



Nutritious Orange-fleshed Sweetpotato for Niassa

**Project Final Technical Report
November 2012–December 2016**

Prepared for:

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Submitted by:

The International Potato Center (CIP)



Nutritious Orange-Fleshed Sweetpotato for Niassa

**Contract Number: 8/GRANT/12/MOZAMBIQUE for Irish Aid
Agreement Period: 1 November 2012 – 31 December 2016**

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TABLE OF CONTENTS

Abbreviations and Acronyms.....	ii
Acknowledgment.....	iii
Executive summary	iv
1. Introduction.....	1
2. Project Background	1
2.1 OVERALL OBJECTIVE OF THE PROJECT	1
2.2 TARGET AREA/GROUP.....	2
2.3 MAIN ACTIVITIES AND ACHIEVEMENTS MADE	2
3. Project management and partnerships.....	8
3.1 STAFF STRUCTURE AND EQUIPMENT.....	8
3.2 PARTNERSHIPS	8
3.3 MONITORING AND EVALUATION.....	10
3.4 COORDINATION MEETINGS.....	10
4. Project progress: Implemented Activities and outputs achieved against agreed work plan.....	11
4.1 SPECIFIC OBJECTIVE 1: INCREASE VITAMIN A AND ENERGY INTAKES	11
4.2 SPECIFIC OBJECTIVE 2: INCREASE SUSTAINED ACCESS TO QUALITY PLANTING MATERIAL AND IMPROVED KNOWLEDGE OF OFSP.....	14
4.3 SPECIFIC OBJECTIVE 3: DEVELOP FRESH ROOTS, VINES AND BREAD MARKET IN LICHINGA	18
4.4 SPECIFIC OBJECTIVE 4: MANAGE PARTNERSHIPS AND INTEGRATE EFFORTS INTO PROVINCIAL-LEVEL MULTISECTORAL PLANNING AND IMPLEMENTATION EFFORTS CONCERNING FOOD SECURITY AND NUTRITION	22
5. Key Issues	25
6. Significant developments in the sector	27
7. Incorporating Lessons LearnT.....	27
8. Case studies.....	28
9. Financial report.....	30
10. Conclusion	30

Tables

Table 1. Planned main activities and the achievements during the project implementation: Nutritious Sweetpotato for Niassa.....	3
Table 2. Beneficiaries for the four years of the project 2012 - 2016.....	17
Table 3. Puree production cost	20

Figures

Figure 1. Intervention zones in Niassa Province.....	2
Figure 2. Root taste tests in four districts, in percentage by gender.....	15
Figure 3. Means of storage root and and vine yield (Mt/ha) for 10 varieties in four districts.....	15
Figure 4. Mean of storage root and vine yield (Mt/ha) at 33 sites in four districts.....	16
Figure 5. Beneficiaries per district and per partner	18
Figure 6. OFSP value chain in Niassa	19
Figure 7. Price differential of processing power bread	21
Figure 8. OFSP Production cost and net return according to the yield.....	22
Figure 9. Curve of puree production cost in Meticaís.	22

ABBREVIATIONS AND ACRONYMS

AP	Associação Progresso
ADPP	Ajuda de Desenvolvimento do Povo para Povo
CIP	International Potato Center (Centro International de la Papa)
DPASA	Director Provincial da Agricultura e Segurança Alimentar
DVM	Decentralized vine multiplier
FOFEN	Forum das Organizações Femininas do Niassa
HDDS	Household dietary diversity score
HH	Household(s)
IDDS	Individual Dietary Diversity Score
IAM	Instituto de Investigação Agrária de Mocimboa do Ocidente
INGO	International non-governmental organisation
kg	Kilogram
L	Litre
M&E	Monitoring and evaluation
MLE	Monitoring, learning, and evaluation
MMMR	Movimento de Mulher Mozambicana Rural
Mzn/MZN	Meticais
Mzn/ha	Meticais/hectare
Mzn/kg	Meticais/kilogram
Mt/ha	Metric tonnes/hectare
NGO	Non-governmental organisation
NPK	Nitrogen–phosphorus–potassium fertilizer
OFSP	Orange-fleshed sweetpotato
OFT	On-farm trial
PAMRDC	Plano de Acção Multi-sectorial para a Redução da Desnutrição Crónica
SDAE	Serviço Distrital de Actividade Economicas
SETSAN	Secretariado Técnico de Segurança Alimentar e Nutricional
SUN	Scaling-Up Nutrition
ToT	Training of trainers
UCA	União dos Compostos e Associações de Lichinga
VAD	Vitamin A deficiency

ACKNOWLEDGMENT

The International Potato Center (CIP) expresses its appreciation to the Government of Mozambique through Niassa Provincial Directorate of Agriculture for its support in the implementation of the project, “Nutritious Sweetpotato for Niassa”. We also thank Irish Aid for providing the funds that enabled CIP to implement the project activities for the past 4 years. The project made significant contribution to food and nutrition security in Niassa Province as a whole. We also thank all partners, direct or indirect, for their significant contributions to project milestones and objectives.

The project was implemented in eight districts in partnership with several organisations: Provincial Directorate of Agriculture and Food Security, Department of the Governor of Niassa, through the District Service of Economic Activities (SDAE) and its extension agents, Technical Secretary of Food Security and Nutrition (SETSAN) expanding the orange-fleshed sweetpotato (OFSP) outside of the intervention zone, and the Instituto de Investigação Agrária de Mozambique (IIAM). We also acknowledge the support of Associação Progresso, Anglican Diocese of Niassa, and União dos Camponeses e Associações de Lichinga (UCA) e Forum das Organizações Feminino do Niassa (FOFEN) on vine distribution; Ajuda de Desenvolvimento do Povo para Povo (ADPP) and WeEffect on sensitization about OFSP at their community-based organisation beneficiaries; Padaria Pastelaria Maria, Pastelaria Pastry Safeera, Padaria de Niassa, Padaria Sanjala, Pao Dourado, Padaria Abas, Padaria de Mandimba, and Padaria de Cuamba on demand creation of the OFSP for urban consumers; and the platform of international non-governmental organisations for sharing information and expand OFSP production by other institutions outside of intervention zones such as Mundukide in Marrupa.

Thanks to all CIP technical experts and colleagues for their continuous advice and commitment in supporting the project during its lifespan. Finally, we thank all the beneficiaries; it is with them that we measured our achievements on eliminating food insecurity and improving the nutrition in all households (HH) in Niassa Province.

EXECUTIVE SUMMARY

Malnutrition and vitamin A deficiency (VAD) among young children are among the biggest challenges in developing countries. Niassa Province in Mozambique has the highest number of HH with malnourished children below the age of 5 years. To address this issue, Irish Aid funded a 3.5-year project, “Nutritious Orange-fleshed Sweetpotato for Niassa”, implemented by CIP and partners.

Mozambique’s multi-sectorial action plan on the reduction of chronic malnutrition in the country between 2011 and 2015 was endorsed at the highest level of government (Republic of Mozambique 2010). The government has strong political support at the provincial level for concerted efforts to combat the province’s high rates of malnutrition, echoed at national level through Mozambique’s “early-riser” status as part of the Scaling-Up Nutrition global initiative. Food-based approaches using pro-vitamin A-rich OFSP are recognised as an effective strategy for helping to combat VAD.

This report summarises the activities during the project implementation (1 November 2012–31 December 2016) in Niassa Province. The activities included:

1. The opening of the project office in Lichinga, the recruitment of CIP staff for the project, signing of sub-grant agreements with partners, and purchase and acquisition of different project assets and equipment in its first and second years.
2. Introducing nine OFSP varieties into Niassa Province by CIP/IIAM at the end of December 2012, through participatory on-farm trials (OFT); establishment of decentralised vine multipliers (DVMs) during the first two years in two intervention zones of Niassa Province; and introducing 76 breeding lines for multi-location trials at IIAM, followed by OFT in Lago and Chimbunila districts in the second year season. Seven of these lines were later released in Mozambique in 2016.
3. Capacity building of more than 760 participants; 74 field technicians (13 females) from 11 partners. Capacity was built on general agronomy of OFSP for root production and vine multiplication, vine conservation, processing and storage of harvested roots, and other post-harvest practices. Participants were trained in the techniques of responding to emergencies in terms of seed supply, baseline, and endline surveys.
4. The performance of the DVMs was good, and the project milestones and objectives were met. CIP supported the establishment of net tunnels by 25 primary DVMs to help maintain virus-free, clean vines. Fifteen DVMs successfully managed to conserve and multiply vines through the net tunnel system, and the project supported 57 secondary DVMs who were able to distribute OFSP vines to the intervention areas and beyond.
5. Awareness of OFSP was achieved through campaigns during field visits, opening of the agricultural season, and followed immediately by dissemination of the adapted and adopted varieties through association networks and “Equipa de Vida”. NGOs such as Associação Progresso (AP), União dos Camponeses e Associações de Lichinga, and Anglican Diocese, as well as SDAEs were involved in the campaigns and dissemination of OFSP planting material. A total of 28,044 HH benefited through these partnerships by the end of the project. Some 78% of these HH had children under 5 years, with 37,262 children benefitting. At least 56,000 HH indirectly benefitted. Mundukide project, SDAEs Mecula, and Metarica received OFSP vines, and the SDAEs displayed OFSP roots during Nutrition Gala in August 2016.
6. Nutrition training and culinary demonstration were organised together with the Anglican Diocese and AP for project beneficiaries. This was after implementing partners had been trained in dietary practices. The training was used as a strategy to shape the intervention and develop key nutritional messages and other teaching materials. This was done in

collaboration with SETSAN, the provincial health department. A training package comprised six topics areas on nutrition. A total of 109 nutrition animators selected by Anglican Diocese at 7 communities were trained and who in turn cascaded the training to about 2,180 nutrition counsellors. These counsellors reached 13,109 HH directly within six months (January–June 2016). A total of 18,784 HH (17,009 females) participated in nutrition training from July 2014 to July 2016.

In 2013, a baseline survey was conducted among 396 HH living in 24 communities in eight districts. In 2014, a market survey was also conducted in four districts. In 2015, a preliminary assessment was conducted with 271 HH in eight districts and, in 2016, a project evaluation was conducted among 1,032 HH in these previous eight districts.

As part of the OFSP value chain approach, OFSP puree was introduced into bread making. The resulting bread was named “power bread” composed of 30–40% OFSP puree and 60–70% wheat flour. The training was offered to provincial bakeries, small bakeries, and women who sell cakes on the streets as a way of diversifying the use of OFSP. The bakeries—Padaria Maria, Padaria Doradouro, Padaria de Niassa, Padaria Sanjala, Padaria Abass, Padaria de Mandimba, and Padaria de Cuamba—participated in the training. One of the bakeries, Padaria de Sanjala, has incorporated production of power bread into their long-term plans. Other bakeries (e.g. Padaria de Mandimba and de Cuamba) started making power bread in 2016. Product sensory test results conducted with 1,047 participants showed that 90% of consumers preferred power bread (with 35% of OFSP) over whole wheat bread (100% wheat flour).

Annual evaluation and planning meetings were held in Lichinga with all partners and Irish Aid representatives. These were followed by operational planning meetings at the district level.

A no-cost extension for the project was requested in Y3, and a proposal for an interim phase of the project for 2017 was submitted to Irish Aid in 2016. Project partners such as SDAEs, Ajuda de Desenvolvimento do Povo para Povo, the feminist-based forum in Niassa, and the Netherlands Development Organization Mundukide have included OFSP in their agriculture and nutrition programmes for 2017 and beyond.

1. INTRODUCTION

The average national population density in Mozambique is reported as 30 persons/km². However, in Niassa Province, the population is more sparsely distributed, with about 11–12 people/km². The province suffers from very high rates of child malnutrition: national statistics indicate that 44% of the children were malnourished in 2013.¹

To help reduce malnutrition among children, the International Potato Center (CIP), with funding support from Irish Aid and together with some provincial partners, led the implementation of the project “Nutritious Orange-Fleshed Sweetpotato (OFSP) for Niassa”. The project was for 3.5 years (November 2012–December 2016), including a 9-month no-cost extension phase. The project was implemented under the following themes: nutrition, agriculture, marketing, and capacity-building components targeting at-risk groups to improve their intake of beta-carotene (a vitamin A precursor) and energy and boost their incomes. The project aimed to target at least 20,000 households (HH) with young children (less than 5 years of age)—the group most vulnerable to vitamin A deficiency (VAD). This target was reached by expanding production and consumption of OFSP in Niassa Province as well as by selling and processing the surplus of storage roots. OFSP is well established and is currently among Niassa’s main crops (as mentioned specifically in Objective 4 of Plano de Cacao Multi-sectorial para a Redução da Desnutrição Crônica (PAMRDC), led by the Secretaria Técnico de Segurança Alimentar e Nutricional (SETSAN). By the end of the project, planting material for OFSP varieties is now multiplied beyond the initial intervention districts of the project.

This technical report is the eighth and final one of the project to be submitted by CIP to Irish Aid.

2. PROJECT BACKGROUND

2.1 OVERALL OBJECTIVE OF THE PROJECT

The overall objective of the project was to improve the intake of vitamin A and energy intake of at least 20,000 rural HH with women and young children under 5 years. The approach used OFSP-based products, ensured that at least 20% of HH growing OFSP earned at least \$50/year from OFSP sales, and increased average sweetpotato yields by 50%. Capacity building and testing novel approaches to maximise impacts from OFSP-based nutritional and agricultural programming were keys to achieving the overall objective. The project had the following specific objectives:

- Increase intake of vitamin A and energy of 20,000 vulnerable HH (particularly those with pregnant women and children under 2 years) by (1) linking access to nutritious OFSP roots and leaves and improved nutritional knowledge to other community programmes, and (2) strengthening the capacity of implementing organisations to integrate agriculturally sensitive interventions into their on-going programmes and promote second-season cropping.
- Increase sustained access to quality planting material and improved knowledge of OFSP production by building the capacity of the Instituto de Investigação Agrária de Mocimboa do Ocidente (IIAM) and other partners to establish, train, and support private decentralised vine multipliers (DVMs) and their ability to serve as knowledge centres for improved crop husbandry, storage, and utilisation techniques.
- Support the local market development for fresh roots, vines, and processed products by:
 - Conducting promotional campaigns to increase demand
 - Developing and disseminating improved storage of fresh roots
 - Introducing “power bread” and developing a supporting supply chain.
- Manage project partnerships and collaborate closely with provincial-level policymakers through SETSAN and other nutrition-focused activities. These activities were developed as

¹ SETSAN report 2015.

part of the Scaling-Up Nutrition (SUN) effort to ensure that OFSP is fully integrated into provincial-level, multisectoral planning and implementation efforts concerning food security and nutrition.

2.2 TARGET AREA/GROUP

The principal target groups were poor, rural women and their young children (from 6 months to 5 years) in sweetpotato-producing areas within 8² districts: Chimbunila, Lago, Muembe, Sanga, Mandimba, Cuamba, Mecanhelas, and Lichinga (Fig. 1). However, attention was also given to men, especially influential community leaders and husbands, and mothers-in-law (who often have a considerable say in child-caring practices). This helped to ensure that beneficiaries understand the importance of investing in nutritionally rich foods and good care-giving practices, as they influenced decisions made and implemented. A second target group was urban consumers, many of whom rely on purchased foods. Poor urban women and children would particularly benefit from a diet that includes nutrient-rich roots. Understanding the breadth of preferences among high- and low-income consumers for fresh roots enabled farmers to better target their varietal selection and market to specific areas and target groups so as to realise more revenue from sweetpotato sales.

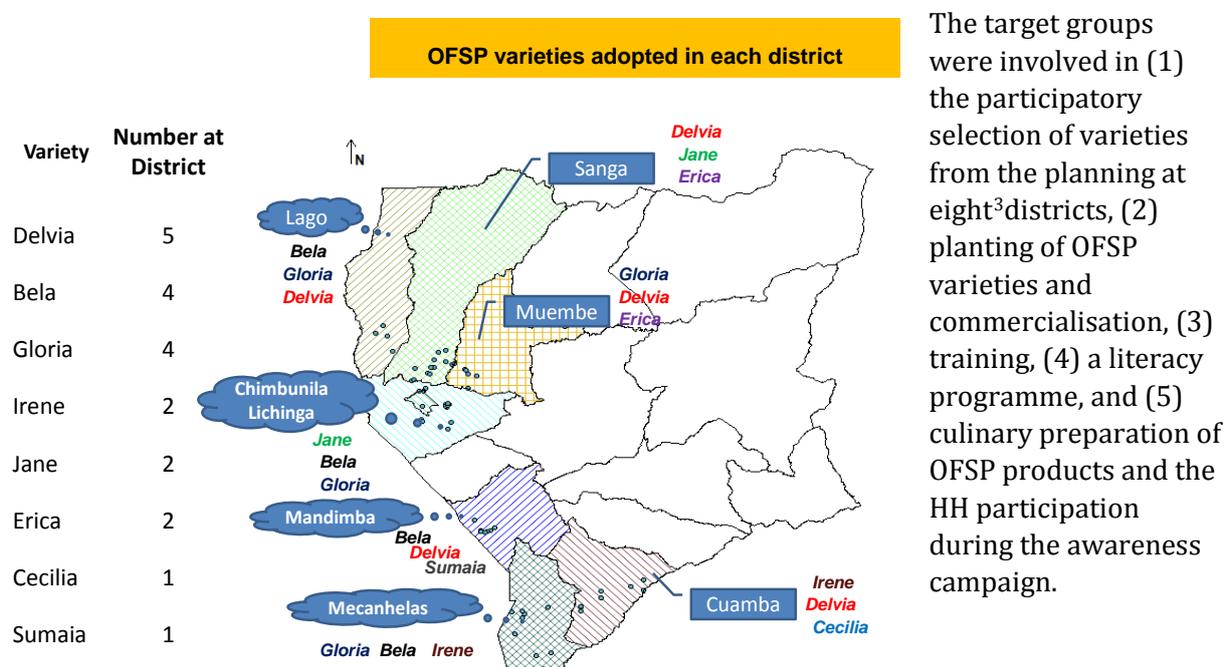


Figure 1. Intervention zones in Niassa Province.

2.3 MAIN ACTIVITIES AND ACHIEVEMENTS MADE

The activities for the project were discussed with Irish Aid annually. The details of the minutes with Irish Aid and the agreed matrix were annexed in previous annual reports. Summary of the main activities and project achievements are presented in Table 1.

²After June 2014, Lichinga becomes an independent district out of Chimbunila.

³Chimbunila and Lichinga are actually two districts as of June 2014, but the disaggregated results are still for seven.

Table 1. Planned main activities and the achievements during the project implementation: Nutritious OFSP for Niassa

VISION OF SUCCESS FOR PROJECT: The potential of OFSP to combat VAD and food insecurity has been recognised and acted upon by policymakers and several development agencies in Niassa Province, with at least 20,000 HH benefiting from increased frequency of vitamin A intake and 20% of them demonstrating 50% higher yields of sweetpotato and receiving at least \$50 or more in OFSP sales annually.

SPECIFIC OBJECTIVE 1: To increase vitamin A and energy intake in at least 20,000 vulnerable households			
ACTIVITIES	OUTPUTS	TARGET GROUPS	PERFORMANCE INDICATORS
1.1 In collaboration with SETSAN, the provincial health department, and expertise from Helen Keller, conduct formative research relating to “best-bet” behavioural changes in dietary practices and child care to inform strategy and develop key messages/teaching material	1.1 Report of strategy for achieving nutritional impact given the cultural context of major ethnic groups in Niassa that is reviewed by SETSAN stakeholders and modified.	Women with children under 5, pregnant women, very food insecure, or HIV-affected HH identified in collaboration with local authorities	<ul style="list-style-type: none"> • Report present and discussed at provincial and relevant district levels in 2014 • Education and communication materials developed have incorporated key messages developed during this activity
1.2 In collaboration with Associação Progresso (AP), develop material to integrate OFSP production and utilisation into the adult literacy programme and pilot test it in 8 groups in 4 districts (2 per district)	1.2 Report testing an innovative way of potentially delivering OFSP through linking it to adult literacy programmes, including an analysis of whether it is worthwhile to expand the intervention to other literacy groups	Illiterate individuals and their HH; teachers and education official linked to literacy programme	<ul style="list-style-type: none"> • Report reviewed and analysed by education officials as well as SETSAN stakeholders • Update of OFSP by illiteracy course participants in pilot experience and, if approved for expansion, in other groups
1.3 Conduct a baseline survey, capturing baseline information on sweetpotato production levels, levels of nutritional knowledge, and degree of dietary diversity	1.3 Baseline report, in a sample of at least 50 HH/district	Farm HH	<ul style="list-style-type: none"> • 75.5% of HH growing different types of sweetpotato • 9.1% of HH growing OFSP • 66.4% among target women and 70.3% of men have heard about vitamin A • HDDS of 25%, 28%, and 47% classified respectively as “low”, “medium”, and “high” dietary • IDDS for children aged 6–23 months, where 63%, 12%, and 25% classified respectively as “low”, “medium”, and “high” dietary
1.4 Integrate key nutrition and health messages, alongside agricultural messages, into selected community nutrition/health efforts, testing vouchers as a tool to initially link young child-care givers to OFSP vine	1.4 Training and other communication materials used for integrating key messages and section in progress reports describing a test of vouchers as a dissemination tool	Women and men with children under 5 years, pregnant women, and community health workers	<ul style="list-style-type: none"> • 2,500 training materials tested in different community-level health and development projects • 16,000 updated training materials used from Y3 • 500 calendars, 500 T-shirts, and 900 capulana

multipliers. In Y1, two awareness-raising modules (on OFSP nutrition and agriculture) will be developed and tested with pilot health and literacy groups.			produced and distributed
1.5 Deliver training at scale in collaboration with development partners selected during Y1	1.5 Progress reports and final endline evaluation, detailing number of persons trained (disaggregated by gender) and the uptake of improved practices	Women and men with children under 5 years, pregnant women, and development agents	<ul style="list-style-type: none"> • 18,784 HH (17,009 women) trained on nutrition utilising OFSP and improved nutrition practices • 2 assessments conducted: December 2015 and June 2016; and reported submitted
1.6 Conduct a final impact assessment and produce results that integrate key monitoring data	1.7 Final assessment report	Donor, provincial-level officials, and district and community leaders	<ul style="list-style-type: none"> • 95.7% of HH growing different types of sweetpotato • 'Delvia', 'Gloria', and 'Irene' were the main preferred new OFSP varieties • 62.3% had access to diet information • HDDS of 19%, 53%, and 28% classified respectively as "low", "medium", and "high" dietary
SPECIFIC OBJECTIVE 2: Increase sustained access to quality planting material and improved knowledge concerning production of OFSP			
ACTIVITIES	OUTPUTS	TARGET GROUPS	PERFORMANCE INDICATORS
2.1 CIP supplies 8 new drought-tolerant OFSP varieties to the IIAM sub-station in Lichinga, and primary multiplication fields are established	2.1 Quality foundation planting material to be supplied to secondary multipliers	IIAM staff and identified multipliers	<ul style="list-style-type: none"> • 2.2 ha and 15 net tunnels under primary multiplication
2.2 Ensure key trainer of trainers among NGO partners attend Everything you ever wanted to know about sweetpotato course	2.4 At least 4 trained trainers who will train others	Extension personnel	<ul style="list-style-type: none"> • 8 extension personnel (1 woman) attending course
2.3 Establish agreements with Y1 partners and conduct on-farm trials in 7 districts, 12 trials/district, including taste tests (Y1)	2.3a. Partner agreements 2.3b. Report on on-farm trial results	Rural men and women producers and their children	<ul style="list-style-type: none"> • 49 out of 70 trials conducted with successful data collection and analysis performed
2.4 Develop key training material for DVMs and farmers in appropriate local languages	2.4 Portable flipcharts for training and training materials for extension personnel	Extension personnel	<ul style="list-style-type: none"> • 2 job tools developed and tested • 69 extension personnel (12 women) receiving training material
2.5 Establish key primary multiplication fields	2.5 At least 2 ha of primary multiplication established	IIAM station and private sector multiplier near Lichinga	<ul style="list-style-type: none"> • 15 primary DVMs (5 women) trained on net tunnel and OFSP vines management • 2.2 ha established and maintained

2.6 Identification and training of secondary multipliers in each district	2.6 At least 2 secondary multipliers established in 4 target districts by the end of Y2	Farmer multipliers	<ul style="list-style-type: none"> • 57 secondary DVMs (17 women) trained • 5.4 ha under management of secondary multipliers
2.7 Exchange visit by extension personnel, secondary multipliers, and selected smaller multipliers to visit DVMs in Malawi	2.7 Report on visit, including evaluation by participants of the value of the visit		<ul style="list-style-type: none"> • 6 participants in visits and key lessons learned
2.8 Identification and training of tertiary multipliers in each district	2.8 At least 80 DVMs established and trained by the end of project	Farmer multipliers	<ul style="list-style-type: none"> • The project used 2 levels of DVMs
2.9 Establish partner agreements for remainder of project and develop dissemination protocols integrated into selected partner programs using vouchers for DVMs, distribute vouchers, and assure adequate voucher redemption and monitor dissemination	2.9a Agreements with selected partners for scaling out 2.9b At least 15,000 direct beneficiary HH supplied with vines via DVMs 2.9c Databases of recipients, including village and varieties, received	Farmers, 75% being women with children <5-year-old	<ul style="list-style-type: none"> • Agreement with AP, Anglican Diocese, and SDAE at 8 districts signed • 28,044 HH—140% of the objective (14,405 women, 13,639 men)—received OFSP vines directly, with 78% with 37,262 children under 5 years • 55% 'Delvia', 24.3% 'Gloria', and 9.4% 'Irene' the most disseminated varieties at 406 villages over 8 districts
2.10 In final year, engage in widespread mass dissemination in key target areas to increase coverage alongside broader awareness campaign	2.10 At least 5,000 additional HH reached	Rural men and women producers and their children	<ul style="list-style-type: none"> • No. of beneficiary HH, with recipients disaggregated by gender
SPECIFIC OBJECTIVE 3: To develop the local market for fresh roots, vines, and a processed product			
ACTIVITIES	OUTPUTS	TARGET GROUPS	PERFORMANCE INDICATORS
3.1 Conduct an initial diagnostic study on sweetpotato markets (Nov./Dec. 2012)	3.1 Report on diagnostic study to understand potential interest for golden bread and status of fresh root markets	Bakers, growers within radius of Lichinga	<ul style="list-style-type: none"> • Not done
3.2 Conduct a second diagnostic study on sweetpotato markets after the sweetpotato harvest (May/June 2013)	3.2a Report on diagnostic study to understand the demand for sweetpotato roots, the characteristics of traders, and prices of sweetpotato relative to other vitamin A-rich foods and starchy staples 3.2b Strategy for market intervention	Traders, consumers within Lichinga area	<ul style="list-style-type: none"> • 28 traders interviewed • 202 small-scale producers interviewed • 55 roots consumers interviewed • 19 small bakeries interviewed • 1 bakery interviewed • 157 bread consumers interviewed • Focus group discussions conducted in 24 communities
3.3 Develop and implement preliminary	3.3 Description of campaign in	Consumers	<ul style="list-style-type: none"> • Niassa OFSP Logo painted at:

awareness campaign	progress reports		<ul style="list-style-type: none"> ○ 2 places at the central market in Lichinga: one where a woman always sells sweetpotato and one place for UCA member ○ 10 places in 5 districts (Lago, Sanga, Muemba, Chimbunila, and Mandimba)
3.4 Identify and develop 2 initial bakery links, including supply chains, and at least 2 promotion campaigns	3.4 Description of experience in progress reports	Bakers contracted farmers	<ul style="list-style-type: none"> ● Padaria Pastelaria Maria started in 2014 but abandoned in 2015 ● Formal contract not yet effective
3.5 Expand the number of bakers, including supply chain links, and at least 4 promotion campaigns	3.5 Description of experience in progress reports	Bakers contracted farmers	<ul style="list-style-type: none"> ● Other 6 bakers (Padaria de Niassa, Sanjala, Abas, Pao Dourado, Mandimba, Cuamba) and one cafeteria (Pastelaria Pastry Safeera) trained ● 112 small bakeries (47 women) from 8 districts trained
3.6 Economic evaluation on profitability of the golden bread marketing chain	3.6 Evaluation of profitability of the investment	Bakers contracted farmers	<ul style="list-style-type: none"> ● Profit margin of enterprise: US \$2.43–3.28/50-kg bag ● A woman selling OFSP fresh roots at the central market
3.7 Conduct operations research to assess consumer acceptance and functioning of the golden bread value chain	3.7 Operations research report	Consumers, bakers, and farmers	<p>With a yield of 20 Mt/ha and \$1 =75 MZN:</p> <ul style="list-style-type: none"> ● OFSP production cost = \$0.02/kg ● If OFSP roots price = \$0.07/kg, producers earn \$2.5/50-kg bag ● Puree production cost = \$0.13/kg ● If puree price = \$0.20/kg, puree producer earns \$3.28/50 kg of bag roots ● Actual wheat flour = \$0.45/kg. The baker earns \$2.43/50-kg bag more by using 30% of OFSP puree ● Power bread production shows a win-win business along the value chain ● More than 90% of 1,047 consumers surveyed appreciated the power bread than the flour bread
3.8 Final assessment of long-term economic viability and consumer acceptance of golden bread	3.8 Report on power bread value chain	Consumers, bakers, and farmers	<ul style="list-style-type: none"> ● One bakery producing power bread ● If the baker used 1,000 kg of puree (highest puree demand for 1 month), this baker generates an additional net return of \$255.8 more than when using wheat flour

SPECIFIC OBJECTIVE 4: Manage partnerships and integrate effort into provincial level multi-sectoral planning and implementation efforts concerning food security and nutrition			
ACTIVITIES	OUTPUTS	TARGET GROUPS	PERFORMANCE INDICATORS
4.1 Hold regular monthly planning meetings with key partners, and conduct partnership health check-up annually	4.1 Minutes of meetings and health check-up reports	Partners on project	<ul style="list-style-type: none"> • 34 meetings held and participant lists
4.2 Hold major annual stakeholder meeting	4.2 Minutes of meeting	Stakeholders	<ul style="list-style-type: none"> • 4 meetings held with 4 participant lists, including 4 participant evaluations of meeting
4.3 Participate regularly in SETSAN committee meetings and at least one other activity related to implementation of SUN programme in Niassa	4.3 Minutes of meeting	Stakeholders	<ul style="list-style-type: none"> • 19 meetings with SETSAN • One strategies/plans/projects with OFSP as a component
4.4 Participate in field days and other events to promote awareness of OFSP and nutrition improvement	4.4 Reporting of event outcomes in progress reports	Women and men with young children; other vulnerable HH	<ul style="list-style-type: none"> • 3 field days, 4 agricultural kick-offs, 3 nutrition events, 10 culinary contests and demonstrations, and 2 cultural musical song contests

NOTE: HDDS = Household dietary diversity score; HIV = Human Immunodeficiency Virus; IDDS = Individual Dietary Diversity Score

3. PROJECT MANAGEMENT AND PARTNERSHIPS

3.1 STAFF STRUCTURE AND EQUIPMENT

The project had one project manager, administrator/finance assistants, one monitoring, learning, and evaluation (MLE) specialist, technicians, and two drivers. The project manager was hired from 9 January 2013, to 8 January 2016, then a one-year extension until 31 December 2017.

The three administrator/finance assistants participated in the financial and administration training in Maputo and Nairobi in 2013, 2014, 2015, and 2016; learned English; and were refreshed on CIP's One Corporate System.

The two research technicians worked on variety selection and production of planting material as well as roots. Each had a different expertise: one was a researcher experienced in research design and variety selection, and the second one had experience in M&E, marketing, and business plans approaches. Both technicians came from IIAM-Lichinga.

Three M&E and marketing specialists were recruited during the lifespan of the project. The high turnover was due to technical challenges within the team. The second recruit on M&E participated in the MLE-community of practice training in Nairobi in 2014. He left due to other demanding responsibilities from IIAM-Lichinga. The third recruit participated in the MLE community of practice training in Kigali in 2016. Collaboration with the project field technician and the AP technician led the endline survey under the supervision of the country M&E specialist and project manager. He was skilled in computer management and, in particular, data management, including cleaning the data and data analysis. The project recruited two senior and two junior drivers over the 4-year period. Staff turnover was high.

The project procured two vehicles, two motorcycles, four laptops and two desktop computers, a printer, two scanners, seven office tables, nine chairs, two back-up generators, five irrigation kits used by technicians for demonstrations, seven irrigation pumps to support DVMs, one electronic scale, and one puree machine with a specific electronic balance.

3.2 PARTNERSHIPS

IIAM, Associação Progresso (AP), and Diocese de Niassa (Anglican diocese) were the official partners over the 4 years with sub-agreements. União dos Componeses e Associações de Lichinga (UCA) joined the project during Y1. CIP developed additional collaboration with Serviço Distrital de Actividade Economicas (SDAEs) of the eight districts for mass dissemination and data collection done by their extension agents for Y3 and Y4, and for the coordination of all OFSP activities at each district. The Ajuda de Desenvolvimento do Povo para Povo (ADPP) partnered with CIP to disseminate OFSP for nutrition at their intervention districts. Manda Wilderness Agricultural Project is working at Manda reserve communities in Lago district and initiated the OFSP production in collaboration with CIP. Additionally, CIP contributed to SETSAN's efforts (specific Objective 4) in all the project intervention districts, supplied OFSP planting materials to other districts, and continued to integrate into the INGO⁴ platform in Niassa since March 2014. On OFSP processing, seven bakers were trained on how to process OFSP into puree and flour and on baking power bread. Padaria Sanjala increased the daily usage of the OFSP puree for power bread and committed to continue in 2017. The project trained 81 small bakers (33 women) in eight districts for baking power bread with 30% of OFSP puree. A coffee shop, Pastry Safeera, in Lichinga that produces cakes and biscuits, stopped buying OFSP puree due to lack of refrigeration facilities for puree conservation.

⁴INGO regroups all international non-governmental organisation platforms to facilitate the coordination of activities on Niassa.

IIAM is CIP's long-term partner in Mozambique for breeding and other research for development programmes. The project implementation site was in IIAM's Niassa north-western zone. The director of IIAM updated the provincial government on the progress of the project. IIAM provided (1) a technician to evaluate on-farm trials (OFT) and multi-location trials during the first and second years of the project; (2) an MLE from April 2014 to November 2015; (3) a screenhouse technician from December 2012 to February 2015; and (4) one field worker who worked in the screenhouse to keep the planting material in 2016. The screenhouse at IIAM was used for basic seed multiplication of virus-free vines derived from in-vitro tissue culture plantlets during the 4 years. The effort aimed to conserve clean planting material for supplying net tunnels at district levels. Each district had three net tunnels; one for demonstration purposes and two black-and-white nets for experiments.

During the 4-year period, **AP** was responsible for OFSP vine distribution. They also conducted literacy classes in five districts: Chimbunila, Sanga, Muembe, Lago, and Mandimba during which vines were distributed by three technicians: one in 2013, the second in 2014, and the third in 2015 and 2016, who also organised contests on different OFSP recipes. The same technicians were responsible for M&E of HH already growing OFSP. About 11,554 beneficiaries (55% of women) received OFSP vines cumulatively from December 2013 until the end of June 2016. AP was supported technically and financially by CIP in the OFSP-related activities.

SETSAN is a well-established, technically competent, dynamic, and multi-sectoral body that monitors the food security and nutrition situation in Mozambique and produces regular technical reports and updates. The 5-year (2015–2019) Plano de Acção Multi sectorial para a Redução da Desnutrição Crónica (PAMRDC) was approved by the government of Niassa on 3 April 2015. SETSAN called all partners to help deliver the objectives of PAMRDC. As a result, CIP fully integrated its project activities into PAMRDC through the implementation of the nutritious sweetpotato project, and contributed to the strategic Objective 4 of PAMRDC. CIP trained the newly recruited technician of Director Provincial da Agricultura e Segurança Alimentar (DPASA), participated in 19 coordination meetings organised by SETSAN at Direcção Provincial da Agricultura. CIP engaged one staff member from SETSAN to take part in the participatory planning process of the project in seven districts. Two SETSAN staff members participated in the evaluation of OFSP needs outside the intervention zones and supplied cumulatively 4,435 kg of OFSP vines to eight districts outside of the intervention zones (135 kg in 2015, and 4,300 kg in 2016). DPASA Cabo Delgado received 4,500 kg of OFSP planting material from April to June 2016, for multiplication during the off season.

UCA distributed OFSP planting material during the first year and continued in Y2 though at low scale. UCA was passive in Y3 and Y4 regarding distribution of planting material. However, the association, supported by the WeEffect organisation, is active in the field and continues to produce OFSP vines and roots.

WeEffect (formerly Swedish Cooperative Centre) is a development cooperation organisation applying a long-term, rights-based approach to effect change. WeEffect is supporting associations on natural resources and land rights, whereas CIP supported some of these associations on access to OFSP.

Diocese of Lichinga is an Anglican NGO working with “Equipa da Vida” and has direct experience in nutrition. CIP helped the Anglican Diocese in Sanga implement a new approach to nutrition training. There were six topics for a 6-month period, which ran from January 2016. About 13,109 HH (13,000 females) were trained during the 6-month period. Community participation in nutrition training contributed to the improvement in local diet such as the diet diversification, taking into account the food groups and increase in the number of diets per day.

SDAEs in eight districts involved in OFT

Twelve agronomists (2 women) were involved directly in the monitoring field trials, OFSP vine multiplication, and distribution in 2014. Three agronomists participated in a training of trainers (ToT) course, “Everything you ever wanted to know about sweetpotato”, in Maputo in June 2014. SDAE agronomists ensured the coordination and selection of adapted varieties, vine multiplication, and dissemination of OFSP varieties at the district level. From 2015, 67 extension agents (12 females) were involved directly in OFSP vine multiplication, distribution, and data collection; 65 of the extension agents (7 females) participated in the training on general agronomy on OFSP production and planning at the district level. In term of beneficiaries, technicians at Mandimba and Mecanhelas districts distributed vines to 135 HH (34% females) in 2014. Technicians of SDAEs at eight districts distributed OFSP vines to 1,916 HH (40% women) by the end of 2015, and 5,916 HH (39% women) by the end of 2016.

Manda Wilderness Agricultural Project in Lago district started to work on the project from 2015. There was a small discontinuation when its project manager left in October 2015. The new manager joined in mid-2016 and collaborations with CIP resumed.

The University of Lurio in Sanga supported the project through student work. The students helped in data collection during surveys, evaluation of trials, and use of net tunnels.

Bakeries

Six bakers and one coffee shop were involved in power bread processing from 2014 to 2016. **Padaria Pastelaria Maria** started to produce power bread with the project in 2014 and stopped when their manager left for Zambezia. **Pao Dourado** tested the power bread in 2015 and did not adopt the technology because the size of the bread was reduced. **Padaria de Niassa** tested and appreciated power bread in February 2016 but expected to be supported by the project to continue; it was not sustainable. **Padaria de Mandimba** and **Padaria de Cuamba** started to participate in May 2016. Despite their commitment, they are far from Lichinga, and the owners did not request puree. **Pastry Safeera**, the coffee shop, was faced with a lack of puree conservation and bought limited puree for the production of cake and biscuits. **Padaria Sanjala** started to produce power bread in March 2016 and increased the usage of OFSP puree from 10 kg/day to 30 kg/day. Padaria Sanjala will continue for 2017 once roots are available.

ADPP invited the project manager to present the project goals and expectations, and trained the field animators in March 2016 on the basic information about OFSP multiplication, distribution, and production.

Irish Aid is the project donor; its representative in Niassa helped to monitor the project. Irish Aid participated in field visits and annual planning meetings.

3.3 MONITORING AND EVALUATION

There was a high turnover of staff for this section, which affected the quality of the information. The M&E specialist was responsible for conducting baseline, market, endline surveys, and M&E of field activities. He was also responsible for the supervision of the puree and power bread production. The baseline, market, and endline survey reports are available. Part of the project results was presented at the African Potato Association conference held in Addis Ababa in October 2016, and was shared on the CIP open access platform for wider use.

3.4 COORDINATION MEETINGS

Thirty-four coordination meetings were held from May 2013 to August 2016, with a major focus on planning, coordination of field activities approaches on vines distribution, assessment of field

conditions, project assessment, and preparations of the annual meetings. Representatives from SETSAN's, IIAM, the Anglican Diocese, ADPP, AP, SDAE–Lichinga, UCA/FOFEN/Movimento de Mulher Mozambicana Rural (MMMR), Padarias, and Pastry Safeera fully participated in each meeting. Progress and status of the project such as the no-cost extension and the related activities were presented to all partners during the meetings. Specific coordination meetings with Diocese and AP were undertaken to discuss specific issues on nutrition training plan, advice on technical and financial reports, and a disbursement of funds. In November 2015, as part of the OFSP awareness programme, radio broadcast and singing competitions were organised together with the Anglican Diocese and AP.

4. PROJECT PROGRESS: IMPLEMENTED ACTIVITIES AND OUTPUTS ACHIEVED AGAINST AGREEDWORK PLAN

Under the four specific objectives (nutrition, OFSP production, market, and coordination), 27 activities programmed were carried out.

4.1 SPECIFIC OBJECTIVE 1: INCREASE VITAMIN A AND ENERGY INTAKES

Six activities were undertaken to achieve this specific objective.

4.1.1 Conduct formative research relating to “best-bet” behavioural changes in dietary practices and childcare, develop key messages/teaching material, and conduct training in nutrition using OFSP-based food teaching materials

A CIP nutrition consultant collaborating with SETSAN conducted research on dietary practice for a mother with children under 5 and childcare in Lago and Chimbunila, from March 2014. From the results, CIP developed one set of training materials in Portuguese which was presented and discussed at a meeting in Lichinga on 28 April 2014; 19 representatives (11 females) from the farmers, government institutions, and NGOs attended. Forty sets of the training material on nutrition were developed in Portuguese and printed. The sets were also translated into local languages (Niyianja and Niyaa). Different OFSP recipes were demonstrated from 2014 to 2016 to different communities.

4.1.2 Develop training material to integrate OFSP production and utilisation to the adult literacy programme.

AP developed 2,500 leaflets with an integrated message of OFSP that reflected agriculture, nutrition, and market in three languages in 2013: 625 leaflets in Portuguese, 625 leaflets in Niyianja, and 1,250 leaflets in Niyaa. All of the leaflets were distributed and tested in eight groups of adult literacy course in four districts. Feedback from the initial leaflets that were developed show inadequacy in sweetpotato agronomy and optimum planting dates. Revised leaflets were made, and 16,000 were produced and distributed to 11,554 adult literacy groups and others HH in Lago, Muembe, Sanga, Chimbunila, and Mandimba by 2016. Cumulatively, all 11,554 adult literacy groups and other HH received the leaflets from 2013 to 2016.

4.1.3 Conduct a baseline survey, capturing baseline information on sweetpotato production levels, levels of nutritional knowledge, and degree of dietary diversity

Data from 396 HH living in eight districts were collected by 12 enumerators in June–July 2013 (Lichinga, Chimbunila, Muembe, Lago, Sanga, Mandimba, Cuamba, and Mecanhelas) The M&E specialist was trained in Maputo on the Census and Survey Processing System for data entry and data analysis and supervised 8 trained data entry clerks who entered the data. The results framework matrix was reviewed after completion of the baseline survey report (available as a separate document). Some important keys indicators for the impact evaluation are following:

- 75.5% of HH grew different types of sweetpotato regarding flesh colour

- 9.1% HH grew OFSP varieties
- 41% of HH used lowland areas and 14% small garden plots for vine conservation
- 56% of HH conserved vines in upland fields
- 30% of HH sold sweetpotato but not OFSP
- About 66.4% among targeted women and 70.3% of men have heard about vitamin A
- The household dietary diversity score (HDDS) of 25%, 28%, and 47% were classified respectively as “low”, “medium”, and “high” dietary diversity.
- The individual dietary diversity score (IDDS) for children aged 6–23 months where 63%, 12%, and 25% are classified respectively as “low”, “medium”, and “high”; 25% of children 6–23 months have IDDS > 6 classified as “high dietary”.

4.1.4 Integrate key nutrition and health messages, alongside agricultural messages, into selected community nutrition efforts

The project produced materials that integrated key nutrition message after the first year of implementation and learning process: 500 calendars, 500 T-shirts, and 900 capulana (a type of a sarong worn for women primarily in Mozambique) with nutrition messages. The materials were used during the awareness campaigns and were distributed to field technicians, local authorities, DVMs, and participating HH.

The project participated in an annual agricultural kick-off campaign in Chala on November 8, 2013; Mandimba on October 4, 2014; Bandeze in 2015; and Lussanhando in 2016, by displaying different OFSP products as campaigning messages.

CIP show cased OFSP products in other platforms, such as the National Land Forum in Lichinga on 5–6 December 2013; field days at IIAM on 18 April 2014; Lussanhando on 28 May 2014; at the Nutrition Day at Bandeze Lago in 2015; and at the Nutrition Gala at Lichinga in 2016.

The project also made a presentation on research results at a workshop in Nampula on 22–23 April 2014; during the coordinator council in Lichinga on 29–30 April 2014; to Irish Aid in Maputo on 28 May; and at the University of Lurio in Sanga on 23 September.

The OFSP market places in Lichinga were painted, one for a private seller and a large one for UCA producers; 12 sites at 6 districts were also painted. The painting carried messages showing benefits of producing and consuming OFSP. OFSP messages incorporating agriculture, health, and commerce/market information were aired three times a day for 90 days on a community radio in Lago, Sanga, Chimbunila, and Lichinga districts from November 2014.

4.1.5 Deliver training at scale in collaboration with development partners selected during Y1

During the annual planning meeting in June 2014, a programme for nutrition training and promotion campaign was developed. ToT on nutrition began on 3 July 2014, for 18 participants (10 women). The training at district levels were done with 703 mothers with children under 5 (69% of women). The Diocese trainees trained 2,275 mothers with children under 5 (72% of women). Eighty-three literacy educators were trained in OFSP production and cooking demonstration, which was implemented in their literacy programme where AP held a contest on OFSP nutrition with 135 participants (106 women) in four districts. Three of the districts had winners who grow OFSP and process OFSP. A total of 5,998 HH were trained on nutrition from 2014 to 2015.

From the lessons learned in 2014–15, the Anglican Diocese developed a training package of six topics for 6 months on introduction and practice of dietary diversity for children, a strategy at a larger scale. Seven villages in Sanga district were involved with 14–16 animators at each village;

109 animators (36 women) were trained in seven villages. Each animator trained 20 counsellors, resulting in 2,180 counsellors. Each counsellor was expected to work with 10 HH to cover a total of 21,800 HH in the plan. However, some of the counsellors did not reach their objective, and the total HH reached were 13,109 (13,000 women). According to the findings observed during the training, some signs of behaviour changes were recorded after the fourth topic was covered and documented as success stories. AP trained 80 community promoters with 24 women in nutrition. The cumulative HH trained reached 18,784 (17,009 women) from 2014.

4.1.6 Conduct a final impact assessment and produce results that integrate key monitoring data

The project conducted an internal assessment in December 2015, with 271 HH (200 men, 71 women) in eight districts in the project intervention areas. The results clearly showed an increased use of the CIP-disseminated approaches regarding conservation of OFSP vines in the lowland and the gardens:

- The HH using lowland areas for vine conservation increased from 41% in 2013 to 58% in 2015, and the use of small garden plots from 14% to 26%.
- The HH conserving vines in upland fields dropped from 56% in 2013 to 7% in 2015.
- About 53% of HH still planted OFSP in June (beyond the main planting season), whereas 24% continued to plant year around.
- Cultivation on small plots dominated from March to December, mainly for vine multiplication.
- 'Delvia', 'Irene', and 'Gloria' were the most preferred varieties by farmers in descending order (43%, 21%, and 20% respectively).
- All HH consumed OFSP roots and 50% of HH consumed OFSP from April to October.
- 56% of HH sold OFSP roots which generated an average income of \$48/HH/year.
- 80% of HH have adopted production of both OFSP and white-fleshed varieties in their fields.

During June–July 2016, the project conducted the endline survey with 1,032 HH interviewed. A total of 626 HH were direct beneficiaries and 406 HH acted as controls in eight districts. Some important findings were:

- 13.1% of HH produced OFSP for the control and 95.7% for intervention communities during the endline in 2016, against 9.1% HH producing OFSP during the baseline in 2013.
- Criteria for OFSP selection and adoption were 70% of HH for root taste, 60% vitamin A, 59% leaf taste, 32% yield, and 29% for health.
- Farmers practicing piece-meal harvesting where > 24% of HH harvested OFSP until 6 months after planting, and > 10% continued with the harvest until 9 months after planting. About 62.3% of the beneficiary group had access to diet information.
- The most important source of information about vitamin A for women was the community health volunteer.
- The low dietary diversity for HH declined to 19% at endline from 25.3% at baseline. The same pattern was observed for the IDD of children 6–23 months and women.
- 52% of the farmers producing OFSP sold part of their products for beneficiaries, any HH sold OFSP for the baseline.
- OFSP was sold by 32% of HH on the roadside near their house, 28.6%, at home and 22.6% at their nearest local markets.
- Average HH revenue from OFSP sale is US \$53.78, with an exchange rate of 1US\$ = 75 MZN, which was above the project target goal of \$50.

- Allocation of income from selling of OFSP: food (80.2%), clothes (67.2%), durable goods (45.6%), and school fees (32.8%). About 21.5% was for further investment in agricultural equipment (7.3%), phone (6.7%), radio (3.3%), bicycle (2.1%), and motorbike (2.1%).
- 41% of men received OFSP income compared with 31.1% of women.

Results of final assessment were disseminated at the districts.

4.2 SPECIFIC OBJECTIVE 2: INCREASE SUSTAINED ACCESS TO QUALITY PLANTING MATERIAL AND IMPROVED KNOWLEDGE OF OFSP

Eight related activities on training and multiplication of planting material to facilitate the access of quality planting material and dissemination of OFSP varieties were undertaken.

4.2.1 CIP supplied 8 new drought-tolerant OFSP varieties

During Y1, 15 OSFP varieties released by IIAM/CIP were evaluated for adaptation and adoption in Niassa. Details on the performance of each variety and adoption results were presented in annual reports of 2013 and 2014.

An additional 79 advanced clones were tested under OFT and multi-locational trials at IIAM–Lichinga. The results contributed to the release of seven varieties in 2016.

4.2.2 Ensure key ToTs among NGO partners attend the “Everything you ever wanted to know about sweetpotato” course

Eight technicians from five project partners participated in the “Everything you ever wanted to know about sweetpotato” course in Maputo in 2012, 2013, and 2014. The trained 760 participants with 74 field technicians (13 women) of 11 partners have been involved in OFSP vine multiplication, production, and the Triple S (storage, seed, sand) method⁵ in Niassa.

4.2.3 Establish agreements with partners and conduct on-farm trials in the districts

OFT were conducted at 40 sites in four districts in 2013, and 30 sites in three other districts in 2014. The participants on these trials were trained in December of each year to understand the process.

Leaf-tasting was carried out at 36 sites, and yield assessments were conducted at 33 sites; roots at 3 sites were stolen after the leaf-taste evaluations. Root taste tests were done at 29 sites.

Four criteria used to evaluate the cooked leaves and roots were the appearance, texture, aroma, and taste. Three different colours were used to rate each criteria: green for high appreciation, yellow for average, and red for rejection/low appreciation. The participants chose one of the colours per criteria and voted three times for each leaf variety and four times for each root variety. The dominant characteristics for the farmers’ adoption of a variety in Niassa were root yield and taste.

In general, ‘Gloria’ was the most preferred variety. Combining all criteria, the preference scale in descending order of preference for varieties were ‘Gloria’, a local variety,⁶ ‘Bela’, ‘Jane’, ‘Delvia’, and ‘Esther’ varieties. This tendency was influenced largely by root taste.

The results from the root tasting is shown in Fig 2. Men preferred ‘Gloria’ the most and ‘Sumaia’ and ‘Ininda’ the least. Women preferred ‘Erica’ the most and ‘Irene’ the least.

⁵ Triple S is a technique to conserve roots for seed stored in sand.

⁶ Different varieties local were used by the farmers at each site.

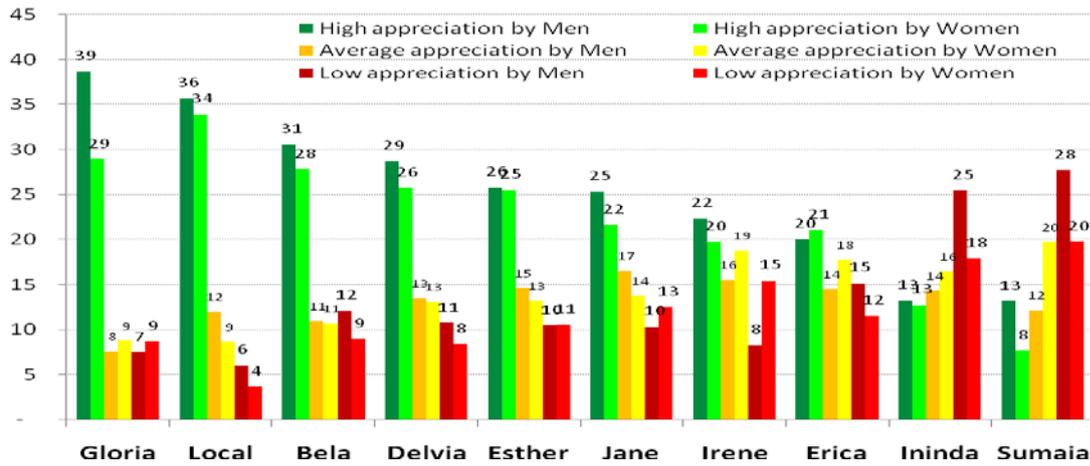


Figure 2. Root taste tests in four districts, in percentage by gender.

In terms of storage root yield, 'Delvia' had 22, 16, and 13 Mt/ha at Muembe, Sanga, and Chimbunila, respectively (Fig. 3). 'Sumaia' had 17 Mt/ha in Lago and 12 and 11 Mt/ha at Chimbunila and Muembe, respectively.

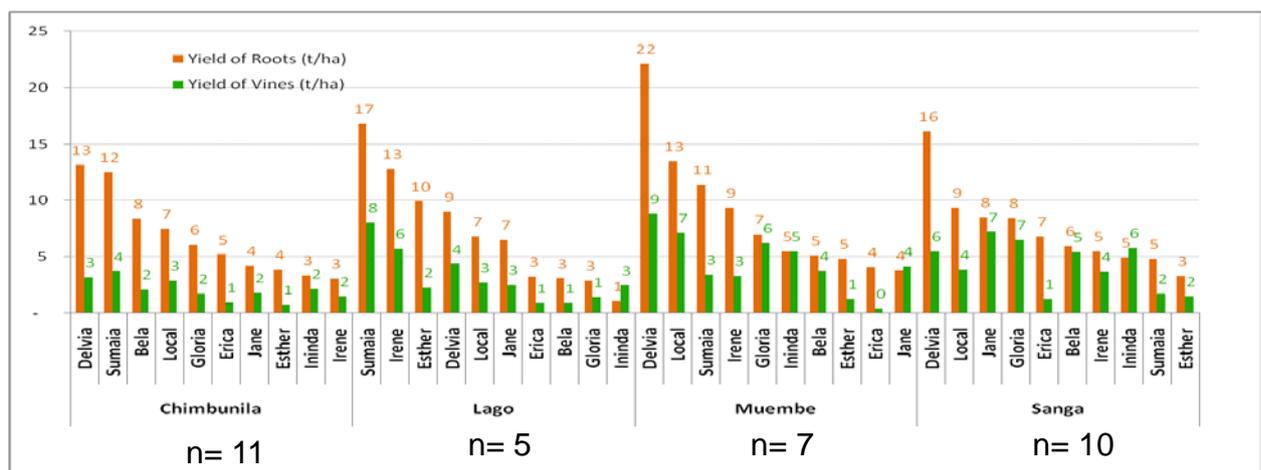


Figure 3. Means of storage root and vine yield (Mt/ha) for 10 varieties in four districts.

The highest root and vine yields were observed in volcanic soil, on fertile soil, and at IIAM station (Fig. 4). The trials at Matitima 1 and 2 in Muembe district had an average yield of 23 and 21 Mt/ha, respectively, and Micucue 2 in Lago district an average yield of 22 Mt/ha, where these trials were planted at the volcanic rich soil. However, the yield in Sanga district at Miala reached 20 Mt/ha, a trial installed in a new open field in the forest and the soil is very fertile. On the other hand, the yield at the IIAM research station reached 20 Mt/ha as the trials were well managed.

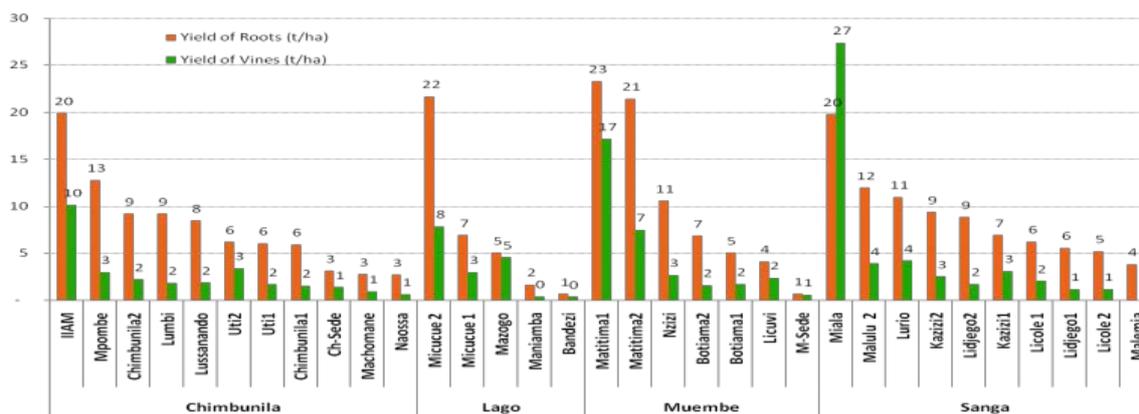


Figure 4. Mean of storage root and vine yield (Mt/ha) at 33 sites in four districts.

Storage root yield was affected by lack of soil nutrients in leached out poor soil at least at six sites: Bandezi in Lago district and Muembe Sede in Muembe recording yield of 1 Mt/ha; at Maniamba in Lago with 2 Mt/ha, and Machomane, Chimbunila Sede, and Naossa in Chimbunila with 3 Mt/ha (Fig. 4). The soils were very poor, and soil management by farmers was inadequate.

Vine yield ranged between 1 and 27 Mt/ha. Vine yield was lower than roots, except in Miala Lago district (Fig. 4), where the harvest occurred before the end of rain and vines had still high water content, and in Muembe Sede, where the root yields were very low.

In the second year of OFT, ‘Gloria’ and ‘Bela’ were the most preferred varieties. Regarding yield, Cuamba district had higher storage root yield (50–86 Mt/ha) than in the other districts. ‘Cecilia’, ‘Sumaia’, ‘Gloria’, and ‘Irene’ had a potential of more than 70 Mt/ha in Cuamba.

4.2.4 Develop and improve key training material for extension personnel, DVMs, and farmers in appropriate local languages

The project developed training material in the first year, tested it, and reviewed it to be used from Y2. The training material highlighted the use of net tunnels and rapid multiplication (reported in Y2 annual reports).

4.2.5 Identify and train vine multipliers in each district

The project anticipated producing OFSP vines by establishing vine multiplication plots for all varieties from February 2013, to speed up the process of vine availability for dissemination at the four northern districts (Lago, Sanga, Muembe, and Chimunila) and also to make available the vines for the OFT at the three southern districts (Mandimba, Cuamba, and Mecnhelas). At each off season, the “selected healthy vines” from the OFT, and the most adapted and adopted varieties, were under multiplication in the lowland by 31 DVM selected during the first season, among whom 7 are women; by 71 DVM (17 women) the second year, by 87 DVM (22 women) the third year; and 72 DVM (22 women) the fourth year. There were 15 primary DVMs with 5 women and 57 secondary DVMs with 17 women. The greenhouse at IIAM–Lichinga had “clean planting materials” from tissue culture. Twenty-five advanced farmers and 8 extension agents were trained and established net tunnels at eight districts guided by geographical localities to facilitate the dissemination. The net tunnel construction and management, vine production and management, and Triple S training were conducted to build technicians’ and farmers’ capacities during the 4 years. The Triple S was conducted in Y4 after the ToT in Nampula and at 8 districts with the participation of 13 trainees. Some 760 participants with 74 field technicians (13

women) of 11 partners were involved in OFSP vine multiplication, production, and Triple S training in Niassa Province.

4.2.6 Exchange visit by extension personnel, secondary multipliers, and selected smaller multipliers to visit DVMs in Malawi

The exchange visit to Malawi was held in Y1 for 4 days: 1 full day for travelling from Lichinga, Mozambique, to Chikhwawa District, Blantyre, Malawi, 2 full days for smooth learning for the farmers, and 1 full day for return travel. The objective was to learn about CIP's OFSP project in Malawi, which had started in 2009. Participating were of OFSP Niassa project manager, a scientist from the IIAM, and local processors.

The exchange visit was held at Chikhwawa District and was organized by CIP-Malawi and its implementing partners. These implementing partners were the NGO Catholic Development Commission in Malawi, the District Agricultural Development Office, and the District Agricultural Extension Office. The six farmers from Mozambique learned a lot about rapid multiplication, the daily routine of the host family, and OFSP processing during this visit.

The results were that all six participants involved in this visit produced their vines under rapid multiplication. Five of them got net tunnels.

4.2.7 Establish agreements with partners and conduct OFSP awareness and dissemination system

Contracts were signed with AP and the Diocese. For IIAM as the government's representative, the collaboration is covered by a memorandum of understanding, which continued with the provincial agricultural department for the eight districts. OFSP vines were disseminated from December 2013 to 2016, with two different strategies according to the season and the lowland availability. From March 2014, HH without lowland got smaller quantities of vines multiplied in their home gardens and irrigated to get OFSP vines during the main season in December and January. HH with lowland continued to plant in the larger plot, as they could at times reach 1 ha.

4.2.8 Engage in widespread mass dissemination in key target areas to increase coverage OFSP alongside broader awareness campaign

After data cleaning, 28,044 beneficiaries (51% women) received OFSP vines directly from the project; 7,778 got vines from the Anglican Diocese (57% women); 11,554 from AP (55% women); 5,916 (39% women) from SDAE; and 2,796 from UCA (Table 2). Of these beneficiaries (37,262) 78% have children under 5. 'Delvia' (55%), 'Gloria' (24.3%), and 'Irene' (9.4%) were the most planted varieties at different districts and by different HH covering 88.7% of the total distribution.

Table 2. Beneficiaries for the four years of the project 2012–2016

Partner	Diocese		Progresso		SDAE		UCA		Woman	Man	Grand Total
	Woman	Man	Woman	Man	Woman	Man	Woman	Man			
Lago	1,962	1,741	1,334	817	175	226	-	-	3,471	2,784	6,255
Sanga	667	55	1,011	764	565	860	-	-	2,243	1,679	3,922
Muembe	-	-	1,354	1,564	114	225	-	-	1,468	1,789	3,257
Chimbunila	-	-	599	387	81	155	28	40	708	582	1,290
Lichinga	-	-	661	690	6	28	1,251	1,477	1,918	2,195	4,113
Mandimba	-	-	1,447	926	447	620	-	-	1,894	1,546	3,440
Cuamba	-	-	-	-	529	949	-	-	529	949	1,478
Mecanhelas	1,794	1,559	-	-	380	556	-	-	2,174	2,115	4,289
Sub-total	4,423	3,355	6,406	5,148	2,297	3,619	1,279	1,517	14,405	13,639	28,044
% Gender	57%	43%	55%	45%	39%	61%	46%	54%	51%	49%	
Total	7,778		11,554		5,916		2,796		28,044		

District of Lago has the most beneficiaries (Fig. 5). Diocese reached about 7,778 beneficiaries and AP about 11,554 beneficiaries. SDAE reached 5,916 beneficiaries ranging from 34 for Lichinga to 1,478 for Cuamba.

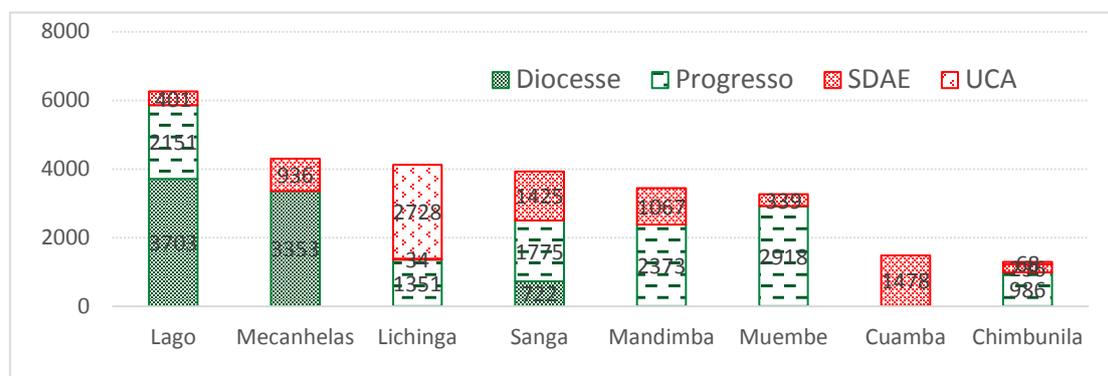


Figure 5. Beneficiaries per district and per partner.

From January 2016, the project supplied vines to partners outside the intervention areas. About 4,300 kg of ‘Delvia’, ‘Gloria’, and ‘Irene’ were distributed through eight SDAE districts of Niassa Province for multiplication during the off season. Another 4,500 kg were multiplied by SDAEs of four districts in Cabo Delgado Province. Indirect beneficiaries were 56,000 HH, where each direct beneficiary distributed vines to two indirect beneficiaries.

4.3 SPECIFIC OBJECTIVE 3: DEVELOP FRESH ROOTS, VINES, AND BREAD MARKET IN LICHINGA

The M&E specialist was actively involved in different activities to strengthen the OFSP value chain. This involved baseline & end-line surveys, monitoring processing of puree and power bread, profitability studies and awareness campaign for the value chain.

4.3.1 Conduct a diagnostic study on sweetpotato markets after the sweetpotato harvest

The first study on the sweetpotato market was conducted in June 2014. The objective was to identify the existing opportunities and challenges of the sweetpotato value chain to recommend strategies where the project could develop OFSP value chain. For this study, 28 traders, 202 small-scale producers, 55 roots consumers, 19 small bakeries, 19 extension agents, 1 bakery, and 157 bread consumers were interviewed. Focus group discussions were conducted in 24 communities. The OFSP value chain in Niassa is presented in Figure 6.

The results of the market study showed that 55% of producers sold OFSP, and 66% of the consumers bought at least twice per week and 13% once a week. A study on the bread market was done, including the cost of production reported (see section 4.3.7). The results indicated the need for awareness campaign about the benefits of consuming OFSP. Small-scale farmers still relied on rains to continue with OFSP production. The current study indicated that during the dry season (Aug.–Dec.) if farmers can take advantage of the existence of the lowlands, they can get a better price with the peak being 15 Mt/kg compared with 3 Mt/kg (Apr.–July). Small bakers are producing bread using traditional ovens built in backyards. The bread produced in backyards had a specific market orientated to families who are most disadvantaged. High demand for OFSP bread led the project to train small bakers to use OFSP and to guarantee that bread consumers get nutritious processed products.

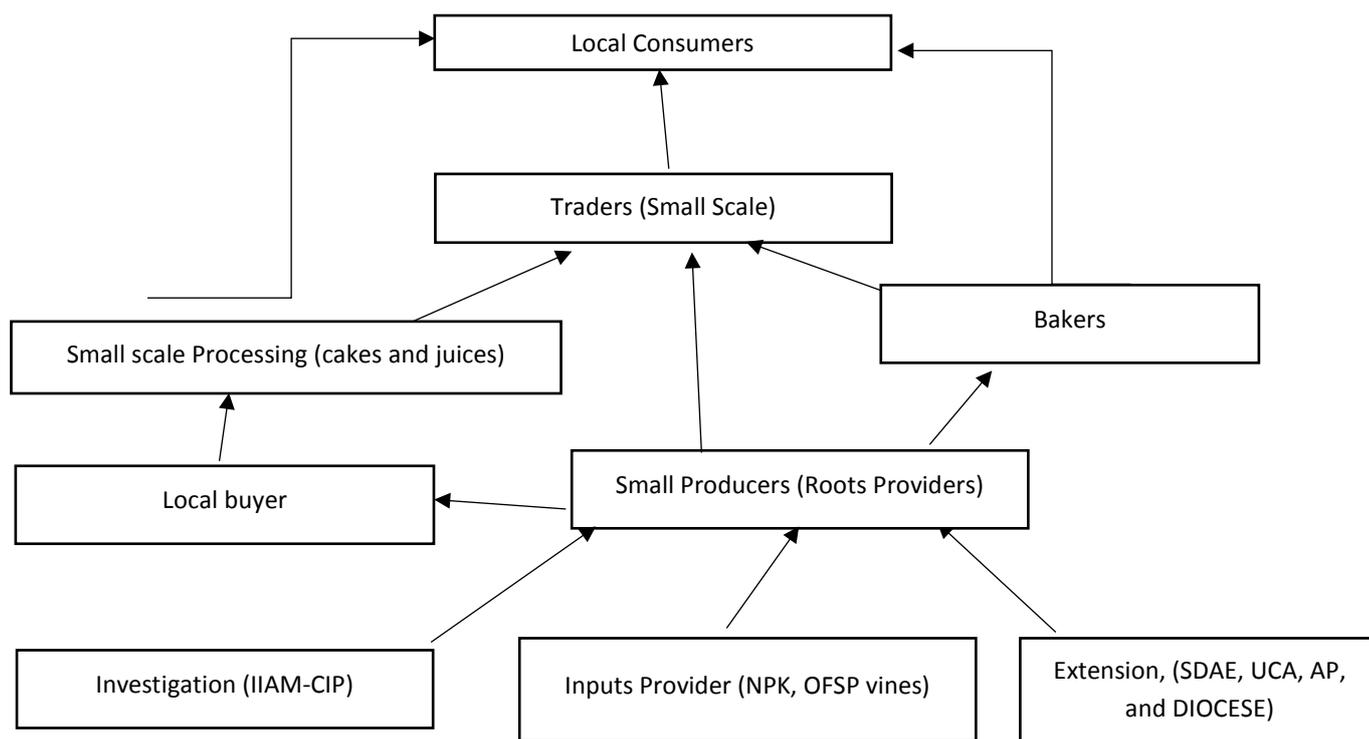


Figure 6. OFSP value chain in Niassa.

The bread market is growing in Lichinga. Every year, the demand increases, peaking during the Ramadan period. The bread that has more demand is the cheapest (simple bread, prepared only with wheat, water, and salt and costing 2.5 MZN each).

4.3.2 Identify and work with one baker to test bakery products with consumers

Padaria Maria was identified and contacted to produce “power bread”, a composite bread with 30–40% of OFSP puree and 70–60% of wheat flour. The advantage of power bread processing was presented, and the baker was willing to work with the project. A representative from this bakery participated in the launch meeting and the training on processing. Consumers appreciated the products from OFSP processing during the agricultural campaign kick-off. However, due to the shortage of fresh sweetpotato roots in Lichinga market, the project postponed the activity, and Padaria Maria tried power bread for the first time in June 2014.

Owing to high demand for OFSP bread, meetings were held with Padaria Maria programming to double the production of bread, from 50 to 100 kg as raw materials. All cost analyses indicate high opportunity from OFSP for bread production. Both high demand for OFSP bread and high interest by farmers increased OFSP production throughout the year to ensure continuous production of the bread. Unfortunately, Padaria Maria stopped bread production. Pastry Safeera and other small bakeries at district levels were interested in OFSP-based products.

4.3.3 Develop and implement preliminary awareness campaign

The awareness campaign was implemented. The project began by painting in orange two places at the central market in Lichinga—one where a woman always sells sweetpotato and one place for UCA member—and 10 places in five districts (Lago, Sanga, Muemba, Chimbunila, and Mandimba), at two administrative posts per district. Leaflets were distributed at different places where bread is sold and at district levels.

4.3.4 *Expand the number of bakers, including supply chain links and at least four promotion campaigns*

Five bakers in Lichinga (Padaria Pastelaria Maria, Pao Dourado, Padaria de Niassa, Padaria Abas, and Padaria de Sanjala) were trained and tested ‘Pão de Forca’, or “power bread” production. Padaria de Sanjala continued and increased the use of puree with a periodic and continuous supply in Lichinga due to high demand for OFSP bread. In Mandimba district, Padaria de Mandimba started in May 2016, and Padaria Pastelaria de Cuamba started in August 2016. The bread quality is highly preferred. At the community, 112 small bakeries (47 women) were trained and planted OFSP to contribute to their own bread by the end of 2015. After evaluation in 2016, 11 (1 woman) of them produced power bread or power cake and were invited to participate in a refresher course on processing. The refresher course was led by Antonio (CIP food technology consultant) and Tawanda Muzhingi (CIP food scientist), who had visited to provide capacity to bakeries. Three successful DVMs started to produce their own power bread at local level. A coffee shop at Lichinga City was using OFSP puree in 2015. The quality of bread in rural areas could be low, but access to OFSP is expected to increase.

Power bread was preferred highly in Lichinga, Mandimba, and Cuamba. Some 1,047 consumers were interviewed when they purchased the bread at the bakers, who compared the 100% wheat flour bread with power bread. Results from analysed data showed that power bread was the preferred choice, with 94% (58% men, 36% women) of consumers supporting power bread (with 35% of OFSP) over normal (100% wheat flour) bread both for its taste and 90% (54% men, 36% women) for its appearance.

About promotion and other awareness campaigns, the project led 12 promotion campaigns conducted during each annual meeting (4), over the opening ceremony for the yearly education (1), the nutrition fair (3), and agricultural kick-off (4) during the 4-year project implementation.

4.3.5 *Evaluate profitability of the power bread marketing chain*

Power bread was preferred by consumers and was more profitable than the wheat flour bread. By analysing the puree production cost according to the average price of roots of 5 MZN/kg, the puree production cost will be 11.48 MZN/kg (Table 3).

Table 3. Puree production cost

Variable	Price (MZN)	Unity	Quantity	Grand Total
OFSP cost	5	kg	100	500
Energy	5	Kw	3.13	15.65
Firewood	50	Unit	1	50
Labour/kg	1	MZN	100	100
Transport per bag OFSP	50	Per/bag	2	100
Machine amortisation	0.5	kg	85	42.5
Water	0.25	L	50	12.5
Packaging	5	Unit	8	40
Overall cost		MZN		860.65
Loss		%		25
Loss		kg		25
Quantity of puree obtained		kg		75
Cost of puree/kg		MZN		11.48

However, if the puree price is 15 MZN/kg and the wheat flour remains at 30 Mzn/kg as the actual price, the net return for the baker selling the power bread will be \$41.3/50-kg bag (Fig. 7).

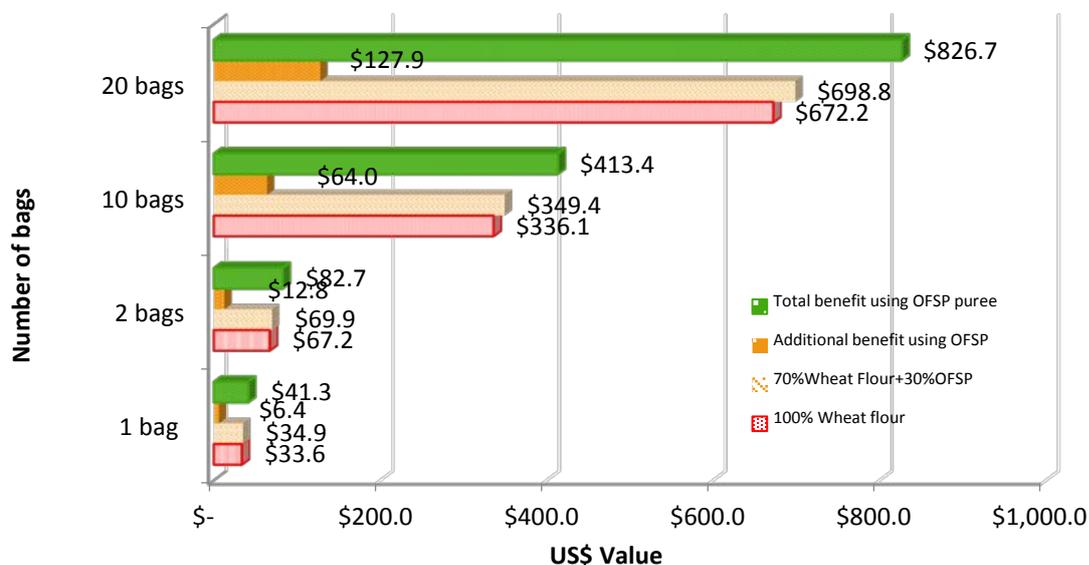


Figure 7. Price differential of processing power bread.

In summary, bakers get the most return in the value chain. If the baker used 1,000 kg of puree (highest puree demand for 1 month), this baker generates an additional net return of \$255.8 more than with the use of wheat flour.

4.3.6 Conduct operations research to assess consumer acceptance and functioning of the power bread value chain

The steps to produce puree and power bread were evaluated to get the efficiency of puree and power bread production. Composite bread using 30% of OFSP puree (i.e. power bread) was developed with six private bakers in Lichinga, Mandimba, and Cuamba, started from 2014 to date. A total of 1,047 consumers were interviewed when they purchased the bread at the bakers, comparing the 100% wheat flour bread with power bread.

4.3.7 Final assessment of long-term economic viability and consumer acceptance of power bread

The long-term economic viability of OFSP and power bread depends on yield, puree production cost, and puree price. For the yield, Figure 8 shows the production cost and net return according to the yield of OFSP. With 20 Mt/ha, OFSP production cost is 1.68 Mzn/kg with a net return of 91.500 Mzn/ha. Once the yield increases, the production cost decreases and the net return increases.

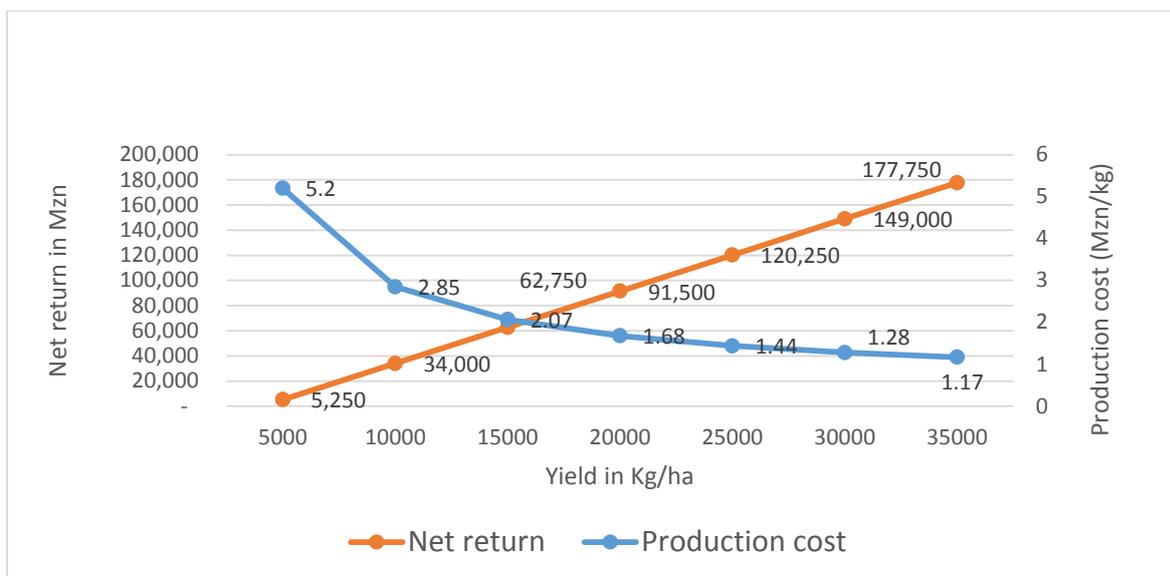


Figure 8. OFSP production cost and net return according to the yield.

The production cost of puree depends on the price of OFSP roots. If the price varies from 3 to 10 Mzn/kg, the puree production cost ranges 8.81–18.14 Mzn/kg (Fig. 9). According to the actual price of 11 Mzn/kg of puree, the price of OFSP root should be reduced to 4 Mzn/kg, but the farmer still gets 71,500 Mzn net return per hectare.

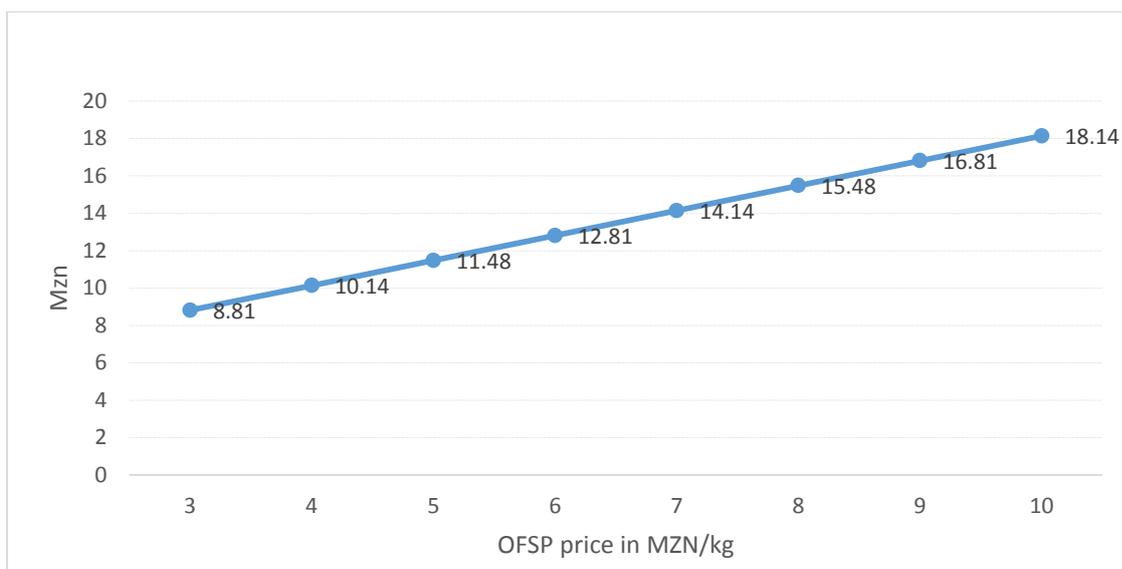


Figure 9. Curve of puree production cost in Meticais.

If the price of puree is the half of the wheat flour price per unit, the power bread gives higher benefit for the bakers.

4.4 SPECIFIC OBJECTIVE 4: MANAGE PARTNERSHIPS AND INTEGRATE EFFORTS INTO PROVINCIAL-LEVEL MULTISECTORAL PLANNING AND IMPLEMENTATION EFFORTS CONCERNING FOOD SECURITY AND NUTRITION

Five activities were agreed on this specific objective.

4.4.1 Hold regular monthly planning meetings with key partners and conduct partnership health check-ups annually

Monthly planning meetings were conducted during the 4-year project: 34 monthly meetings were conducted with the partners monitoring progress. The partner health check-up was recorded only in Y2. A SETSAN representative participated during these coordination meetings at CIP's office.

4.4.2 Hold major annual stakeholder meeting

Four annual meetings were conducted during the project life annually in April. All partners and producers were represented. During project Y1, representatives from five districts (Lago, Sanga, Muembe, Chimbunila, and Lichinga) participated. From project Y2, partners and producer representatives from eight districts (Lago, Sanga, Muembe, Chimbunila, Lichinga, Mandimba, Cuamba, and Mecanhelas) were present. Besides CIP's regional and Mozambique representatives, 18 institutions were involved in the project meetings at least once: IIAM, AP, Diocese, UCA, ADPP, SETSAN, 8 SDAEs under DPASA, 8 Servico Distrital da Mulhere e Acção Social under the Direcção Provincial de Saude, Family Health International 360, FOFEN/MMMR, Padaria Maria, Padaria De Niassa, Padaria Sanjala, Pao Dourado, Padaria Abas, Padaria de Mandimba, Padaria Pastelaria de Cuamba, Pastry Safeera, focal point of Ministry of Foreign Affairs, and Irish Aid.

From Y2, the project included the CIP-updated information in sub-Saharan Africa; the Niassa project's progress presentation in relation to the OFSP nutrition, production, and market and the lessons learned; followed by discussions and identification of opportunities and challenges, and the participatory brainstorming and working group presentation to be considered during the next year planning. The last meeting focussed on the sustainability of the project through the continuation of OFSP production, nutrition, and markets through partners.

An exhibition contest was also held during the last meeting. Seven participants were presented with their results: they were producers from SDAE Muembe, Association FRUMO, AP, SDAE Cuamba, SDAE Lichinga, SDAE Mandimba, and SDAE Sanga. Three contest winners per category of three categories (exhibitors, DVMs, and SDAEs) were rewarded:

- Three exhibitors received from the first to the third: mobile phone with credit and field kits for AP, drip irrigation kits for DVM Juma, FRUMO Association, and a mobile phone with credit for the DVM Venancio, SDAE Sanga
- Three DVMs: a motor pump with tube Fernando Alabe, DVM in Cholue SDAE Chimbunila; a bicycle for Afonso Giboia; and a tube for irrigation pump for Neto Luis, both from Lurio, SDAE Cuamba
- Three SDAEs: Sanga, Cuamba, and Mandimba.

However, all the participants at the exhibitors received some souvenirs.

Padaria Sanjala was visited. Sixty-two participants (13 women) tasted power bread with 30% OFSP.

Field visits were organised at Baia, Sanga district under SDAE Sanga and AP organisation. All the community members had at least a small plot of OFSP and started to plant in the lowland.

4.4.3 Participate regularly in SETSAN committee meetings and at least one other activity related to implementation of SUN programme in Niassa

The project supported PAMRDC of provincial SETSAN from 2015, when PAMRDC was approved by the provincial governor. The project manager was part of a technical group of SETSAN and participated in all SETSAN committee meetings. During the 4-year period, the project participated in 19 meetings organised by SETSAN; 1, 3, 7, and 8 meetings were held in 2013,

2014, 2015, and 2016, respectively. These meetings covered such topics as integration of CIP in technical group to elaborate the PAMRDC, coordination of yearly agricultural kick-off organisation, nutrition day and nutrition gala every year, opening of the academic year, meeting to announce the nutrition gala taking place in Niassa, presentation of the new DPASA, presentation of results, and provincial planning. The project supported SETSAN in food security and nutrition evaluation supervision and OFSP vine transfer to others districts.

4.4.4 Participate in field days and other events to promote awareness of OFSP and nutrition improvement

Some field visits were organised such as field visit with Dr Jan Low (CIP-Nairobi), leader of the Sweetpotato for Profit and Health Initiative, in February 2014, at Lussanhado and Licole, and with DPASA in Lussanhado in April 2014. At each meeting and training at the district level, field visits were always organised. CIP participated in field days at IIAM in April 2014, and in Lussanhado organised by UCA in May 2014.

The project took the opportunity to display OFSP products at any provincial organisations such as agricultural kick off, nutrition fairs, economic fairs, and land national forum. These OFSP value chain products included those made from OFSP roots, vines such as OFSP puree, power bread, power cakes, and biscuits. Beyond the province, the project displayed the OFSP products processed by the bakery such as power bread, cakes, and biscuits during the annual meeting of the Sweetpotato for Profit and Health Initiative in Nairobi in 2014, and Rwanda in 2015, and the kick-off of the Viable Sweetpotato Technologies for Africa project in Nampula in 2015. The project showcased some products, leaflets, catalogues, and the eight volumes of ToTs document about OFSP in Portuguese.

The project presented progress report during the “Research Results” session of a workshop in Nampula, during the coordinator council in Lichinga; to Irish Aid in Maputo; and at the University of Lurio in Sanga in 2014, and the Niassa Governor Council in 2015.

Awareness campaigns were organised during some activities, such as the selection of motivated producers in eight districts and recipes contest in five districts. Plays were staged in the four districts of the northern zone. Some 484 beneficiaries (46% women) received 697 kg of vines during the awareness campaign, and 183 beneficiaries (86% women) received 205 kg of vines during the contest.

Christine Bukania from Nairobi supported the project in documenting successes. These will be available in video and will be used in further campaigns.

4.4.5 Participate in Irish Aid monitoring plan

Every year, the project organised a meeting with Irish Aid to discuss the technical and financial annual reports and the annual planning, where recommendations were considered such as the audit, impact assessment, specific Objective 3 and the follow-up action, synergy with other partners funded by Irish Aid (e.g. WeEffect), extension to other districts in Niassa, and planning for the no-cost extension.

Except during the annual meeting, regular field visits were not done with Irish Aid, with whom CIP reported and coordinated the activities. The first meeting was held to present the 2015 annual report and develop work plan for 2016 in Maputo on 26 March 2016. The second meeting and visit were done by Irish Aid to CIP–Maputo offices on 23 June 2016. Seven CIP staff and seven Irish Aid representatives participated. The report was very informative and comprehensive, which the donor appreciated.

Irish Aid representative in Lichinga participated in the annual meeting on 14–15 April 2016. During his speech, one of the things he emphasised was the need for projects at this stage to be

increasingly innovative and creative and show relevant initiatives. This was a strong message, as nutrition is very urgent and is an important issue in the reduction of chronic malnutrition.

5. KEY ISSUES

- Sending material from Maputo to Lichinga had many risks. The first planting material was lost in 2013, and cuttings were dried out before they reached Lichinga. This was mainly due to airline problems. Challenges came up in many lowlands where water supply was insufficient by September.
 - The production of vines decentralised at the district level was to ensure the prompt availability of quality vines. This reduces the risk of vines drying out during transport and during the planting time, reduces the cost of transport, and facilitates the access to planting material.
 - From January 2014, the project started to facilitate vine multiplication to improve the access of vines from 2014 season.
 - Planting in the lowlands started from March, and plants were strong enough during the cool season and rapidly developed once the temperature increased from the end of August.
 - Distribution of small quantity of OFSP vines for each HH over the year reduces the risk of these challenges and helps HH to properly keep their vines by multiplying small quality of vines for their production in December.
- Isolated sites were totally destroyed by animals (both wild and domestic) and also by thieves. Again, only sweetpotato crop was green in August to October; animals can identify them easily.
 - Animals seldom attacked the variety 'Delvia'. This was observed at the University of Unango, where all varieties were eaten by wild animals except 'Delvia' and the local varieties. This variety is one of most preferred and could be highly recommended for sites at risk of animal attack.
 - Fencing sites, or grouping the planting areas and organising the way to take care the community field, is a possible solution.
- Some sites had low fertility and had very low to no yields. Vines could dry up quickly once planted on the unfertile soil. Nitrogen–phosphorus–potassium (NPK) and urea fertilizer were used incorrectly above the soil by farmers as top dressing to rectify the low fertility.
 - Soil fertility should be considered for all producers willing to produce vines and roots for the next project. Use of compost and/or manures is recommended to get good yield.
 - Soil type such as volcanic soil is very rich and gives high yields. There is a need to maintain this fertility by using compost or manure to keep productivity high.
 - The existence of lots of biomass over all fields in Niassa Province should be valorised for compost production to improve soil fertility. Training farmers in improved production techniques by using compost as organic fertilizer and conservation agriculture should be considered.
 - In case of using NPK and urea, these fertilizers should be mixed with soil to avoid the exposition to the sun.
- Late harvests are exposed to weevils infestation and risk of theft. Weevil attack started from early May and needed to be managed.
 - Early planting at the beginning of the rainy season will lead to an early harvest from April to mid-May 2014, reducing these above-mentioned risks.

- Irrigated fields are attacked less. The project should implement the post-harvest management of roots.
- Staff turnover for the project, as well as partners, was a big challenge affecting project progress and the quality of information. The province is very remote, and isolation could discourage urban, fresh junior, and experienced staff to stay longer.
 - The project should opt for the long term and young staff, just out of the University of Lurio or Cuamba, could be adapted easily and could adopt core values during the learning process. The project should develop tools to monitor and mentor staff during the project's implementation.
- Finding bakers to sustain working with the project took a long time to be effective. Padaria Maria stopped power bread production in mid-May 2015, stating that they did not benefit from OFSP and that workers stole the puree because of lack of supervision during puree production. Many tests were done with six bakers in Lichinga and two outside Lichinga. Small bakers around Lichinga were involved in training. All of them stated that they could benefit from use of OFSP puree; but most would like to get the puree free of charge.
 - Always involve many participants, and someone will emerge. Padaria Sanjala continues to produce power bread and asks for the availability of puree year round. This availability should be a must from 2017.
 - Small bakers from outside of Lichinga continue to produce power bread (Lurio Cuamba, Bandeze Lago, and Mississi Mandimba).
- The DVM annual assessment showed that some DVMs succeed by producing vines on more than 1-ha field plot and some failed on less than 100 m². Soil fertility remains a big challenge for producers despite the training and refresh during the field monitoring.
 - There is a need for additional training to the DVMs to understand the appropriate production of vines, continuous roots production, and the respective market such as the puree production. This facilitation should be part of training for these DVMs.
 - The training materials should include more illustrations than written messages to facilitate the beneficiaries' understanding. Facilitation and monitoring should continue until the end of the project.
 - Linking producers and bakers with contracts motivate DVMs to prioritize their OFSP vines and roots production over the year.
- Some data recorded from 2014 were not coherent and had some HH repetition. The project continued to clean the data until the end of December 2016.
 - The new M&E specialist works closely to clean these data until the end of the project. More than 3,000 duplications from the field were deleted.
- The bad weather with periods of drought or floods affected the production at province level and almost the entire country.
 - The project, SETSAN, and DPA already anticipated OFSP multiplication and production in lowland from April to July plantation period over the districts. The project continues to facilitate the communities for OFSP's staggered planting—mainly from July to October each year—to reduce periods of food scarcity and weather problems.
- Most HH were challenged to have access to products for food, mainly from December to February. HH production and income management contributed to this issue.
 - The project facilitates the communities to OFSP staggered planting, mainly from July to October each year to reduce periods of food scarcity.

6. SIGNIFICANT DEVELOPMENTS IN THE SECTOR

The province has lots of opportunities for development, taking into account the natural resources such as fertile soil, water, biomass, and the availability of land:

- The lowlands in long fallow or never used before have very high economic value if exploited. Some lowlands near the cities are beginning to be exploited for vegetables on a small scale. From this project, some changes were observed. Some farmers understand now the importance of producing OFSP in lowland from April until November–December. The vines are available at the appropriate time during the planting period. The period of harvest coincides with the food shortage, and the price of the roots is higher at this moment. Thus, exploiting the lowlands will facilitate greater access to food, and farmers should be able to sell OFSP at a higher price.
- The extensive amount of existing biomass constitutes a high potential for sustainable agriculture by transforming it into compost and using it as organic fertilizer. Coupled with small livestock, farmers could develop animal traction for labour or/and milk production for the HH, use the manure for developing compost, and use the OFSP waste as silage for animal feeds. Production capacity could be increased, and income could be improved. The challenge will be to see whether farmers are willing to invest in this labour-intensive activity. Potentially this could be an activity targeted at underemployed youth.

The introduction of net tunnels in Niassa province considerably helps the project to improve the availability of quality vines at district level.

- Quality vines distributed in small quantities during the off season helped HH to plan and manage their production and vine storage. A committed DVM received 1 kg of OFSP vines in April 2015, multiplied four times, and got 10,000 kg of vines in March 2016. Small plots at the house garden become common in Niassa for OFSP vines conservation. Awareness campaigns at each community, followed by small distribution, could cover most of the HH and will reduce malnutrition significantly within 2 years at the village of intervention.
- Power bread is now being produced and enjoyed by consumers. Besides appreciation for its taste, power bread is more nutritious.
- Farmers' organisations should be supported to meet market demand and to plant OFSP continuously year round to meet this demand.
- Awareness campaign includes the use of OFSP puree for small bakers and the street dodger and cookie sellers at selected localities. Using 50% of OFSP puree will reduce the production cost and increase net return.

7. INCORPORATING LESSONS LEARNED

Identifying committed HH for their own development is a process, and supporting them could influence the development of the neighbouring community. The project helped these HH to understand the importance of the existing natural resources. After 1 year of project implementation, some farmers were able to manage all the resources (water, biomass, manure) to improve their productivity and production. These HH would be the DVMs. Distribution of vines during off season improves the availability of vines for small HH by multiplying small quantity to meet their demand during the main cropping season.

Planting OFSP on fertile soil or using organic and mineral fertilizer gives more advantages for farmers. Comparative observations in different soil fertility at the same period of plantation and visit showed an evidence of the importance of the soil fertility.

About nutrition training methodology, the project learned lessons from 2014–2015, and developed a new approach that was implemented in 2016. The six topics within 6 months' implementations with the scenario 15–20–10 (15 animators/village, 20 counsellors/animators, and 10 HH/counsellor) reaches 3,035 HH/village. Other lessons were learned, and the methodology will be reviewed to be used for the future project.

Vines were distributed with strong OFSP agronomy messages, such as the facility of OFSP production, the flexibility of crop, and the quantity of OFSP needed to meet daily vitamin A needs. HH at one village could be covered by the project after one awareness campaign. The following case studies on agriculture demonstrate farmers' progress and successes.

8. CASE STUDIES

1. Success stories were registered for DVMs at districts (Lago, Sanga, Muembe, Chimbunila, Lichinga, Mandimba, and Cuamba).

- Mr Joao Chissanda in Matitima, Muembe district, planted his trial on volcanic soil. The harvest on 22 June 2013, was astonishing when, according to local residents, the largest root ever seen in the area was harvested—a root of 'Delvia' weighing more than 4 kg. "We have never seen such a size of sweetpotato". The news quickly spread in the community, and many HH came to see the sweetpotato and request some vines to plant in their field. A greater adoption of OFSP is expected in this village and neighbouring villages. 'Delvia' became a popular variety before its dissemination. The total harvest from 88 m² was 150 kg of vines and 204 kg of roots. Mr Joao was very happy. He gave up on growing local sweetpotato landraces (white-fleshed) and concentrated on OFSP, mainly 'Delvia'.
- Mr Manuel Rachid Medala participated during the OFT in 2013. He multiplied from the trial all the varieties at his initiative. Owing to his strong commitment to OFSP, he was invited to participate in net tunnels installation and compost training. He was one of the trainees who followed the recommendations from all the training he received. After planting OFSP vines under rapid multiplication in the net tunnel at the end of September 2013, he transplanted them into his 125-m² plot in mid-December 2013. Two months later, he produced 960 kg of vines from his first multiplication, and the plants in the net tunnel were ready to be transplanted. He received more than \$300 from the sales of vines and roots in the 2014 farming season. Mr Rachid had OFSP field of around 1,000 m² in the upland field and another 1,000 m² of early multiplication in lowland for 2014. He is now one of the farmers using farmyard manure for all new plots and is no longer burning his fields to clean them. "This is a food and this is a vaccine!" said Mr Rachid, showing two roots in his two hands, 'Kaguera', a local sweetpotato variety, and 'Jane', an OFSP variety. "I always keep my food but I promote the 'vaccine' since it is easy to produce and to improve the health of our community!" A positive mind-set for him after the first harvest of OFT in 2013! He was able to manage the members of his association by influencing them to use manure, plant OFSP, eat roots and leaves, and conserve vines during off season. All of the members learned from what he did and his success. His progress is a step-by-step process, as he started with the trial, multiplied the vines of all varieties, increased the OFSP field, managed all natural resources to improve yield, and now is ready to sell bread in collaboration with Padaria.
- Venancio Assane from Malemia at Sanga sold 12 Mt of vines of 'Gloria', 'Delvia', 'Irene', and 'Sumaia' from 2014, and 150 bags of roots and received 80,000 MZN (\$1,689). He bought a motorcycle and paid school fees for his children.
- Afonso Jiboia, a DVM in Lurio, Cuamba district, became the first producer processing his own OFSP. During the annual meeting on 29–30 April 2015, he participated in the visit to

Padaria Maria and understood the composition of wheat flour and puree needed to make power bread. He took the initiative to make his own bread and cakes with OFSP upon his return home, using a neighbour's oven to practice what he had seen. He baked cakes (350 cakes each time) and power bread without any exact measurements. He was invited to participate in the processing training organised at Lichinga. His initiative was supported by the project, and he had his own oven in December 2016.

- Tome dos Santos from Assumane community at Lichinga district received 4 kg of OFSP vines in February 2015. He was able to supply 1,067 kg of vines in January 2016, and gained 2,667 MZN (\$56.3). Now he is growing OFSP on 5,000 m².
- Luis Neto from Lurio Cuamba received 1 kg of 'Delvia' in April 2015. By April 2016, he had produced 10,000 kg of vines and sold 7,000 kg of vines and 130 60-kg bags of roots. His family consumes OFSP roots daily.
- Fernando Alabe from Cholue Chimbunila received 'Delvia' for OFT evaluation in June 2013. He started multiplying from 1 kg of vines at that time and expanded his OFSP field 2.5 ha by December 2014. He sold 35 bags of roots (each bag weighs 60 kg) and got 5,350 MZN (\$113) in 2014. He increased his OFSP field to 3 ha in 2015, sold 350 bags of roots, and got 101,000 MZN (\$2,132). He built a house, bought a bike, and paid his children's school fees. In 2016 he planted OFSP on 7 ha and harvested 900 bags. He got 225,000 MZN (\$4,749) and built a second house.
- Maimuna Atibo, a literacy participant from Baia community Sanga district, planted 'Delvia' in January 2016 on 100 m² and harvested 480 kg of storage roots in May 2016. Her family consumes OFSP roots daily, prepared in different ways, thereby ensuring food security and nutrition of her grandchildren.

2. Nutrition must be practiced, not just talked about. None of the participants in the training had ever seen sweetpotato prepared as porridge for children. Both men and women were involved in the cooking experiments. We gave children the porridge from OFSP—they liked it. Then the adults tried it as well, and to the surprise of many, they also enjoyed it!

- Though the original demonstration was for a group of 20, people from all around the community heard and came to try the porridge themselves. The chiefs also tried the porridge, and enjoyed it! In Padre Luciano, one chief of the village liked the taste of the OFSP and promised to try the recipe in his community. He made a commitment that in every community meeting he holds, he will set aside 5 minutes to teach about OFSP and nutrition. He also hoped to organise a nutrition fair to demonstrate how his community can eat well using the agricultural produce that local communities grow.
- Ariana is the first daughter of Julia, a loving, 15-year-old mother. Ariana was an indifferent, passive child who showed little interest in her surroundings. She would just sit and play only occasionally. Julia used to give her daughter porridge flour and salt, as well as "jolly juice", which she thought was healthy. Ariana did not have much of an appetite, and during the first interview, another child sat next to Ariana and ate curried cabbage. Ariana, on her own, started eating her friend's food—she was hungry after all. Through the Diocese of Niassa activists, Julia learned how to enrich the porridge, nurse Ariana whenever she wants to snack, eat more curried food, and practice other healthy measures. Ariana is already playing well, eating, and breastfeeding. She is a much stronger and happier child. "When I have OFSP, I prepare porridge for Ariana's breakfast", said Julia. "I also liked the OFSP and wanted to eat, but I kept it for my daughter because she needs good food".
- Matilde Luis, a professor, worked for 7 years in Mississi, Mandimba district. For more than a year, she had had problems with her sight: her eyes stung like they had sand in them. When she started to notice problems, she went to the hospital and got medical treatments with

several ointments without any success. One day, she was aware of the benefits of eating OFSP and went to look for SDAE extension agents. She consumed OFSP from May 2015, prepared in various ways (e.g. roasted, boiled, fried). Within a month, the situation improved considerably. OFSP has now become a major part of her daily diet.

- Jervino Santos in Messumba Lago district was 12 months old in 2015. One month after birth, breastfeeding was not possible due to her mother's poor health. Jervino was fed on milk from the shop until 6 months, where malnutrition was significantly visible. Lucia Bizale, her grandmother, was aware of OFSP and took some vines at the OFSP neighbouring field. This helps her to have OFSP roots from July 2015 up to now as basic food for Jervino. Lucia prepared OFSP puree with groundnut daily, OFSP puree with legumes puree, fish powder, and others during the last 6 months to get this child healthy.
- Antonio Julio is 2 years old and lives with his mother in Mapudje, Sanga district. In the past, he refused to eat anything and only wanted to breastfed. His mother had even taken him to the hospital, but they had not been able to help. However, the day that we practiced making enriched porridge of OFSP and groundnut, his mother tried to give him some. He not only kept eating, but he grabbed the spoon from his mother to eat by himself. Now his mother makes enriched porridge for him every day—and the rest of the family enjoys it, too.
- Before, it was normal for Maria Manuel, Ngongote, Sanga district, to eat the same food for 2 or 3 days in a row. We thought that the preparation method was the only factor that influenced one's health. "Now, I vary what I eat. I prepare foods that protect the body like OFSP. I have a grandchild who is 4 months old and another who is 8 months old. With my experience from the project, I advised their parents to breastfeed the children a lot and continue doing so for 2 years. Also, the 4-month-old baby should only take breast milk, nothing else. I share the information with my neighbours as I want ALL PEOPLE in my community to start consuming healthy foods like OFSP".
- Before learning of nutrition, Adriano Cide, Ngongote, Sanga district, preferred manufactured products. "I have one daughter, but always tried to feed her with powdered juices, cookies, little cakes. However, now I value the food that comes from my field, mainly the OFSP. I no longer spend money by buying food that does not help the body. I now feed my daughter at least 5 times a day and look for foods that will help her stay healthy. Also, I pass on information to my neighbours and others in my community".
- Ana Saide, Nassenhenje, Sanga district, said: "I never knew how to eat well. I did not know how to feed a child. I did not know that it was good to breastfeed a child for a long time. Before, I gave unhealthy food to my son. I gave powdered juice, sweets with sugar, and other foods that do not help. But now, I do the opposite of what I used to do. Now I give my family foods that help maintain good health such as OFSP. I now give the foods that I thought were for poor people, like greens".

9. FINANCIAL REPORT

The financial report will be submitted separately from CIP-Lima with the no-cost extension approved by the donor; some budget line items were reallocated accordingly. All partners contributed to the work plan for project activities until the end of October 2016.

10. CONCLUSION

The project had the following conclusions by the end of December 2016:

- **Objective 1.** The project trained a total of 18,784 beneficiaries (17,009 women). Of these, 13,109 (13,000 women) were trained on OSFP nutrition for 6 months in 2016. It appeared

that the behaviour changes at the communities were significant mainly at the last seven villages of Sanga district where the project implemented the lessons learned from the previous training. The OFSP varieties disseminated at the community level are frequently consumed by HH. Different forms of culinary preparation were registered during cooking and food preparation competition and after the nutrition training. The leaflets produced by AP in 2013 were distributed to the adult literacy course and reviewed to be used from the second year. The baseline, the internal assessment, and the final evaluation were done with high priority to measure the impact of the project. HH producing, consuming, and selling OFSP were captured. Demonstration competitions increased access to vitamin A from different forms of OFSP-based culinary preparation. Access to OFSP for consumption and the HDDS and IDDS were compared between the baseline and endline, with significant positive results obtained.

- **Objective 2.** Six varieties identified during evaluation of OFT are under multiplication with four varieties per district. 'Delvia' is the widely accepted variety and is preferred for the taste of its leaves and roots as well as its high yield. 'Gloria' was the second most preferred because of the culinary taste, which is better than local landraces. 'Irene' took the third position because of its high yield and female farmers preferred it most. The three were the most adapted and adopted varieties. The endline captured three other varieties. 'Bela' was the most diffused variety by indirect beneficiaries according to the endline results. 'Jane' had a good taste with acceptable yield. Participants preferred 'Sumaia' less because of its purported poor taste; however, it has a higher yield than the local variety, took the second position after 'Delvia', had good shape and deep orange-flesh colour, and is recommended for processing.

Under the new clones evaluated in multi-locational trials and the OFT, 'Ivone' and 'Bita' were more preferred than 'Gloria' for taste and yield. These two were later released in February 2016.

'Delvia', 'Gloria', 'Bela', and 'Irene' were multiplied immediately by 31 DVMs (7 women) in the first year in the North Zone and by 44 DVMs by June 2014. The same varieties with 'Sumaia' variety were selected in the South Zone. Some 71 DVMs (17 women) multiplied OFSP vines by December 2014, 87 DVMs (22 women) in the third year, and 72 DVMs (22 women) in the fourth year. HH using lowland areas for vine conservation increased from 41% in 2013 to 58% in 2015, and the use of small garden plots rose from 14% to 26%. HH conserving vines in upland fields dropped from 56% in 2013 to 7% in 2015.

The process of assessing the DVMs helps the project to identify the challenges and focus on the strategy to be developed. Some successes on net tunnels need to be valorised to have quality planting materials over the year. The success of some DVMs on OFSP vine multiplication needs to be disseminated to others to make the project sustainable. At least all districts have one sustainable DVM, but DVMs need to be supported more on vine management. Capacity building on vine management, data collection, and data entry was intensified with all field technicians. All the trainings were conducted (ToT for partner technicians, training for vines producers, processing, OFT). Vine producers were trained intensively during three years.

During the project implementation, clean data showed that 28,044 HH (51% women) received OFSP vines directly; 140% of the fixed objective, where 78% of HH have 37,262 children under 5 years. About the indirect beneficiaries, the number would be at least twice that of the direct beneficiaries. During the field monitoring, direct beneficiaries advanced providing OFSP vines to 2–5 neighbouring HH. Then, the project covered at least 56,000 indirect beneficiaries. All the technicians of SDAEs are involved in undertaking mass

distribution and data collection. The project met its expectation in terms of OFSP vines conservation, use of lowland, OFSP consumption, and an increase in HH selling OFSP, achieving a significant behaviour change on agriculture, nutrition, and market mind-set by the end of the project.

The average yield of OFSP during the assessment in December 2015, and the endline in June–July 2016, were 15.5 Mt/ha and 10.5 Mt/ha, respectively. The reason for the low yield during the assessment was the drought that occurred during the growing period which affected the yield. Yields are above the objective of 50% of national yield with 6 Mt/ha (i.e. 9 Mt/ha).

- **Objective 3.** In 2013, any producer sold OFSP according to the baseline; however, 30% of producers sold sweetpotato. The results of the market study showed that 55% of producers sold OFSP and 66% of HH bought roots at least twice a week and 13% once a week. HH selling OFSP-increased power bread was greatly appreciated in Lichinga.

The high percentage of consumers—more than 90%—that appreciated power bread is justification for supporting OFSP processing. As the power bread has low-cost production and is more nutritious than conventional bread, the project should ensure the availability of puree over the year, and the bakers could produce the bread continuously year round. Partners are encouraged to help these HH to be organised so as to take advantage of market opportunities. The linking of producers to the market was initiated, and contracts will be facilitated. Some farmers are willing to sell power bread at their locality. They will purchase the power products during the OFSP delivery to Padaria. Tools for monitoring the market will be developed and implemented for the next project.

Supporting small-scale bakers in the districts and rural areas would increase OFSP demand. The success of Padaria Sanjala will incentivise other bakers to follow once the OFSP puree is available, taking into account the high appreciation of consumers.

Increasing yield of OFSP keeps the production cost lower. Once the price of puree remains at 50% lower than the wheat flour (see Fig. 9, p. 22), OFSP processing would be sustainable as detailed in Figure 7, and more HH will be motivated to produce more OFSP beyond their production for consumption.

- **Objective 4.** The project realised the objective regarding coordination and partnership. OFSP is well established among the main crops within specific Objective 4 of PAMRDC led by SETSAN. OFSP vines are multiplied in all districts of Niassa Province through SDAEs and SETSAN in collaboration with the project. SETSAN thematic groups help the project to disseminate the OFSP beyond the intervention zone for the indirect beneficiaries. Other projects such as Netherlands Development Organization and Associação Portuguesa de Apoio a África include OFSP in their 2017 programme.

CIP will focus on extending the project to others districts of Niassa for another phase from 2017 to implement the lessons learned. Further projects will start and continue with awareness campaigns focussing more on the integration of OFSP production, nutrition, and market, taking into account all aspects of OFSP advantages. Partners are expected to help broader dissemination of OFSP beyond the intervention zones as indirect beneficiaries.