



HarvestPlus



From 2007 to 2009, HarvestPlus disseminated **orange-fleshed sweet potato** to more than 24,000 households in Mozambique and Uganda to see if we could reduce vitamin A deficiency—through food.

This is what we found.

MOZAMBIQUE COUNTRY REPORT



HarvestPlus

HarvestPlus leads a global effort to breed and disseminate staple food crops that are rich in vitamins and minerals to improve nutrition and public health. We work with public and private sector partners in more than 40 countries. HarvestPlus is part of the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH). It is coordinated by the International Center for Tropical Agriculture (CIAT) and the International Food Policy Research Institute (IFPRI).

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Partners

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International Food Policy Research Institute, USA
International Potato Center (CIP), Peru
Natural Resources Institute, University of Greenwich, United Kingdom
World Vision International, Mozambique

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INTRODUCTION

This report summarizes the outcomes of a four-year research project (2006–2010) led by HarvestPlus. The Reaching End Users (REU) Orange-Fleshed Sweet Potato Project disseminated orange-fleshed sweet potato (OFSP) to smallholder farmers in Uganda and Mozambique to reduce vitamin A deficiency (VAD) among children and women of childbearing age. This report summarizes the findings from Mozambique. Please also see the report “Disseminating Orange-Fleshed Sweet Potato: Findings from a HarvestPlus Project in Mozambique and Uganda” (2010) for a summary of findings and comparisons across the two countries.

What is Hidden Hunger?

More than two billion people in the world suffer from micronutrient malnutrition, or hidden hunger, putting them at greater risk of disease and death (Allen et al. 2006). Women and children are the most vulnerable (Bhutta et al. 2008). Hidden hunger is a severe problem throughout Sub-Saharan Africa. The burden of micronutrient malnutrition among children under five is highest in Sub-Saharan Africa compared with other regions (Caulfield et al. 2006). The prevalence of vitamin A deficiency is especially high with 32 percent of the under-five population estimated to be vitamin A deficient (UN SCN 2004).

The Biofortification Approach

The main interventions for reducing hidden hunger have been supplementation and fortification. Although these interventions are effective, they are limited in reach, especially in rural areas where the majority of the poor live, and often expensive. A new approach called biofortification could fill this gap in coverage among rural populations. Biofortification is the process of breeding staple food crops that have higher micronutrient content. This strategy is particularly suited to rural populations that consume mostly staple foods from local or self-production.

Using OFSP to Combat VAD

Sweet potato is widely consumed in Sub-Saharan Africa (Woolfe 1992).

Conventionally bred orange-fleshed sweet potato (OFSP) biofortified with vitamin A was the first biofortified crop released by HarvestPlus and its partners. This new variety is orange in color, unlike the white or yellow varieties that are traditionally consumed in Africa. Plant breeders have produced several OFSP varieties with beta-carotene contents of 30–100 parts per million (ppm), compared with the 2 ppm in local varieties (the body converts beta-carotene to vitamin A). If orange sweet potato was incorporated into diets in Sub-Saharan Africa, the prevalence of vitamin A deficiency could be significantly reduced.

A study from South Africa showed that daily consumption of OFSP, which provided about 2.5 times the recommended daily allowance (RDA) of vitamin A for four- to eight-year-old children, improved liver vitamin A stores (van Jaarsveld et al. 2005). In Mozambique, a field study that consisted of an integrated agricultural and nutritional intervention in rural areas demonstrated that regular consumption of OFSP significantly improved the vitamin A status of children (Low et al. 2007).

Mozambique was targeted for the REU project due to its high prevalence of vitamin A deficiency—69 percent among children aged 6–59 months. (Instituto Nacional de Estatística 2003,2005).

Project Objectives and Strategy

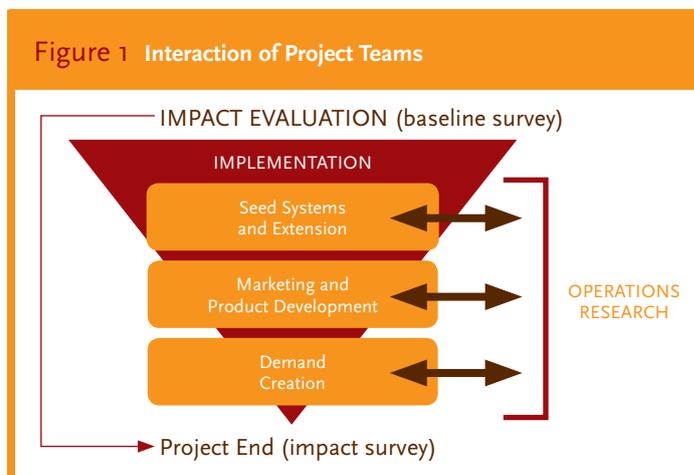
The project disseminated OFSP in Mozambique using an implementation strategy that included three integrated components: (1) seed systems and farmer extension; (2) markets and product development; and (3) demand creation through behavior change communication. (See Figure 1)

Over the course of the project, 14,000 farming households were targeted. After a one-year diagnostic study, project implementation was carried out over three seasons (two and a half years) in Mozambique. By randomly selecting project and control villages and conducting pre-intervention baseline and post-intervention endline surveys, and other state-of-the-art methods, the project assessed OFSP adoption rates and whether adoption resulted in improved vitamin A intakes among young children and their mothers. The project also analyzed alternative dissemination strategies that combined the use of extension personnel linked to community-based promoters for their cost-effectiveness.

Running in parallel to the project, operational research studies were carried out mainly to monitor implementation and recommend improvements. In order to support these activities, three teams of staff were assembled: implementation, operations research, and impact evaluation.

The project had three primary components:

1. Develop an OFSP vine distribution system that includes providing subsidized vines to households



and provide agricultural extension services on OFSP production practices and marketing opportunities to men and women in farm households;

2. Provide nutritional information, in particular about vitamin A deficiency, to women in these same households; and

3. Develop markets for OFSP roots and processed products made from OFSP roots.

Components 2 and 3 were accomplished by using a pyramidal structure of paid extensionist trainers working for nongovernmental organizations (NGOs) and unpaid community volunteers called promoters who were trained by the extensionists. The promoters, in turn, instructed fellow members of pre-existing farmers' groups or community organizations.

Because one key objective was to evaluate cost-effectiveness, the project developed and implemented two dissemination/extension models termed Model One and Model Two. Both models included all three components, but in Model One extension workers were expected to train and provide advice for two years, while in Model Two extension staff was present only for the first year. Both groups were exposed to information through mass media, community drama, and area-wide events such as field event days and market promotion events. Model Two was thus less expensive to implement.

Partners and Coordination

A number of partners and teams were required to achieve the project's goals.

1. Implementation. Implementation was carried out by NGOs that were responsible for disseminating OFSP in target communities. The project collaborated with two international NGOs: World Vision and Helen Keller International (HKI). World Vision provided overall direction and supervision while HKI was responsible for demand creation and nutrition training.

2. Operations research. An operations research team planned dissemination strategies, worked with the NGOs to modify specific implementation activities, and undertook background research during implementation in both countries. The International

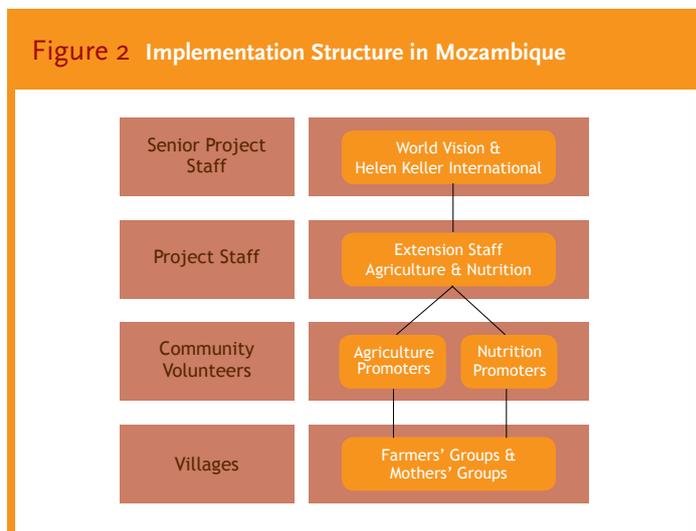
Potato Center (CIP) was responsible for vine systems and farm extension related to production of OFSP. HarvestPlus was responsible for demand creation and provision of nutritional information. The Natural Resources Institute, University of Greenwich was responsible for marketing and product development.

3. Impact evaluation. An impact evaluation team, led by the Poverty, Health, and Nutrition Division at the International Food Policy Research Institute (IFPRI), conducted baseline and endline surveys in Mozambique in both participating and non-participating villages, which were randomly selected for participation. Figure 1 shows the interaction between the different project components.



PROJECT IMPLEMENTATION

Figure 2 illustrates the structure of the project with paid extension staff that were responsible for training volunteer agriculture and nutrition promoters who in turn were responsible for training farmer and mothers' groups in sweet potato agronomy and nutrition/child health.



Due to the lack of pre-existing farmers' groups and the expense of forming farmers' groups and the short duration of the project, which did not allow for the formation of farmers' groups or organizations, it was decided to work through existing church groups and associations. Each church grouping (1–3 churches) recruited 100 households to participate in the project activities. Of the total 108 church groups, 72 were located in the northern districts of Milange and Gurué and 36 in the southern districts of Nicoadala and Mopeia. Pairs of agriculture and nutrition extensionists were responsible for working with 12 organizations in the first year of the project (2006/2007).

Figure 3 illustrates how in Year 1 the project started working with 10,500 farmer households in 108 church groups with 9 agriculture and 9 nutrition extension workers. This included both Model 1 and Model 2 church groups. Another 36 groups were added into the project in Year 2 since Model 2 groups no longer received direct extension intervention, resulting in a total of 14,000 target households. The 36 groups received the same Year 1 training Model 1 and 2 groups received in their first year.

In Year 1, trainings were conducted on planting, quality OFSP production, and vine and fresh root conservation for both Model One and Model Two church groups. Trainings followed the agricultural calendar. Refresher trainings were carried out in Year 2 (2007/2008) and 3 (2008/2009) for Model One church groups only. Model Two church groups did not receive any refresher trainings except the training on planting, which accompanied vine distribution and was considered by the project to be essential for all groups to ensure crop establishment (Figure 3).

Likewise, in Year 1, all mothers registered in the project received training in nutrition and child health. In Years 2 and 3, Model 1 mothers' groups received refresher trainings on selected nutrition topics while the Model 2 mothers' groups did not.

Site Selection

The project built on two previous projects that were implemented in Zambézia Province. The first was a pilot project called Towards Sustainable Nutrition Improvement (TSNI), which found that children in treated communities growing OFSP had higher vitamin A intakes than children in comparison communities (median 426 µg versus 56 µg retinol activity equivalent [RAE]) and higher serum retinol concentrations as well (by 0.075 µmol/L on average) (Low et al. 2007). The second project was Eat Orange, a "bridging project" between the TSNI and the REU project. The REU used the infrastructure and networks of these projects, but sought to scale-up delivery at a lower cost per household.

The REU focused on one province, Zambézia. The main staple crop in the province varies with maize being the major staple in the more fertile north and cassava more important in the south. Sweet potato is grown by 18.3 percent of farmers nationally and almost a third of farmers in Zambézia as a seasonal secondary crop, not a staple.

To maximize the impact, the project focused on specific sites in Zambézia Province where OFSP could be promoted. Selection of project areas took into account climate and soil types across Zambézia Province and the areas where the Eat Orange project had worked. Potential production areas were assessed based on their high levels of vitamin A deficiency. The project selected two districts in the north with good soils and high rainfall and two more in the drought-prone south with poorer-quality soils (Figure 4).

The southern districts were relatively close to the provincial capital of Quelimane, while the northern districts were up to 350 kilometers away.

Figure 3 Project Outreach Strategy

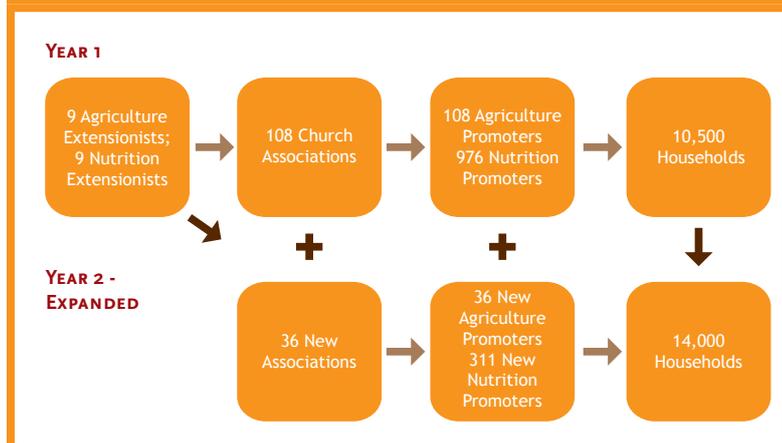


Figure 4 Project Districts in Zambézia Province, Mozambique



A total of 108 villages were initially selected across these areas for implementation; 36 villages were added in the second year. The villages were selected according to the following characteristics:

- Good potential for production of sweet potato (usually determined by the cultivation of white sweet potato in the area)
- Access to moist lowlands in the dry season to aid in conservation of the OFSP vine
- Little or no OFSP currently being grown
- No presence of any NGO working on agriculture- or nutrition-related issues in the area
- Reasonably close to a main road, to assist in linking the production areas to potential markets
- Not being closer than 5 km to any other village selected to work with the project

The high prevalence of vitamin A deficiency was an underlying factor for all areas of Zambézia Province.

Seed Systems and Extension

Selection of Varieties

Four released varieties from previous projects (Resisto, Jonathan, LO323, Cordner) and four new varieties (Gaba-Gaba, MgCl-01, 199005.11, 199062.1) were released for the REU. These eight varieties were recommended for promotion in Year 1.

- Only the five with raw beta-carotene contents of 70 ppm and above were recommended for processing beyond boiling or steaming (Resisto, Gabagaba, Cordner, MgCl-01, 19905.11).
- Jonathan, LO323, and 199062.1 all had roughly 30 ppm beta-carotene and were considered to have good drought tolerance once established.

Seed Multiplication, Distribution, and Planting

Clean plant material was sourced from the Instituto Nacional de Investigação Agronómica (INIA) and the Southern Africa Root Crops Research Network (SARNETT) during the pre-REU Eat Orange implementation period and used to plant the Lualua (Mopeia District) multiplication plot in June 2006. This field initially used the rapid multiplication technique in order to bulk up sufficient material to supply planting material to additional multiplication sites in strategic locations throughout the project operating area. By August 2006, a total of six project multiplication fields (Lualua, Licuari, Lioma, Corromana, Nhazombe A, Chissulo) had been planted, and conventional multiplication of vines was underway in each in preparation for the December 2007/January–February 2008 vine distribution period. The project was successful in ensuring sufficient quantities of vines to meet the needs of all participants in all three distribution seasons.

OFSP Vine Distribution

The project policy for vine distribution and sale had as one of its main objectives the formation of a sustainable seed system. A key challenge in its formulation was the inherent tension between the need to balance the desire for widespread dissemination and impact with the desire not to create a system where smallholder farmers expect free distributions on a yearly basis. Experience had shown that when people pay for something, even a token amount, they value it more highly and hence are more likely to invest in its conservation for the following seasons. Therefore, a system of selling vines was put into place.

The poor 2007/2008 agricultural season was characterized by significant drought and subsequent vine loss and by abnormal patterns of rainfall that adversely affected the project. Based on observations from the 2007/2008 season, several measures were taken in the 2008/2009 season, including:

- Farmers were encouraged to plant vines as early as possible with the first rains;
- A decentralized system of vines producers was identified and trained;
- A system of vouchers was also put in place; and
- Three kg of vines per household were given free of charge, and additional quantities were sold because it was found that two kg of free vines per family was not sufficient, especially in a season with poor growing conditions.

Vine Distribution Policy

Years 1 & 2:

- 2 kg free distribution to each head of household participating in the project for the first time
- No free distribution to project participants having received vines previously
- Additional vines available for purchase at 1.5 MT/kg to project participants
- Vines available for purchase to non-project participants

Year 3:

- 3 kg free distribution if vines planted before a certain date limit
- Additional vines available for purchase to project participants and MSP (date limit)
- Vines available for distribution and purchase to decentralized vine producers (voucher system with or without date limit)

Additionally, distribution of vines was extended to interested men and women in participating households, rather than only the head of household. Fortunately, rains were good in 2009. As a result of efforts made by the project to mobilize the communities, a grand total of 109,733 kg of vines were distributed to a total of 30,747 beneficiaries between the north and the south for the 2009 growing season.

Since subsistence farmers were only expected to produce enough sweet potatoes for home consumption, the project also identified medium-scale producers (MSPs) of OFSP who were able to grow larger amounts that could be sold in local markets. A farmer was considered as an MSP if s/he was able to plant at least 0.5 ha during the first year; this figure was dropped to 0.25 ha in the second year as few farmers were able to plant more. A total of 108 MSPs (14 in the south and 94 in the north)

Table 1 Number of Vines Distributed or Sold

Project Year	Amount of vines (kg)		Beneficiaries
Year 1 (2006/2007)	55,514	Distributed &/or sold	7,312
	23,414	Sold	Governments & NGO projects
Year 2 (2007/2008)	39,226	Distributed &/or sold	12,620
	8,750	Sold	Governments & NGO projects
Year 3 (2008/2009)	109,733	Distributed &/or sold	30,747

were identified and provided with technical support during the first year. Given the good rainfall in the first year, MSPs were successful in planting OFSP in all areas. Some MSPs were successful in selling their surplus, but sales were dependent on their respective locations and ease of market access. The 2007/2008 season saw a decrease in the number of MSPs; the project identified a total of 63 MSPs in the second year, 14 in the south and 49 in the north. Conditions greatly improved for the 2008/2009 season; 61 MSPs worked with the project in 2008/2009. Some of these producers also became decentralized vine producers (DVPs) who decided to grow OFSP as a dual-purpose crop for both vines and roots. With the good rains of that season, many of these farmers were willing to expand their area under OFSP production, and they were able to provide vines to other farmers in their areas.

Demand Creation

The main objective of the demand creation component was to promote the production and consumption of OFSP through nutrition education as well as through additional forms of communication

targeting mothers, the wider community, consumers, and policymakers. In order to influence people's behavior, available and affordable channels of communication were selected for the delivery of messages, and training material was developed.

Training manuals for the training of trainers were produced for the project by HKI, the project's institutional partner for the implementation of the demand creation component in Mozambique. They were addressed to those responsible for trainings: nutrition extensionists and nutrition promoters. Nutrition extensionists were responsible for training nutrition promoters who then trained groups of ten mothers. The nutrition training for mothers was more broadly based than households participating in the project and was open to other mothers from the community. In Year 2, key nutrition awareness raising training was conducted with grandmothers and community leaders who were considered to be influential groups in the community. In Year 3, to support the agricultural component aimed particularly at women farmers, the nutrition promoters received training on planting. This was done to ensure crop establishment and project sustainability.

Field days were held to promote OFSP within the community and facilitate linkages between the different actors (i.e., farmers, traders, consumers). They consisted of several elements: a theater piece, general nutrition training by the responsible nutrition promoters, testimonies by OFSP producers and sweet potato traders, distribution of vines, and a planting demonstration. A total of 77 field days were carried out reaching more than 13,000 attendees. The total number of theater performances was 407 plays over the 3 years reaching more than 50,000 people.

Radio programs (approximately 8 minutes long) and spots (20 seconds) were recorded and broadcast on the Mozambique and Malawi radio stations (government and community radio stations). Topics included agriculture, nutrition, and marketing of OFSP. The programs were in Portuguese, Chuabo, Lomwe, and Chichewa. Each program consisted of several episodes, which were transmitted up to four times, and spots (agriculture, marketing, or nutrition) transmitted up to 30 times. The theme song for the project was broadcast on all stations and often accompanied the programs and spots.

Wall murals were painted in strategic viewing locations in Quelimane and Milange. The slogan "Para Boa Saude e Visão consuma Batata Doce de Polpa Alaranjada Rica em Vitamina A" (For good health and vision, eat orange-fleshed sweet potato rich in vitamin A) was used frequently on the murals and road signs.

Other visual tools of promotion used included "bancas" (small shops), "tenda" (raised sales tables), advertising plaques and signs for farmers, traders, and bakers, and project vehicles painted orange and featuring the logo.

Marketing and Product Development

In addition to the before-mentioned activities, the REU project also evaluated different strategies for increasing and improving the marketing of OFSP. Marketing trainings were focused on sweet potato traders (22 training sessions that involved 226 traders in total between 2007 and 2009). However, the training was later extended to include training of MSPs (91 MSP were trained in total). Given the constraints experienced by some OFSP producers with respect to distances to markets, transport costs, and difficulties in attracting buyers into some of the

Food Day events each year organized in Zambézia Province. In 2008 the project was represented at the International Trade Fair and Agricultural Exhibition (FACIM Trade Fair) in Maputo. This event was attended by both the present and past presidents of Mozambique who showed interest in the OFSP products on display at the project's stall.

Another aspect of the marketing strategy was product development. Golden Bread (Pão d'ouro), substituted some wheat flour for cooked mashed OFSP, and this was promoted with six different bakeries in Quelimane, Gurue, and Milange. The project also trained informal bakers who sold smaller quantities of homemade bread in the smaller local markets (a total of 50 small bakers). Other minor products were cakes, snacks, and biscuits. Additionally juice made from OFSP was also widely promoted and made both in homes and commercial establishments.



Murals and artwork used to promote OFSP.

production areas, the project decided to form and train market management committees (MMCs). The MMC concept is similar to the farmer association/farmer forum structures often promoted by projects in rural areas of Mozambique to enable collective agricultural marketing. MMCs were comprised of 20–30 producers, and their aim was to facilitate the bulk sale of OFSP.

Connecting the various participants in the OFSP marketing chain was a key component of the overall strategy. Traders participating in the trader trainings were taken to the fields of MSPs and introduced to these OFSP producers. Likewise, MSPs participating in trainings were taken to markets and introduced to sweet potato traders. Both producers and traders were linked to the bakeries producing Golden Bread so there could be a steady supply of roots. Additionally, business links were formed between traders of OFSP roots or of Golden Bread to the hospitals in Quelimane, Milange, and Nicoadala.

The project also worked to raise awareness and increase demand for OFSP. This was achieved by the use of wall murals, large advertising signs, billboards, plaques for the trained OFSP traders, and Market Promotional Days in some of the main markets (8 were held with an average attendance of 150 people).

The project also participated in the annual World

KEY FINDINGS

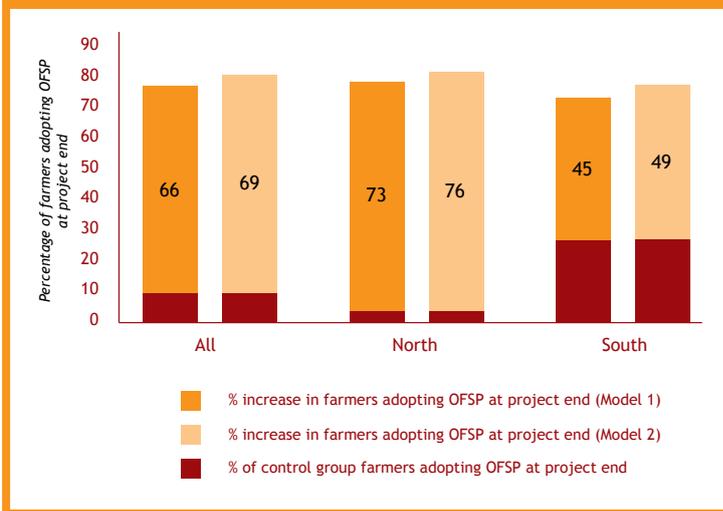
OFSP Adoption

The REU project successfully reached its goal of promoting OFSP and increasing adoption of this nutrient-rich crop in rural Mozambique. It led to a 66–69 percentage point increase in the probability of OFSP adoption in Mozambique (Figure 5).

There were no significant differences in these estimates across Model One and Model Two. The degree of success of OFSP adoption depended somewhat on underlying contextual factors, such as size of land holding, types of crops being grown, gender of the head of household, ability to speak Portuguese, and distance from market.



Figure 5 Impact on OFSP Adoptions Rates in 2009, Mozambique



Yields

As shown in Table 2, the yields of OFSP compared favorably with the yields of white sweet potato except in one district (Milange), where a white sweet potato that came from Malawi (Admarc) had high yields.

Table 2 Average Yields of OFSP Varieties Disseminated, Compared with Local Varieties by District in Mozambique (metric tons/acre)

	Gurué	Milange	Nicoadala/ Mopeia
MGCL 01	4.45	4.62	2.15
Jonathan	3.28	4.01	3.08
Cordener	6.11	4.17	3.12
Resisto	6.84	4.25	1.74
Local (não BDPA)	2.97	5.67	3.00

OFSP Share

In Mozambique the average area cultivated with OFSP at project end was between 0.04 (north) and 0.06 (south) acres. The total area cultivated with sweet potato was no higher for households in the intervention than in the control group, but the REU dramatically increased the share of OFSP in total sweet potato area. OFSP share increased by 54–57 percentage points in Mozambique from a base of 6.5–11 percent (Figure 6). The project led to a 68 percentage point increase in the OFSP adoption, and OFSP share increased by 56 percentage points in Mozambique.

To put these numbers in perspective, 0.1 acre of OFSP under cultivation by each household and yields averaging 4 tons per acre (as in the more productive regions) would translate into about 400 kilograms of OFSP per household, or 50–65 kilograms per person per season. With allowances for storage and sale, this production would translate to between two to two-and-a-half months of consumption.

OFSP Intakes

The REU intervention resulted in a significant increase in the intake of OFSP among children and women in Mozambique. Data from the follow-up survey at project end for total sweet potato intake and proportion of sweet potato consumed as orange, yellow, and white varieties are shown in Figure 7 for children 6–35 months of age and mothers (19–49 years).

Adoption of OFSP resulted in substantial substitution of OFSP for other sweet potato. The intake of OFSP in the intervention groups was more than 35 and 115 grams/day among children 6–35 months and women, respectively. There were no differences between the two intervention strategies (Model One and Model Two) in this regard.

Figure 6 Impact on Proportion of OFSP in Sweet Potato Area, 2006–2009, Mozambique

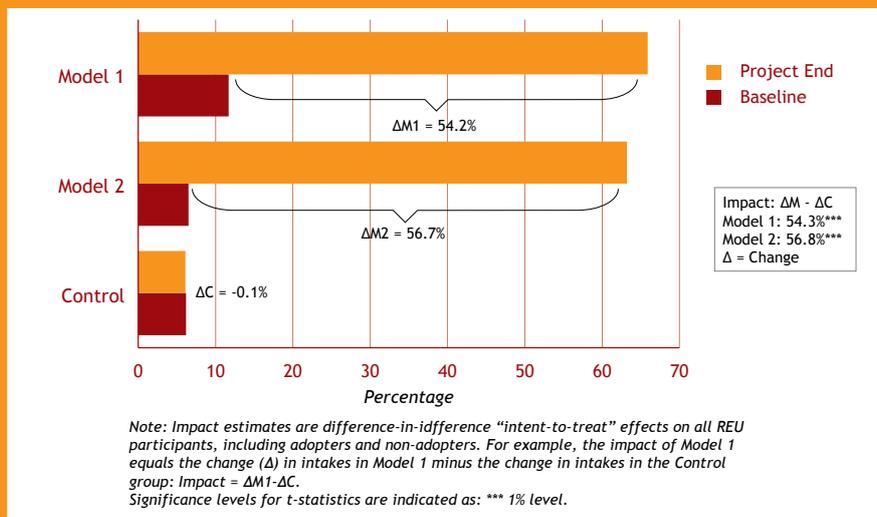
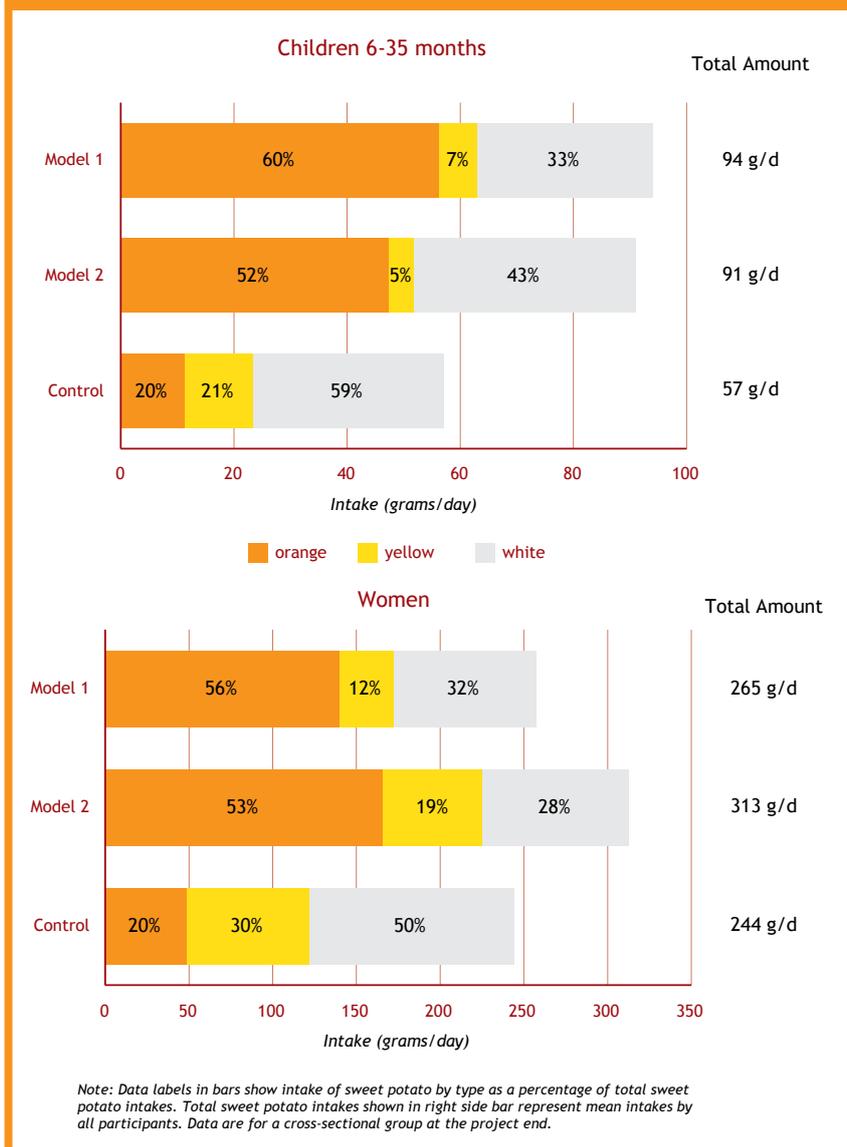


Figure 7 Sweet Potato Intakes by Age Group at Project End, Mozambique



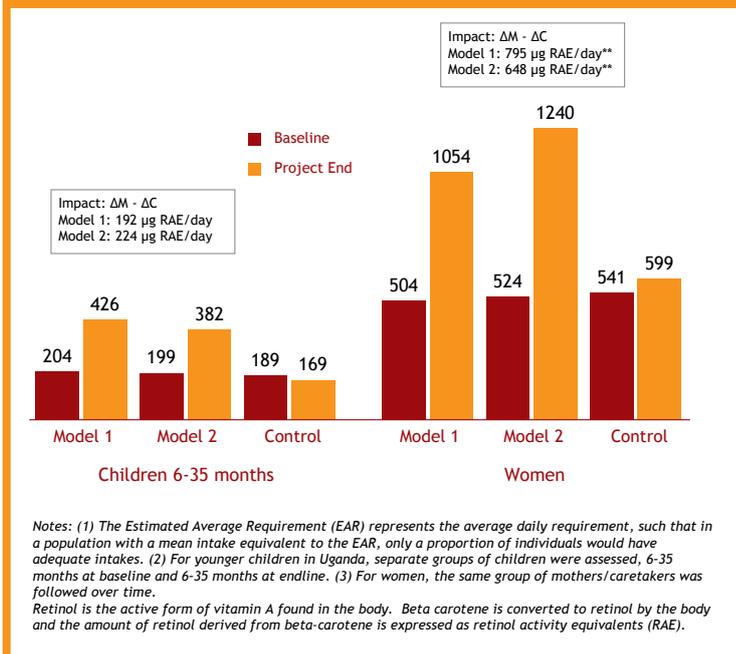
Vitamin A Intakes and Dietary Sources

As a result of increased intake of OFSP, a significant increase in total vitamin A intakes was found among children and women in Mozambique at project end (Figure 8).

Baseline intakes were about equal to the Estimated Average Requirement (EAR) at which vitamin A intakes are adequate for only a proportion of individuals. Vitamin A intake doubled for all age by project end. For the age group of greatest concern, children aged 6–35 months, OFSP contributed 76 percent of the total vitamin A intake in Mozambique. There were no statistically significant differences in vitamin A intakes between Model One and Model Two groups.

The OFSP and vitamin A intakes were recorded during the main postharvest periods. As noted above, home production of OFSP could be expected to provide these levels of intakes for two to three months of the year. However, piecemeal harvesting (sweet potato left in the field and harvested as needed for meals) extends consumption up to five months in Mozambique, on average.

Figure 8 Impact of REU Intervention on Mean Vitamin A Intakes (μg Retinol Activity Equivalents (RAE)/day), Mozambique



Lessons Learned

Since this was the first large-scale project to distribute a biofortified crop to a target population, the project looked closely at the lessons learned throughout the different phases that could be applied to future projects to deliver other biofortified crops in other countries.

Seed Systems

- Selecting the appropriate varieties with desired agricultural traits is the top priority in any sweet potato project.
- Seed system design is driven by agroecological conditions. In areas where rain is abundant, farmers are clearly in a better position to maintain their own vines on the farm than those with a prolonged dry season.
- Having a well-organized system for vine multiplication (i.e., free-disease planting material, access to irrigation), transport, and delivery is critical. Using trained decentralized vine multipliers (DVMs) and a voucher system for accessing planting material appeared to be a success in the third year of the project.
- Commercially oriented vine multiplication schemes are preferable because they are more sustainable due to the profits they generate.

Extension

- The project chose to work with pre-existing groups, which had its advantages and disadvantages. The lack of cohesiveness in church groups proved to be a challenge because membership was fluid thus making vine distribution and training difficult for extensionists. In addition to the frequency of trainings, content, relevance, and type of training are very important in influencing knowledge retention.
- Transmitted messages should be clear, straightforward, and communicated in a simple manner. Extension staff should be trained in adult education accordingly.

Demand Creation

- To have an impact on child health, it was not enough to focus solely on the production and consumption of OFSP. Implementers found that mothers needed information on child health and nutrition, in general, as well as hygiene and sanitation.
- The most effective, most preferred, and most trusted source of information among farmers is the direct contact between project extension workers, promoters, and mothers.
- Drama is an effective communication tool for getting messages to a broader community. It is important, however, to

monitor messages so that they are accurate and consistent.

- Radio is an important source of information; however, in Zambézia Province where radio ownership and listenership is low relative to other countries, traders and male farmers, in general, had better access to this source than women.
- In order to have significant impact, it was critical that the unit of intervention was the household rather than just men or women because culturally defined gender roles clearly indicate that mothers bear responsibility for childcare and feeding, but fathers play a key role in providing resources.

Market and Product Development

- More OFSP tended to be sold where there were existing marketing channels and for consumers and traders since OFSP could be easily substituted for other varieties of sweet potato.
- A marketing approach for OFSP is more likely to be sustainable if many market actors are involved.
- Key drivers of adoption were availability of OFSP in the market and consumer awareness of the health benefits of consumption. One of the key challenges in market development for OFSP was availability since quantities were not very high.

Project Management

- Diagnostic research was a key element for the success of the project. The suggested duration of diagnostic phase is a year.
- Project designers should think about exit strategies as early as inception so that beneficiaries are able to continue on their own when projects shut down.

Gender

- Designing the project intervention with a gender perspective from the beginning is crucial since the role women played not only as caregivers of young children but as producers and retailers was critical to the success of OFSP dissemination.
- Our data show that female nutrition extension workers were significantly more successful than their male counterparts in teaching messages about child feeding and vitamin A to volunteer nutrition promoters. Where possible, therefore, projects need to recruit and train women extensionists. Finding sufficient numbers of adequately qualified women to be extension agents can be a challenge. In such cases, male extensionists need to receive additional training in a culturally sensitive context to enhance their ability to effectively

communicate with women.

- It is important to reach women with materials and messages on agricultural production, as well as on practices to improve nutrition in the household. At the same time, men control family resources and are key decisionmakers regarding allocation of land and crops, so their role cannot be ignored.

Reducing Costs

To be viable, the cost of delivering vitamin A through biofortified foods must be lower than the cost of other interventions. Because there were no significant differences in impact between the two models, the less-intensive Model Two would be cheaper to implement (by about 30 percent). The marginal and average costs per target beneficiary (children 6–59 months and mothers) for this were US\$36 and US\$86, respectively. In a non-research context, managerial capacity could be freed up, which is why it is important to cite marginal costs (the cost of adding an additional beneficiary).

These costs could have been reduced through the following modifications:

1. The project could have improved knowledge retention by focusing on a few key messages directly related to how OFSP can alleviate vitamin A deficiency and eliminating modules on other nutrition practices and agronomic practices. The number of modules per topic could also have been better aligned with the agricultural calendar, reducing the number of extensionists and promoters needed.
2. Farmers reported selling OFSP at the same rate as other types of sweet potato, but we found no evidence that small-scale farmers chose to grow OFSP due to the project's marketing efforts. However, given the relatively short two-year duration of the project, this finding might not be surprising, as developing markets and products usually takes longer.



Scaling Up: The Way Forward

Although this pilot project was implemented in small, focused areas, scaling up at the country level is feasible if costs per beneficiary are kept as low as possible, and there is support from policymakers and stakeholders. The following points should also be considered:

1. In regions identified for scaling up, OFSP yields or profitability should be equal to or greater than that of white sweet potato. Sweet potato should also be an important staple in the diets of target households; if it is a secondary staple, at least 50 percent of households should be producing sweet potato.
2. Farmers should be trained in viable methods for vine conservation, especially when OFSP can be grown for only one season a year. A minimum amount of subsidized vines (say, 5 kilograms) should be distributed to target households to enable timely planting.
3. Nutrition messages should focus on how OFSP reduces risk of vitamin A deficiency. It is also critical to convey both nutrition and agronomic messages to women. Building an “orange brand” to raise awareness of vitamin A and OFSP as part of a marketing campaign is also very effective.
4. Once OFSP has been adopted by a critical mass of core households and a base of community knowledge on OFSP has been developed, complementary activities that encourage diffusion to other non-adopting households should be undertaken. Developing markets for OFSP and other related food products will also encourage diffusion and adoption in the long term.

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