 0.25 ha of OFSP roots each. Marketing groups will be set up only in areas with good road access so that they will be accessible for long distance root marketing.



- Key:**
- DVM<sub>1</sub>** (Green Triangle): **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** (Orange Circle): **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** (Purple Square): **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 4 – Schematic representation of how your investment can ensure 43,000 households are producing and benefiting from vitamin A rich orange-fleshed sweetpotato within three years.**

The number of CNGs each extension agent will support will increase each year (see Figure 4). At the beginning of each new season, there will be a celebratory field day during which each CNG member (direct beneficiary) will give vines of the two OFSP varieties to five other households (indirect beneficiaries) to assist in scaling out the investment and OFSP nutritional benefits. Further spillover activities immediately after the end of the three-year investment programme, in which each CNG member will provide OFSP cuttings and information to five other households, will result in another 52,800 households being reached indirectly, giving the total households reached directly or indirectly as 96,360. This spillover approach should be encouraged to continue in future seasons.

## 4.2 Understanding the role of sweetpotato in the food system

To plan for strategic investments along the OFSP value chain that can simultaneously reduce the burden of vitamin A deficiency and build the capacity to sustainably produce, consume and earn an income from OFSP, it is necessary to understand the current role of sweetpotato in the focal food system. In addition to reviewing relevant literature, this would include conducting surveys or focus group discussions with farmers – making sure to include men, women, the poor, the wealthy and different age groups – and key informant interviews, to understand:

- **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, when, what quantities and for what value?
- **Trends affecting sweetpotato** – What have the trends over the last 10 years been with regard to sweetpotato consumption and marketing in the focal community, and is everyone equally affected by the trends? What is likely to happen over the next 20 years, given the growing urbanization, likely climatic changes, increasing population and changing landholding sizes?
- **Sweetpotato calendar** – When do farmers start preparing their land and how long does it take? Which crops do they plant and how and in what order? Where do they get their sweetpotato planting materials from? Do they usually have sufficient planting materials? When does it rain? What varieties do they plant? When and how do they weed; apply fertilizer; harvest, transport to the market, sell, process and cook the roots; and conserve the vines? And who does each of these activities? Do most farmers have access to valley bottom land where sweetpotato could be produced during the dry season?
- **Main constraints to production, consumption and marketing of sweetpotato** – What factors constrain production, consumption and marketing of sweetpotato? Do these constraints affect everyone? If not, why not? What options exist for addressing these constraints? Are these 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 the varieties, diseases, planting methods, nutritional attributes, and practices?
- **Roles and responsibilities within the sweetpotato value chain** – Who controls the productive resources such as land, water, labour and labour-saving technologies used in sweetpotato production? Who does each of the sweetpotato farming activities, and, if both men and women are involved, what proportion are their roles? Who does the decision-making regarding each activity and in what proportion? Who does the marketing, processing, storage, food stock monitoring, transport and large or small-scale trading of sweetpotato roots, vines, leaves, fresh or processed products, and who makes decisions about what should be done at each stage? How is the income generated from sweetpotato sales used and who decides how it should be used?
- **Nutritional behaviour and awareness** – What nutritional awareness and behaviours exist amongst the different age, sex and ethnicity groups? Who is involved in decision-making on nutrition, e.g. on the crops to produce, food to buy, how young children are fed or how diverse the diet will be? How often are children under two years of age fed during the day? Have women heard of vitamin A? What kind of nutritional messaging has been used, whom did it target and what were its strengths and weaknesses? What other opportunities exist?
- **Other relevant initiatives** – What other relevant local or other level initiatives exist, such as programmes on nutrition and vitamin A deficiency levels and school feeding, relief activities, policies, other agricultural projects, and food processing ventures? How can OFSP enterprise promotion interact with them?

### 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 is provided at <http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides/>

### 4.3 Availability of OFSP varieties

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 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, skin and flesh colour, taste, texture, dry matter content, pest and disease resistance, and yield.

The flesh of sweetpotato roots comes in an amazingly wide range of colours, from white, through yellow to deep orange and even deep purple, and also differs by taste, texture and dry matter content. The colours are natural and not the result of genetic modification. The deeper the orange colour of the flesh, the higher the beta-carotene content.

Which varieties farmers plant is influenced by the varieties they can access and what they plan to use the crop for, e.g. food, selling, processing, animal feed etc., as well as the local pest and disease pressures, agroecological factors, climate and the length of the 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 officers, traders, research stations and specialized seed producers. Sweetpotato breeding programmes work closely with farmers and consumers to select new varieties. Breeding a new sweetpotato variety is complex and expensive. It takes about four years and involves building crossing blocks; establishing seedling nurseries; and carrying out observations, yield assessment, and advanced and on-farm participatory trials prior to the official release of the variety. However, using popular varieties from neighbouring countries is a good shortcut for acquiring new varieties.

Some of the OFSP varieties recently released in different SSA countries are shown in Table 6. The *Orange-fleshed Sweetpotato for Africa Catalogue* for 2014 is available on the Sweetpotato Knowledge Portal ([www.sweetpotatoknowledge.org](http://www.sweetpotatoknowledge.org)) and has a contact list of breeders in these countries. The CIP Support Platform ([cip-nbo@cgiar.org](mailto:cip-nbo@cgiar.org)) can also assist investors in identifying the best-bet OFSP varieties for each specific African agroecology.

Viruses and other diseases can dramatically reduce the yields of sweetpotato varieties, and so 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 tissue cultured plantlets 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 trained farmer vine multipliers, who will then produce sufficient quantities of clean planting materials for the direct beneficiary households.

As performance of a variety varies depending on agroecological situations, there is need for farmers and their agricultural service providing partners such as extensionists, NGOs and researchers to test varieties so that they can select those that perform well in their specific locations and meet their intended use requirements. This should be done with a representative range of farmers, including both men and women, as some farmers may be more interested in varieties with market-related characteristics, while others may be keener on root or vine yield or cooking qualities.





Once several suitable OFSP varieties have been identified, demonstration trials with promotional field days should be organized. Such events will provide many more farmers, traders, processors and consumers with the opportunity to view, handle and taste the OFSP varieties. Handouts can be prepared with photos, names and



characteristics of the different varieties and contact details of the vine multipliers who will later assist farmers and traders obtain the planting materials or roots.

**Table 6 – Orange-fleshed sweetpotato varieties now available in Sub-Saharan African countries**

Country	Released OFSP varieties
Mozambique	Tio Joe, Namanga, Bela, Lourdes, Ininda, Irene, Cecilia, Erica, Delvia, Melinda, Amelia, Sumaia, Esther, Jane, Gloria (bred especially for drought tolerance)
Tanzania	Mataya, Kiegea, Ejumula
Nigeria	King J (Umuspo/1) and Mother's Delight (Umuspo/3)
Ghana	Bokye, CRI-Apomuden
Burkina Faso	Tiebele, Bagre, Jewel, BF138, BF139 (registered in 2014)
Malawi	Zonden, Ana Akwanire, Kadyaubwerere, Mathuthu, Kaphulira, Chipika
Uganda	SPK004 (Kakamega), Ejumula, NASPOT 8, Vita (NASPOT 9 O), Kabode (NASPOT 10 O), NASPOT 12 O, NASPOT 13 O
Kenya	KENSPOT-3, KENSPOT-4, KENSPOT-5, SPK004 (Kakamega), Kabode (NASPOT 10 O), Vita (NASPOT 10 O)
Rwanda	97-062 (Gihingamukungu), SPK004 (Kakamega), Caceapedo, RW11-2560, RW11-4923 and RW11-2910 (Ndamirabana)
Ethiopia	Kulfo, Tulla, Birtukane, Kero, Guntute, Koka-12
Zambia	Zambezi, Kalunguwishi, Lukusashi
South Africa	Bophelo, Impilo, Khano, Serolane, Purple Sunset, Isondlo. USA cultivars being distributed are Resisto, Beauregard, W-119

## 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
<b>Total</b>	<b>35,740</b>	<b>53,848</b>	<b>36,280</b>	<b>125,868</b>

\*This budget is based on using OFSP varieties already existing in the country or importing best-bet OFSP varieties from nearby countries as opposed to breeding new OFSP varieties, which is a more costly and longer term 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 service providers

### Training of trainers on everything about sweetpotato

Between 2011 and 2014, the Reaching Agents of Change (RAC) project supported the development of a training of trainers (ToT) course and manual. The 10-day, hands-on course on ‘Everything You Ever Wanted to Know about Sweetpotato’ has since been delivered annually to build the capacity of public sector extension and NGO personnel to implement projects investing in promoting vitamin A rich OFSP. The course is based on the fact that adults learn best through practical, hands-on experience dealing with issues that are relevant to their lives, and by sharing and comparing observations with their peers.



RAC’s goal was to see sustained capacity building for development workers (who in turn train others) on the latest developments in sweetpotato production and utilization in each of the major subregions of SSA, which are eastern and central Africa, southern Africa and West Africa. RAC worked with Sokoine University of Agriculture (SUA) in Tanzania, the University of Eduardo Mondlane (UEM) in Mozambique and the Agricultural and Rural Management Training Institute (ARMTI) in Nigeria to host the ToT course. To date, 224 OFSP service providers, or change agents, have been trained in this course, and they in turn have trained over 4,000 others. The goal is to reach as many farmers, traders and processors as possible. The course contact details are provided in section 4.13.



Good trainers are typically people whose deep enthusiasm for and understanding of the subject of concern shines through in all their activities and who do not dominate the learning activities but make sure that participants find out something relevant about the topic themselves, as opposed to just being passive listeners. OFSP investors should select two enthusiastic staff to participate in the ToT course, and these trainers will then train 12 field officers each on all the nutritional and agricultural aspects of the OFSP enterprise.

The trained field officers will interact on a regular basis and in accordance with the agricultural calendar with farmers, traders and processors to (1) support the establishment of OFSP seed systems, community nutrition groups and marketing groups; (2) improve crop management, nutrition education and behavioural change; (3) organize OFSP promotion events; (4) develop capacity of OFSP processors; (5) support linkages among farmers, traders and processors; and (6) monitor outcomes.

### Resource requirements

Activity	Year 1	Year 2	Year 3	Total (US\$)
Sponsor 2 staff to attend ‘Everything You Ever Wanted to Know about Sweetpotato’ ToT course	8,000	0	0	8,000
12 ‘Everything You Ever Wanted to Know about Sweetpotato’ course 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
<b>Total</b>	<b>68,390</b>	<b>4,017</b>	<b>4,139</b>	<b>76,456</b>

## 4.5 OFSP vine conservation, multiplication and dissemination

### Selecting healthy planting materials

Vines are the planting material used for sweetpotato. However, sweetpotato vines can be infected with viruses or infested with insect pests, which subsequently reduce yields and act as sources of infection in the newly planted crop. Therefore, only clean planting materials should be used. Selecting the top part of the vines from plants without visual symptoms of diseases such as stunting, chlorosis (veins without colour) and curled leaves helps reduce disease pressure. Sometimes the virus becomes so pervasive that clean planting materials can be produced only by using thermotherapy, after which they should be maintained in tissue culture. Low-cost net tunnels, which cost approximately US\$ 150 each and last three years, can also be used to maintain clean planting materials by preventing their contact with insects that infect the plants with the viruses. When farmers see the yield difference between the clean, virus-free planting materials and their normal planting materials of the same variety (see Table 7), the demand for clean planting materials will increase. Demonstration plots can be used to exhibit the huge yield increase that farmers can achieve through simply using clean planting materials. Farmers should be taught how to identify signs of virus attack and to remove infected plants from their field.



Table 7 – Yield and income benefits 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 – farmer’s own	7.3	0.0	1,314	86	1,228	

### Conserving planting materials through the dry season

Sweetpotato farming is typically rain fed and, therefore, there is a need to conserve planting materials between seasons. This can be challenging in areas where there is a prolonged dry season, when sweetpotato vines may dry up or may be eaten up by livestock. The lack of clean sweetpotato planting materials at the onset of the rains is a major bottleneck for sweetpotato enterprises. Farmers can be trained in methods to overcome this constraint such as the following:

- **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 six–eight weeks before the rains are expected, the now sprouting roots are planted in a garden near the homestead and watered every few days. They will sprout vigorously, and just 40 roots can generate about 1,500 cuttings.
- **Dry season irrigation of planting materials** – Irrigation is used to preserve quality planting material in the first half of the dry season, then to rapidly expand the amount of planting materials starting from two months before the rains are expected.



## Rapid multiplication of planting materials

To rapidly increase the supply of planting materials, defoliated cuttings of vines three nodes long can be planted at a tight spacing of 50 cuttings per m<sup>2</sup> (20 x 10 cm spacing) in a fertile seedbed that can be easily watered and protected from livestock or intense sun. The resulting vines can be harvested after just six–eight weeks and a second harvest can be cut a few weeks later. While the multiplication rate of sweetpotato varieties differs, with this method 50 cuttings can typically produce 1,500–2,100 vines within 4 months.

## Approaches for large-scale dissemination of planting material

To have large-scale impact on improving yields and incomes of small-scale farming households and reducing vitamin A deficiency, a clear strategy needs to be developed for planting material multiplication and dissemination. This strategy will vary with the context, and needs to be carefully thought through.

**The ‘single-shot’ dissemination approach** involves one-off distribution of planting materials to the target community, who then integrate the materials into their farming systems and subsequently maintain their own stocks of planting materials. This is often the approach chosen following an emergency or in the dissemination of a new variety, and can work well where the dry season is not prolonged and where the varieties being distributed have resistance to viruses. In the single-shot approach, the planting material is usually either sold to farmers at subsidized prices or given free.

**An ‘on-going access’ dissemination approach** involves annual or repeated distribution of planting materials to the target community. It might be a necessary activity in areas where prolonged dry seasons make access to planting materials a constraint or where the varieties being disseminated are susceptible to viruses, and regular injection of clean planting materials can help maintain good yields. This approach may start out with the distribution of the planting materials at highly subsidized prices and then gradually become more commercial as the varieties become better known and valued by the beneficiaries and as local DVMs begin offering them for sale.

The key factors in deciding which planting material multiplication and dissemination strategy 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, purchasing power, institutional capacity, existence of vine multipliers, and presence of farmers’ organizations. A helpful decision framework is presented in the implementation guide.

In addition to determining the planting material dissemination approach, investors need to decide how many and what type of beneficiaries they want to reach and where, which intermediaries to work with, what human and financial resources are required, and 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. It is unlikely that a commercialized dissemination strategy would work immediately, but it can be sustainably developed over time.

## Centralized versus 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** is typically closely managed by researchers and usually involves irrigation to ensure the planting materials are not wiped out during dry spells. Efficient logistical coordination is required among the recipients, the transporters, the harvesters and packers to prevent the drying up or loss of viability of planting materials or their delivery to locations where they are not expected.

**DVMs** 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. They typically provide planting materials to farmer group members. Their

planting materials should be inspected before any are harvested to ensure that they are pest and disease free. DVMs will be expected to continue to produce clean planting materials at the community level after the project in which they are involved has ended, so their operations need to become commercially viable as soon as possible. Decentralized demonstration plots, where the new and/or clean varieties are grown, are powerful in raising awareness and demand amongst the local community. With DVM systems the planting materials can remain in the ground until the recipients prepare their fields and then go to purchase or use their vouchers to collect them. Clear information about where the DVMs are located and the varieties they are producing, when they will be ready for collection and what they will cost needs to be given.

Investors also need to understand how the sweetpotato seed system links to other segments of the sweetpotato value chain to help ensure that demand drives the need for quality materials from the seed system, as opposed to the materials being pushed by public sector or NGO actors.

Seed systems are likely to be more sustainable if they are run commercially, but for this to work farmers need to be willing to pay for sweetpotato planting materials, which requires that they value access to clean, high yielding planting materials of nutritious varieties. Farmers are more willing to pay where new sweetpotato varieties are being made available; sweetpotato is the 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 a market demand for sweetpotato roots.

### Advanced planning for timely production of planting materials

To ensure sufficient planting materials are ready for the onset of the rains, detailed advanced planning is required at least seven months before their dissemination is expected. Find out when sweetpotato farming activities 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 need to start at least seven months in advance of the dissemination period. In addition to the planting time, you will need to know (1) how many households you want to target, with how many cuttings and of which varieties; (2) what the multiplication rates of the selected varieties are (these vary depending on the soil type, irrigation schedule, climate and field management); (3) where virus-free planting materials can be obtained; (4) whether you are going to use just centralized mass multiplication or also decentralized multiplication, and what the training and resource needs are; (5) where the multiplication sites will be located; (6) how well your funding is aligned with the agricultural calendar; and (7) how much you would need to charge for the cuttings 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 (that is, for every 1 cutting planted 15 can be harvested 4 months later), and you are starting with about 900 cuttings, the time frame shown for variety A in Table 8 would be relevant. However, if you also have another variety with a different multiplication rate (see variety B in Table 8) or you are starting with a much larger number of cuttings of one variety (see variety C in Table 8), you need to accommodate their planning calculations into your work plan. An Excel [planting material multiplication strategy calculator](#) has been created to help with this. Once you have determined the time frame and scale, you will need to decide whether your operation will use a centralized or decentralized approach, and then you can determine how many farmer vine multipliers you need to train and work with and the land size they will need to put under vine multiplication. If you use a decentralized vine multiplication approach, the planting material production plans in Table 9 (available as an [interactive Excel sheet](#)) will help you to reach 10,500 households directly and another 33,000 indirectly within three years.

In order to maximize the impact of such planting material production activities, most projects require direct beneficiary households that receive the 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 reach a larger number of households indirectly, i.e. 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 supply commercial quantities to the local community.

**Table 8 - Example of multiplication calculations and timings for three varieties**

	Nov 2014	Dec	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May	Jun 2015	Jul 2015	Aug	Sep 2015	Oct 2015	Nov 2015
Target no. of households and timing													<b>10,000</b>
No. of cuttings of Variety A	900				13,500				202,500				3,037,500
<i>Variety A – Multiplication rate /4 months</i>	15				15				15				
No. of cuttings of Variety B					1,875				75,000				3,000,000
<i>Variety B – Multiplication rate /4 months</i>					40				40				
No. of cuttings of Variety C					7,500				150,000				3,000,000
<i>Variety C – Multiplication rate /4 months</i>					20				20				

## Resource requirements

### *Reaching 43,000 households in three years through decentralized vine multiplication*

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

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

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 CNG members as shown in Figure 4. For example, year 1 = 11 extensionists x 4 CNGs, each having 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 decentralized vine multiplier (DVM) who has 2 net tunnels that are each planted with 360 cuttings, 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 in 2.5 months (2 vine harvests), then the 11 DVMs will be able to produce 11 x (360 x 2 x 8) = 63,360 cuttings. If losses are included, the result will be about 62,568 cuttings being available after a 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 (6,688 cuttings x 15) = 938,520 cuttings. With some losses included, this will result in about 926,789 cuttings being 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 OFSP vines in their demonstration fields.

**Table 9 – OFSP planting material multiplication plan for reaching 10,500 households in three years (year 1 is shown below and years 2 and 3 on subsequent page)**

			Year 1							
<b>DEMAND</b>	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							
	<b>Multiplier</b>	<b>Method</b>	<b>Cuttings per unit</b>	<b>No. of units</b>	<b>Multiplication rate (MR)</b>	<b>No. of multipliers</b>	<b>No. cuttings harvested</b>	<b>Wastage factor</b>	<b>No. cuttings available</b>	<b>Time taken</b>
<b>SUPPLY</b>	<b>Research station (primary multiplier):</b> 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
	<b>DVM enterprise (secondary multipliers):</b> 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).  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	360	2	8	11	63,360	0.0125	62,568	2.5 months
			5,688	1	15	11	938,520	0.0125	926,789	4 months
	<b>Community nutrition group promoters (tertiary multipliers and demonstration site):</b> 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/>.

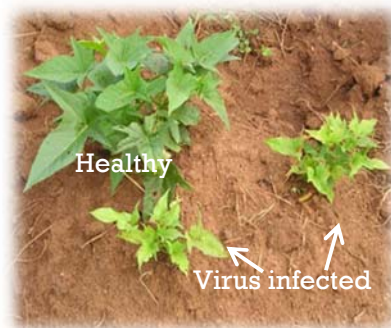
		Year 2									Year 3								
<b>DEMAND</b>	Direct beneficiary households (HHs)	3,960 HHs									5,280 HHs								
	Total no. of cuttings required @300 cuttings of each variety/ HH:	2,376,000 cuttings									3,168,000 cuttings								
	No. of cuttings per variety per HH	300									300								
	of OFSP Variety A	1,188,000									1,584,000								
	of OFSP Variety B	1,188,000									1,584,000								
	<b>Multiplier</b>	<b>Method</b>	<b>Cuttings per unit</b>	<b>No. of units</b>	<b>Multiplication rate (MR)</b>	<b>No. of multipliers</b>	<b>No. cuttings harvested</b>	<b>Wastage factor</b>	<b>No. cuttings available</b>	<b>Time taken</b>	<b>Cuttings per unit</b>	<b>No. of units</b>	<b>Multiplication rate (MR)</b>	<b>No. of multipliers</b>	<b>No. cuttings</b>	<b>Wastage factor</b>	<b>No. cuttings</b>	<b>Time taken</b>	
<b>SUPPLY</b>	<b>Research station (primary multiplier):</b> 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	
	<b>DVM enterprise (secondary multipliers):</b> 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 ratoons (each net tunnel is 1 unit). 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	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	
			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	
	<b>Community nutrition group promoters (tertiary multipliers and demonstration site):</b> 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 throughout the sweetpotato value chain, it is imperative that farmers be skilled in sweetpotato crop management to reduce the constraints and maximize the yields and income earning opportunities. This requires training of field agents (see 4.4) who will then train farmers at the relevant times throughout the year on the following aspects:

- **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 in getting sweetpotato production moving (see more details in section 4.5).
- **Land preparation** – Sweetpotato does well on many types of soil, but it does best on deep, moderately fertile, sandy loam soils. Adequate drainage and soil aeration are important, which is why the crop is usually grown on mounds, ridges or raised beds. Farmers rarely apply fertilizer to 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 ideally should be separated from recently harvested or existing fields, particularly where weevils and viruses are a problem. Gender awareness is required regarding land use control and decision-making, and both men and women should be consulted.
- **Planting** – Sweetpotato is planted on mounds, ridges or raised beds. Mounds and ridges ensure good drainage and make harvesting easier especially when it is done in a piecemeal fashion. Vine cuttings of three to five nodes (about 20–30 cm long) are usually planted at a spacing of 25 cm between plants and 60–100 cm between ridges, or three vines per mound. Closer spacing results in smaller root size. Around 33,300 cuttings are required per hectare. At least two nodes of each cutting should be placed under the soil with the vine tip left exposed above. Many farmers prefer to stagger the planting of their sweetpotato crop to ensure a longer supply of fresh roots, to avoid a glut at harvest, to spread the risk of crop failure from dry spells, and to spread their demand for planting materials and labour. However, if planted late in the season, the crop may be exposed to very dry conditions and high weevil attack.
- **Intercropping** – Where land pressure is high and labour for constructing ridges is limited, sweetpotato is often intercropped. If intercropping, the farmer should try to minimize competition for light and nutrients between the crops being grown together. Crops that farmers intercrop with sweetpotato include pigeon pea, maize, beans, soybeans, peas, cassava and sugarcane, as well as fast-growing agroforestry trees or shrubs.
- **Weeding and hilling up** – As with all crops, weeds may compete for light and nutrients and so need to be removed. To protect sweetpotato roots from exposure to sun or weevils, soil should be hoed up around the base of the plant (hilling up) to fill the cracks in the soil caused by the expanding storage roots.
- **Virus management** – The two main sweetpotato viruses are transmitted by aphids and whiteflies. These insects cannot fly long distances so they tend to spread the viruses to plants close together. But long distance transport of infected planting materials can spread the virus widely. Virus symptoms include plant stunting, chlorosis, misshaped 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 the symptoms appear, planting sweetpotato varieties that are resistant to the virus, avoiding planting a new sweetpotato crop where another one was grown the previous season, and planting a new sweetpotato crop away from other sweetpotato crops.



- Weevil management** – The sweetpotato weevil (*Cylas* spp.) is the main pest of sweetpotato, and is found all over the world. The weevil lays eggs inside the vines or exposed roots. On hatching the larva feeds and tunnels through the vine or root. The tunnels reduce the market value of the crop and give the root a bitter taste. Farmers can integrate a number of pest management methods to reduce losses from weevils, including (1) hilling up the soil around the roots so that weevils cannot access them via cracks in the soil, (2) field sanitation, which involves removing and destroying any old vines or roots, (3) using clean planting materials from the tips of vines, (4) harvesting the roots before the soil cracks as it dries, (5) rotating crops so that there is no continuous source of food for weevils, (6) separating sweetpotato plots using barrier crops or wide distance to reduce weevil transmission, (7) encouraging predatory natural enemies of the weevils such as ants, earwigs, ground beetles and spiders to move through the crop, (8) mulching to reduce soil cracking, and (9) flooding the field after harvest for at least 48 hours to drown all the weevils in the soil.



- Harvesting** – Sweetpotato can be harvested three to eight months after planting. Using a piecemeal approach ensures that the supply of roots is matched with the food or small-scale marketing requirements of the household. By growing several varieties and staggering planting dates the sweetpotato harvest can be spread over a longer period. Harvesting is typically done manually with a sharp stick or hoe. Surface wounds can allow disease to enter the roots and also reduce their value. Women typically do the harvesting for household consumption needs.



- Storage of fresh sweetpotato** – Fresh sweetpotato roots when available outside the main harvest season fetch a high market price. Despite this, there are few acceptable small-scale methods for storing fresh sweetpotato roots. A traditional method among some communities involves storing mounds of fresh sweetpotato roots in pits or piles lined with grass and/or ash and covered with soil, sometimes adding a bamboo pole in the middle for aeration. Only top quality roots must be stored, as damaged roots will spread disease or pests to other stored roots. Research is going on about the viability of storing fresh roots in layers of sand or in evaporative or low-energy cooled structures.

- Storage of dried sweetpotato** – Sweetpotato roots can be sliced, sun-dried and stored as food stocks for consumption in stews or porridges or for small-scale selling in local markets. Beta-carotene levels in OFSP are best maintained in the chips during sun-drying by turning the pieces regularly, making sure that they are dried in a thin layer (less than 4 kg/m<sup>2</sup>), protecting them from rain, and preventing them from over-drying, which will happen if they are left in the sun for longer than necessary. Beta-carotene losses also occur during storage. To reduce this, storage should be limited to periods of just two months and the product should be stored in a cool room in closed and opaque containers and, ideally, vacuum packed. Sacks holding the roots should be stored off the ground, protected from moisture and regularly monitored for pests 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: crop production and management were covered in earlier visits)	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 orange-fleshed sweetpotato (OFSP) can reduce vitamin A deficiency. Production of OFSP can provide small-scale farmers with new income earning opportunities and improved food security, and processors of all scales can incorporate OFSP into popular nutritious food and beverage products.

The promotion of OFSP also provides an important public good, as it increases the nutritional awareness of the population about the need for dietary diversity and consumption of different foods in order to meet our multitude of nutrient requirements. In many SSA countries, an increasingly narrow range of foods are now being consumed, and the eating of indigenous nutrient-dense crops, fruits and vegetables has been decreasing. Raising nutritional awareness, together with promotion campaigns for OFSP fresh roots and products, can play an important role in increasing consumer demand for OFSP and other nutritious food crops.

The hidden hunger nature of micronutrient deficiency – which is very hard to detect and often goes unrecognized until it becomes severe – makes raising consumer awareness, concern and behavioural change difficult. OFSP activities can have a role in changing this. For example, following an OFSP promotion campaign in Mozambique, three quarters of consumers said they preferred OFSP roots to white-fleshed sweetpotato roots, and similar activities over a two-year period in Uganda and Mozambique led to women and children consuming at least 66% more OFSP.

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

### How to promote OFSP

Key elements of a successful OFSP promotion campaign for the reduction of vitamin A deficiency include:

- **Identifying and understanding the existing nutritional knowledge and behaviours** of the different target groups including food processors (who could substitute OFSP puree or flour for wheat or other ingredients) traders and different types of farmers.
- **Creating awareness** about the importance of vitamin A and of the high vitamin A content in foods such as OFSP, pumpkin, pawpaw, mango, carrot, liver and milk.
- **Developing behaviour-change strategies** for the different target groups and appropriate messages, for example on improving feeding practices for young children, diversifying household diet, improving marketing chains for sweetpotato roots and/or leaves and products, and substituting OFSP puree for wheat flour in a number of marketed processed food products. A situation analysis (see section 4.2) will help understand the existing food and marketing customs of the different target groups. Tailored promotion 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. It is important to monitor the success of the approaches and to change or modify them as necessary to enhance behaviour change.



## Examples of successful OFSP promotion activities

- Radio or TV programmes or jingles, billboards, community theatre, songs or short videos with sticking messages that last, and posters and promotional materials on vitamin A and OFSP production and use.
- Using the orange colour to create brand images, for example for market stalls selling OFSP, OFSP product labels and outfits for trained OFSP extension staff.
- Establishing variety demonstration plots.
- Organizing product tasting events.
- Painting slogans on vehicles, caps, T-shirts and wraps worn by women.
- Organizing stakeholder meetings with local leaders or health service professionals.
- Running group nutrition sessions, cooking demonstrations and counselling sessions with parents of malnourished children.
- Organizing field days and advertising campaigns with subsidized new OFSP products and planting materials.
- Integrating OFSP information, planting material vouchers and food-based nutrition training into child health days 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 as well as other micronutrients as part of a healthy diet.
- Providing training tools and aids to extensionists and community health workers or OFSP promoters.



## Resource requirements

Activity	Year 1	Year 2	Year 3	Total (US\$)
Radio/ TV programmes, theatre or song: design and translation etc. for advertising and use during 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 ( <i>kitenge, capulanas</i> ) to sell at cost	35,000	0	0	35,000
<b>Total</b>	<b>44,398</b>	<b>14,100</b>	<b>5,070</b>	<b>63,568</b>

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

## 4.8 Nutrition education for behaviour change

### Eating a balanced diet

People select the foods they eat for many reasons including taste, level of hunger, food availability, convenience, affordability and their socioeconomic status. But 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 (Figure 5).

Vitamins and minerals are needed in only small amounts and that is why they are called micronutrients. Despite that they are needed in small quantities, micronutrients play important functions in the body and are essential for normal metabolism, growth and physical well-being.

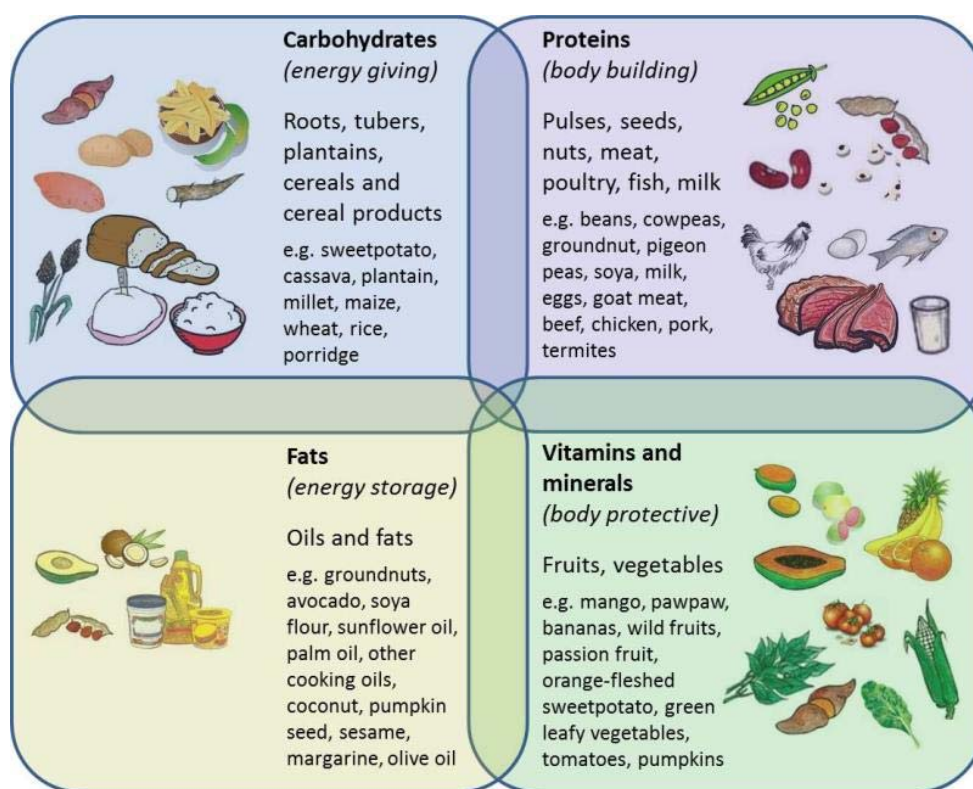


Figure 5 – Examples of the foods that are good sources of nutrients.

### Malnutrition and micronutrient deficiency or hidden hunger

Economic growth and human development require well-nourished populations that can quickly 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 might suffer from malnutrition or deficiencies in macronutrients or micronutrients.

Some 35% of African children under five years of age are chronically malnourished and stunted, and nearly half of all deaths in that age group are attributable to undernutrition. Every dollar invested in nutrition returns US\$ 30 in increased health, schooling and productivity.

Micronutrient deficiency refers to the 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 may be referred to as hidden hunger, as often they present no visible warning signs, so sufferers may not be aware of their existence despite the disastrous consequences.

## Vitamin A

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 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, pumpkin, amaranthus and other dark green leafy vegetables, and breadfruit. Typically the deeper the colour of the fruit, vegetable or root, the higher the concentration of vitamin A. Some animal products are also very rich in vitamin A, including liver, whole milk, egg yolk, fish and fish oils. Cooking oils, margarines and sugar may be artificially fortified with vitamin A and other nutrients. In order to maximize the benefits from vitamin A rich foods, it is important to eat them together with a small amount of fat, which helps the body absorb and use the vitamin.

If incorporated into the diet, OFSP can help eliminate vitamin A deficiency in children and adults. The OFSP root is eaten after boiling or roasting or is mashed into a puree for use in a range of products including bread, chapatis, cakes, juices, porridge etc. Just one medium-size root or a handful (150 g) of OFSP pieces can meet a child's daily needs of vitamin A. In most locations across SSA, an area of just 500 m<sup>2</sup> of OFSP can provide enough vitamin A for a family of five each year. The roots can also be cut into small pieces, sun-dried and stored as an important food stock, although this has to be done carefully to maintain the beta-carotene levels. In addition to the vitamin A and energy that OFSP roots provide, they have high levels of vitamins C and E, several B vitamins, iron, zinc, potassium and fibre. The good levels of fibre mean the glycaemic index of sweetpotato roots is moderate, i.e. 70 compared with 111 for baked Irish potato. OFSP is a gluten-free, high energy food. Across SSA, OFSP is one of the cheapest sources of vitamin A.

## 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 our nutritional awareness and understanding and bring about behaviour changes that will see us eating a diverse and balanced diet as opposed to one predominantly composed of starchy carbohydrates.

Approaches for raising nutritional awareness will need to be adapted for specific consumer groups (e.g. grandmothers, traders, food processors, male or female farmers, teenagers, local leaders, school teachers, and school cooks) and will need to build on and integrate into the existing nutritional beliefs and food systems of the target populations.

The promotion of solutions to micronutrient malnutrition is particularly challenging because micronutrient deficiencies are often hard to detect and can go unnoticed until they are severe. If people do not realize that they have a problem, they will not likely take up behaviours promoted as solutions by others who are aware of the problem. Therefore, there is a need to start with creating a 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 and milk

These might include antenatal nutrition sessions, radio/ TV programmes, community info-seminars, posters, drama, primary and secondary school level modules on the importance of vitamin A to all age groups, the need for a balanced diet and the main food groups, the value of OFSP, how to grow the crop, good child-feeding practices, and other foods rich in vitamin A.

Designing and implementing programmes that will **enable actual nutritional behavioural change**, typically related 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;
- Community nutrition group sessions led by trained extension or community health workers and intended for various groups, including those who influence nutritional behaviours 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;
- Advertising campaigns on subsidized access to OFSP planting materials and OFSP products.

## Resource requirements

Activity	Year 1	Year 2	Year 3	Total (US\$)
Local nurses working on mother and child nutrition – 1 day workshop	4,500	4,500	0	9,000
Community nutrition group training on vitamin A rich foods – ½ day	1,760	5,280	7,040	14,080
CNG training on balanced diets 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 a cooking demo – ½ day	2,640	7,920	10,560	21,120
<b>Total</b>	<b>12,420</b>	<b>28,260</b>	<b>31,680</b>	<b>72,360</b>

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

Farmers in locations with limited road and market linkages perceive the marketing of fresh sweetpotato roots as problematic. Markets are often located far from farming areas, meaning high transport costs, given the bulky nature of the crop, or farmers are forced to take whatever farm-gate price the sole trader buying from their area offers. Rural markets are typically oversupplied around the harvest season, but fresh roots eventually become scarce, leading to large seasonal price variations.

Sweetpotato supply chains tend to be short because of the bulkiness of the crop, its short shelf life and its relatively low value. Large-scale traders move sweetpotato in trucks, using local agents to locate and arrange the bulking of the crop before the truck arrives. Small traders use bicycles, motorbikes or public transport to move sweetpotato. In many SSA countries, the market retailing of sweetpotato roots and customer interaction are done mainly by women, while travelling to the rural areas to obtain the roots is usually done by men.

In urban markets, fresh sweetpotato roots are traded most of the year. Traders regularly purchase fresh roots from several geographical areas to create a fairly continuous year-round supply.

The cost and the tax arrangements for sweetpotato transporters and urban markets in East Africa have led to sweetpotato roots being jammed into large extended bags, which are difficult to carry and are responsible for bruising and damaging many of the roots they contain. This lowers the quality of the roots and further shortens their already short shelf life. Farmers usually obtain market price information from traders or neighbours, although mobile phones are increasingly playing this role.

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

Rapid urbanization, population growth, shrinking farm sizes, climate change and variable staple food prices are expected to drive the increase in consumption of sweetpotato across SSA.



Market orientation: meeting customers' needs.



An analysis of the sweetpotato value chain will identify the weak links and the opportunities for strengthening them. The process typically involves analysing prices, volume data and operations, and relationships at each point along the value chain, taking into account the relevant cost factors such as labour, inputs, transportation, taxes etc. and the returns on the produce marketed. This information can then be used in scenarios with higher volumes of consumed or sold sweetpotato roots and benefits realized from improvements in production yields, product quality, postharvest procedures, processing, market diversification etc. Following this, the opportunities for upgrading the activities and improving the returns (whether food or income) through transformation along the value chain are evaluated and used to develop a work programme e.g. for clean seed; new varieties; production practices; nutritional knowledge of farmers, consumers and traders; postharvest handling; fresh root storage to extend availability; improved relationships between the value chain players; farmers' marketing skills; new sweetpotato products such as breads or animal feed; and service providers' capacity.

Marketing activities could include market assessment; root price monitoring; trader identification and training on OFSP; formation of OFSP farmer marketing groups and their training on business skills and negotiations, OFSP crop management and postharvest handling; and promotion and promotional events.

Several African countries export sweetpotato out of Africa. Egypt and South Africa are currently the largest exporters, but smaller scale exporting to the European Union is happening in many countries, often by air cargo. Prior to exporting, the soil-free packaged roots have to be inspected by the plant health authorities and a certificate issued. Traceability standards are also gaining increasing importance.



Sweetpotato ready for export.

### Marketing OFSP processed products

Many of the fresh root marketing constraints are relevant also to processed OFSP product value chains. But those intending to market processed OFSP products also need to:

- Identify their target groups of customers;
- Find out about the current and potential OFSP product opportunities for those groups;
- Develop and test OFSP products, answering questions such as, is it cost-effective to substitute some wheat flour with sweetpotato flour or sweetpotato puree? Do consumers like this change?
- Develop relationships with others involved in the value chain;
- Develop attractive, cost-effective packaging that will keep the product in good condition;
- Determine the price and promotion and distribution methods for the OFSP products;
- Monitor the market to retain customers and develop new products.



A growing number of processed OFSP products are being marketed in SSA, including bread loaves, biscuits, flour and juice, while more others are sold locally in the farming communities such as 'mandazi' (doughnuts), crisps, chapatis, crackles and chips.

The key supply issues limiting the processing of OFSP products include the unreliability of the root supply; the poor quality of dried chips associated with poor drying techniques and the high labour inputs required to wash, peel and chip sweetpotatoes; and organizational and market development constraints.

Some drying and storage techniques reduce the beta-carotene content of OFSP, which then limits its nutritional value in the processed products. Food preparation methods can also reduce the beta-carotene levels, but if



25% or more of the wheat flour is replaced with medium- to dark-intensity OFSP in puree or flour form, the product will contain significant amounts of pro-vitamin A.

While a huge range of delicious processed products can be made from sweetpotato, it is important to carefully figure out which of these makes commercial sense in your specific context, what the purchasing power of the local communities is, and whether you should use OFSP puree or flour. Since 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, it usually makes economic sense to use puree if a reliable source of fresh OFSP roots exists for most months of the year. Projections suggest that SSA will be importing 35.4 million tonnes of wheat by 2050, or about 80% of its demand. Clearly, there are opportunities to replace some of these imports with locally produced ingredients.

**OFSP Golden Power Biscuits – US\$ 342,000 of sales from one factory in 2 years**

#### Sweetpotato superfoods in Rwanda

Recipes were developed and test-marketed for four OFSP products: biscuits, ‘mandazi’ (doughnuts), bread and queen cakes.

The Urwibutso (SINA) Enterprise then began purchasing OFSP roots from local farmers (mainly women) who had obtained high yielding planting materials and crop management training from the project. The factory processed the roots into a puree and produced biscuits and mandazi. An attractive tube or aluminium foil 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 had factory gross sales of US\$ 146,490 from the OFSP Golden Power Biscuits and mandazi. This increased to US\$ 195,384 in 2013/14.



Experience from Mozambique, Rwanda, Uganda and Kenya suggests that product-related training efforts should focus on people already engaged in selling processed products or those in businesses such as restaurants that serve such products. As such people integrate OFSP into their commercial products, demand for fresh roots and high yielding OFSP varieties will increase rapidly, helping OFSP farmers, many of whom are women, to earn better incomes from expanding OFSP root sales. It is important to align the growth of root production with that of the value-added products to prevent raw material supply shortages. Packaging can make or break a product’s success and needs to be tested.

### 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 & retail) & 2-day 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, (5) designing a 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
<b>Total</b>	<b>18,460</b>	<b>27,840</b>	<b>5,940</b>	<b>52,240</b>

## 4.10 Processing OFSP

### Value-added OFSP

OFSP roots are usually consumed after boiling, steaming or roasting. However, there are other ways in which they are prepared that increase their value. The fresh OFSP roots can be boiled and mashed into a puree or transformed into flour. These primary products can be used as ingredients to replace some of the wheat flour in a range of popular, value-added products such as bread, mandazi, chapatis, cakes etc.

By consuming just one OFSP chapati, a child can obtain 100% of the vitamin A daily requirement. OFSP can also be mixed with millet, cassava, amaranthus, roasted soybean or maize flours and used to produce a nutritious porridge.



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



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



Chapati from OFSP and wheat flours at 30:70 ratio



Relish made from sweetpotato leaves

Sweetpotato flour is more complex to make than sweetpotato puree, and the beta-carotene is more easily lost during flour preparation, particularly if the product is stored for more than a month. Sweetpotato flour produces a lighter product, which makes it easier to transport and store, and it can be easily used to replace 25–50% of wheat flour in many recipes. Using sweetpotato puree in such products 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. Sweetpotato puree is being used commercially in bread, where it constitutes up to 30% of the ingredients; in mandazi, constituting up to 40% of the dough; and in biscuits, where it makes up to 45% of the ingredients. Profit levels are determined by the relative cost of sweetpotato roots or flour compared to wheat flour and the degree of substitution. Most new products require support and promotion to develop a market demand. A major supermarket in Kenya is incorporating OFSP into its bakery line, improving the nutritional value of the bakery products and increasing profits through substituting some of their wheat flour with the much cheaper OFSP puree.

In Rwanda, the Sweetpotato Superfoods project has worked with large-scale processors to produce OFSP biscuits, mandazi and juice, and marketed them in improved packaging. Most processors will initially require support in developing their supply chains, consumer testing, packaging and marketing their OFSP products.



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

In China, Japan and elsewhere there are many commercial sweetpotato products.



Breakfast cereal, snacks and baby food made from sweetpotato.

### Using OFSP to improve household nutrition

For rural households, emphasis should be put on adding OFSP to the existing diet several times a week. Boiled, fried or roasted sweetpotato can be incorporated into the households' weekly menu. OFSP can be 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. The young, tender leaves can be eaten as a vegetable, prepared as most African leafy vegetables are. Better-off households may be encouraged to use OFSP in pastry products.



Sweetpotato can be one of the first complementary weaning foods that infants receive at 6 months, helping to fill their small stomachs with a thick nutritious porridge. Weaning porridges should be thick and need to 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 its naturally sweet flavour.

Sweetpotato can also be used as animal feed. The wilted 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 first and then add to them supplementary fish meal or soy beans to increase the protein content. Some farmers chop up the roots and dry them as chips and cut and dry the vines as hay. The vines can also be fermented or made into silage.



### Resource requirements

#### Producing OFSP processed products

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 & 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
<b>Total</b>	<b>1,080</b>	<b>20,480</b>	<b>1,000</b>	<b>22,560</b>

## 4.11 Enhancing multisectoral collaboration

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

Malnutrition is a complex and multifaceted problem that a single institution is unlikely to be able to address adequately. To reduce malnutrition, there needs to be increased interaction and collaboration between the health and other relevant sectors (Figure 6). Multisectoral collaboration could involve relationships between different sectors at the same government level, between agencies at different government levels, and between 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 having a shared vision, a provision for institutional incentives and an understanding of how others gauge the costs and benefits of participation in the OFSP work. It is unrealistic to imagine that 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 the collaboration sustainable and functional. The management styles and approaches of the individuals involved play a large role in the success of multisectoral processes.

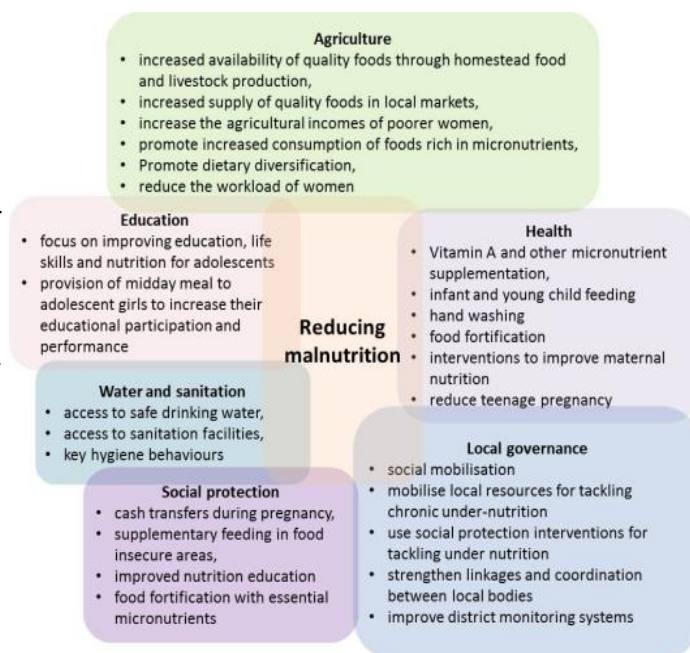


Figure 6 – Roles of the various sectors in reducing malnutrition.

Given the diversity of farming environments and the types of changes occurring and their rates, there is a need to enhance local 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 several approaches, as they are largely aimed at the underlying causality factors, which are at the community or family level and nearly all are in the domain of non-health sectors.

Multisectoral plans can often be very broad and may propose an unrealistic number of measures and actions for each sector without focus or priority, which will cause problems with their implementation downstream. Strategic entry points should be identified and prioritized in each sector for real impact to result.

### 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
<b>Total</b>	<b>2,400</b>	<b>600</b>	<b>1,800</b>	<b>4,800</b>

## 4.12 Monitoring, measuring and sharing the impact of your investment

To determine whether your OFSP investment is making a difference and to whom, in what ways, at what scale, and over what time frame, you 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 plan 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 7).

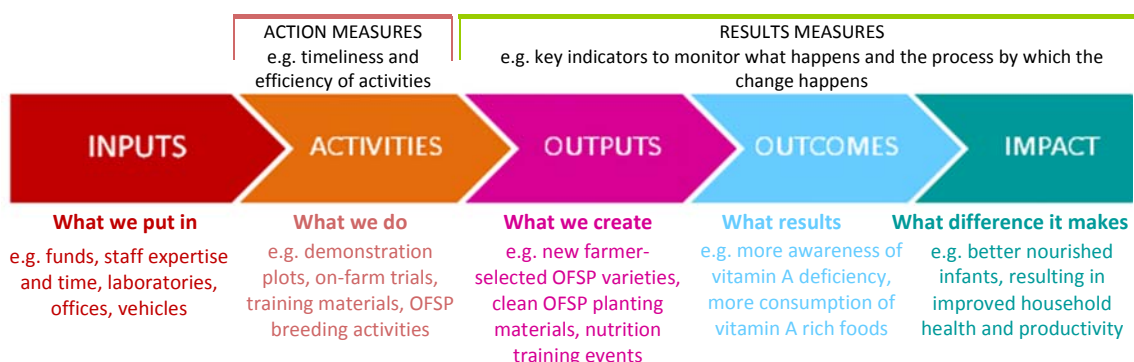


Figure 7 – Different aspects of an investment’s logic that need monitoring and evaluating.

Determine what information you will need to collect in order to prove that your investment has had the anticipated impact. How will you obtain that information? For example, will it be from existing data, questionnaire surveys or focus group discussions? And who will collect it, enter it into a database or 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 or farmers trained on various aspects of OFS, the frequency of consumption of OFSP and other vitamin A rich foods by young children, the level of understanding of the nutritional benefits of OFSP, and vitamin A deficiency levels.

It is useful to collect the information before and after making the investment to be able to assess the change that occurs. However, ongoing monitoring throughout the activities will enable you to see if things are going according to plan. It is important to incorporate review or reflection opportunities, as changes often need to be made to initial plans.

### Resource requirements

Activity	Year 1	Year 2	Year 3	Total (US\$)
Technical assistance and workshop to develop impact pathway and design the 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 & refresher training (2 d/m 15 pers.)	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 write-up	9,000	0	9,375	18,375
Stakeholder dissemination meetings (at national & district level)	0	0	10,000	10,000
Best practice briefs	0	1,000	2,000	3,000
<b>Total</b>	<b>109,140</b>	<b>62,040</b>	<b>109,415</b>	<b>280,595</b>

## 4.13 OFSP advisory services

It is our hope that as you read this *OFSP Investment Guide* you started planning how you will invest in the OFSP value chain in order to improve health and wealth across your country. The more detailed *OFSP Investment Implementation Guide* provides further practical information and is available at <http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides/>.

If you have further questions, please contact the specialists listed below.

	Investment questions	ToT course on 'Everything you ever wanted to know about sweetpotato'
<b>Tanzania</b>	Dr Nessie Luambano Sugarcane Research Institute, Sweetpotato Program - Kibaha Email: nluambano@yahoo.com	Dr Anna Temu Dept of Agric. Economics and Agribusiness Sokoine University of Agriculture (SUA) Email: aatemu@gmail.com
	Margaret Benjamin Helen Keller International (HKI) – Tanzania Email: mbenjamin@hki.org	Dr Joyce Lyimo Macha, Associate Professor, Institute of Continuing Education Sokoine University of Agriculture (SUA) Email: joylimac2@yahoo.com
<b>Mozambique</b>	Dr Maria Isabel Andrade CIP – Mozambique Email: M.Andrade@cgiar.org	Dr Angela Loforte Remane Faculty of Agronomy and Forestry Engineering University of Eduardo Mondlane (UEM) Email: angelaloforte63@gmail.com
	Helen Keller International (HKI) - Mozambique Email: info@hki.org	Elias Munda CIP – Mozambique Email: E.Munda@cgiar.org
<b>Nigeria</b>	Dr Jude Njoku National Root Crops Research Institute (NRCRI) Email: J.Njoku@cgiar.org	Mr Anthony Njoku Agricultural and Rural Management Training Institute (ARMTI) Email: njokuzo@yahoo.com
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	Dr Simon Heck International Potato Center (CIP) Email: S.Heck@cgiar.org	Dr Hilda Munyua International Potato Center (CIP) Email: H.Munyua@cgiar.org

In case of problems with the web links, please contact: Luka Wanjohi of CIP on [L.Wanjohi@cgiar.org](mailto: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 diseases, 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, highlighting the need for an integrated and holistic approach to addressing vitamin A deficiency.



If incorporated into a diet, orange-fleshed sweetpotato (OFSP) varieties can help prevent vitamin A deficiency in children and adults. This is due to their high beta-carotene content, which is converted into vitamin A in our bodies. OFSP production improves household food security and provides income generating opportunities. The OFSP root can be boiled or roasted and mashed into a puree for use in a range of products including breads, chapatis, porridge, cakes and juices. In most locations across SSA, an area of just 500 m<sup>2</sup> of OFSP can provide enough vitamin A each year for a family of five.

This *OFSP Investment 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 key investment opportunities exist along the OFSP value chain is presented. Each of these investment areas is then unpacked in more detail, providing 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.

An example OFSP value chain investment programme is presented. It is designed to reach 10,500 direct beneficiary households with young children (organized into community nutrition groups of 30 members). In-built spillover activities will allow OFSP planting materials and nutritional information to reach a further 33,000 households indirectly within the proposed three-year time span, with the potential for further spillover after that. The main outcomes of the OFSP investment programme are 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 adding value to their OFSP roots or vines through processing. The OFSP investment programme described in this document deliberately builds the capacity of all those involved in the OFSP value chain so that these activities will inevitably continue beyond the initial 3-year programme.

This guide is targeted at national level technical experts in public, private and development institutions to support them through multisectoral and multi-stakeholder actions to identify and attract investments and implement pro-poor, nutrition-sensitive agricultural growth and vitamin A deficiency reduction programmes. We hope this guide will support and inspire those developing and managing OFSP investment programmes. If you have further questions please contact the OFSP advisory services contacts found in section 4.13.

Two related OFSP investment products have also been developed:

- The *OFSP Investment Summary* for policy-makers and high level management;
- The *OFSP Investment Implementation Guide* intended for those implementing OFSP investment programmes, providing details on the activities required to transform OFSP value chains.

These publications are available at <http://sweetpotatoknowledge.org/projects-initiatives/reaching-agents-of-change-rac/ofsp-investment-guides/>.



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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.

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