Biofortified foods

Building Nutritious Food Baskets

Reaching Agents of Change Project: Successes, lessons and recommendations

Ex-post evaluation report

CIP INTERNATIONAL POTATO CENTER
A CGIAR RESEARCH CENTER

CIAT International Center for Tropical Agriculture
Since 1967 / Science to cultivate change

CIMMYT International Maize and Wheat Improvement Center

IITA Transforming African Agriculture

HarvestPlus Better Crops - Better Nutrition

CGIAR Science for a food-secure future

FARA Forum for Agricultural Research in Africa

NEPAD TRANSFORMING AFRICA

Reaching Agents of Change Project: Successes, lessons and recommendations

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May 2018

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Project summary

Project name	Reaching Agents of Change (RAC)
Donor	Bill & Melinda Gates Foundation
Goal	To reduce vitamin A deficiency (VAD) by creating an enabling environment for new investments and through capacity building of national implementing agencies to allow long term continuation of OFSP activities
Implementers	International Potato Centre (CIP) and Helen Keller International (HKI)
Targeted countries	Mozambique, Tanzania, Nigeria, Ghana and Burkina Faso
Project lifespan	April 2011–August 2015
Type of evaluation	Ex-post evaluation
Reporting period	September 2015–October 2017
Data collected	Qualitative and quantitative
Interviewees	Advocates, researchers, project managers, trainers, trainees, government staff, policy-makers, traders, farmers, processors, decentralized vine multipliers, and small and medium enterprises
Purpose of the evaluation	To evaluate the sustainability of the activities, achievements, contribution and lessons learned from RAC in order to inform programming of similar projects in future
Countries visited	Mozambique, Nigeria and Tanzania

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CIP and Helen Keller International (HKI) accumulated experience over the implementation of the Reaching Agents of Change (RAC) project from April 2011 to August 2015. That experience relating to orange-fleshed sweetpotato (OFSP) is believed to be highly pertinent to reaching agents of change in other biofortified crops. Accompanied by Godfrey Mulongo, the evaluator visited Tanzania, Nigeria and Mozambique over 13 days from August to September 2017, to interview key persons in the current projects and assess their use and the usefulness of the technical, institutional and policy management lessons.

This evaluation would not have been possible without the cooperation, involvement and consent of the communities, households, farmers, processors, consumers, policy-makers and other key stakeholders in the OFSP value chain, including project change agents, ambassadors and champions from key line government ministries.

Vehicle drivers and local guides played important roles in the process. To them we are deeply grateful for the time, commitment and diligence they provided throughout the study.

The opinions expressed herein are those of the independent evaluator and do not necessarily reflect the views of CIP, HKI or the donor - the Bill & Melinda Gates Foundation.

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Acronyms and abbreviations

ARMTI	Agricultural and Rural Management Training Institute, Illorin, Nigeria
BNFB	Building Nutritious Food Baskets project
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CIP	International Potato Center
CRS	Catholic Relief Services
DFID	Department for International Development of the United Kingdom
DVM	Decentralized Vine Multipliers
FAO	Food and Agriculture Organization of the United Nations
FARA	Forum for Agricultural Research in Africa
FMARD	Federal Ministry of Agriculture and Rural Development
HKI	Helen Keller International
IFPRI	International Food Policy Research Institute
IIAM	Institute for Agriculture Research, Mozambique
IITA	International Institute of Tropical Agriculture
NACCVC	Nutrition Awareness and Cash Crops Value Chain Project, Tanzania
NFFA	National Food Fortification Alliance, Tanzania
NGO	nongovernmental organization
OFSP	orange-fleshed sweetpotato
PVA	pro-vitamin A
RAC	Reaching Agents of Change project
RECODA	Research, Community and Organizational Development Associates, Tanzania
REU	Reaching and Engaging End Users
SASHA	Sweetpotato Action for Security and Health in Africa
SPHI	Sweetpotato for Profit and Health Initiative
SUA	Sokoine University of Agriculture
SUGECO	Sokoine University Graduate Entrepreneurs Cooperative
TFNC	Tanzania Food and Nutrition Centre
TOT	training of trainers
TSNI	Towards Sustainable Nutrition Improvement
USAID	United States Agency for International Development
VAD	vitamin A deficiency
VISTA	Viable Sweetpotato Technologies in Africa
VITAA	Vitamin A for Africa partnership
WFP	World Food Programme
WFSP	white-fleshed sweetpotato
WHO	World Health Organization

Executive summary

The ex-post evaluation assessed the experiences, achievements and lessons from the Reaching Agents of Change (RAC) project in its three primary countries of operation, namely Mozambique, Tanzania and Nigeria. RAC was a collaborative project implemented between April 2011 and August 2015, and funded by the Bill & Melinda Gates Foundation. The goal of the project was to contribute to the efforts to reduce vitamin A deficiency (VAD) through policy reforms, advocacy for new investments, and capacity development. Vitamin A deficiency (VAD) is a critical and a widespread public health problem. CIP proved the concept that consumption and scaling up of biofortified orange-fleshed sweetpotato (OFSP) is an effective strategy for reducing VAD in children.

Biofortification is recognized as an effective and sustainable approach to dealing with micronutrient malnutrition and complements supplementation, industrial fortification and dietary diversification among vulnerable groups. For example, supplementation depends on the presence of health systems and budgets, industrial fortification assumes people can afford to buy enriched processed foods, and dietary diversification is contingent upon high productivity and income levels, access to the food options available and change in food consumption patterns at the household level.

Biofortified crops such as OFSP have the advantage of making available high levels of vitamin A and other minerals to vulnerable populations through their consumption of its roots and leaves. A 100-g serving (about half a cup) of its boiled roots can supply the daily vitamin A requirement of a young child. The difficulty is in ensuring that children aged 0–5 years are fed the sweetpotato.

Given the challenge of drawing lessons from countries whose experiences do not match, the evaluation used the logic model as its conceptual basis and a mixed methodology involving a synthesis of project literature, field visits and interviews with individual farmers, groups of men and women sweetpotato growers and traders, policy-makers, sweetpotato processors and CIP experts. Field work was conducted from 23 August through 14 September 2017.

Analysis of the evaluation data shows that CIP, along with its partners, has succeeded in proving that modest amounts of OFSP consumed by children could reduce the prevalence of VAD and that farmers, but largely women, would maintain sweetpotato vines for planting and grow OFSP for consumption and local markets. For this achievement CIP and HarvestPlus shared the 2016 World Food Prize.

According to HarvestPlus, a major program looking at biofortification across several crops, a country's OFSP program may be at one of the following stages: stage (1), which is farm level consumption; stage (2), which is market development; or stage (3), namely, production for modern value chains. This evaluation found that Mozambique, with the longest involvement and experience with OFSP, is currently at stage two; Nigeria, which is a major root crop and sweetpotato producer is at stage one, since OFSP is relatively new there, having been introduced by the RAC project in 2012; and Tanzania is on the way to stage two. It is difficult to predict whether any country will get into stage three, since only Nigeria seems to be significantly funding its own sweetpotato projects, research and development. Nigeria is in a better position to get the actors together at the national level compared with Mozambique and Tanzania, which tend to rely more on donor funding.

The key achievements of RAC are as follows:

- A total of 14 policy and strategy documents that positioned OFSP at the top of the nutrition agenda and made it a central crop for biofortification programs were promulgated and enacted between 2011 and 2017, seven of which were in Mozambique, four in Nigeria and three in Tanzania.

- The funds raised by RAC surpassed the target of US$ 18 million by 20%. The bulk of the funding came from international donors and was highest for Mozambique, which had the longest involvement with OFSP.

- Some 77.8% of the funds raised went to vine multiplication and dissemination and OFSP production and processing; 7.4% to OFSP awareness creation and promotion in the mass media and 14.8% to capacity development.

- Five new OFSP projects surveyed during the ex-post evaluation received funding in the range of US$ 500,000 to US$ 12 million from international donors for implementing gender-sensitive OFSP projects between 2015 and 2017 in the three primary countries. The donors were the African Development Bank, the Department for International Development of the United Kingdom (DFID), the International Fund for Agricultural Development (IFAD), Irish Aid, the Japan International Cooperation Agency (JICA), the United States Agency for International Development (USAID) and the World Bank.

- National governments continue to allocate resources for biofortification work in their annual budgets of key line ministries, national research institutions and provincial and district councils. For example, the Federal Government of Nigeria provided US$ 819,289.34 (then equivalent to N134,500,000) in funding for the Rainbow project, which helped reach well over 40,000 households and supported participation in the 10-day TOT course by covering in full the trainees' fees after RAC ended. The Tanzania government has committed US$ 115 million for the implementation of the five year (2016–2021) Multi-sectoral National Nutrition Action Plan (NMNAP). In the 2017/2018 fiscal year, the government budgeted 11 billion Tanzania shillings (approximately US$ 5 million), an equivalent of 1000 Tanzanian shillings (US$ 0.44) per child, to support children's nutrition and health. It is anticipated that some of this money will fund OFSP programmes.

- Besides the financing for nutrition initiatives, RAC's work on farm trials, breeding and agronomic research has resulted in the release of four OFSP varieties in Mozambique, to make a total of 19. Three other varieties are in the pipeline for release in 2019. Six OFSP varieties have been released in Tanzania – Mataya, Kiegea, Ejumula, Kabode, UKG 05 and Kakamega – and nine others are in the pipeline for official release. Nigeria hopes to release two new varieties by February 2018.

- RAC and follow-up projects have trained decentralized vine multipliers (DVMs) and distributed more than 24,434,952 vine cuttings to 390,966 farmers directly in the three countries, 20.3% of whom are women.

- The project built the capacity of change agents on two innovative technologies, i.e. the use of net tunnels, and storage of small roots in sand and sprouting them in protected beds (Triple S), for conserving seeds during the dry season, which DVMs have started using.

- The country-level advocacy materials and training manuals uploaded to the sweetpotato knowledge portal have become key reference materials for new projects in disseminating information about OFSP.

- Through the step-down training approach, a total of 71,602 extension workers, teachers, pupils, nutrition workers at village level and farmers have received training from just the 38 trainers interviewed for this study in the three countries.

- Traditionally perceived as a poor person's and a major disaster-response crop, OFSP is now gaining popularity as a regular food across RAC countries.

- More than 41,216 children from 174 elementary schools in Nigeria are consuming OFSP weekly as part of the school feeding program. In Mozambique, 32% of the sweetpotato produced is orange-fleshed and people eat it two to three times a week, according to the report published by the national agriculture production study in 2015.

- In Tanzania, the Viable Sweetpotato Technologies in Africa (VISTA) project reports that the production and consumption of OFSP in its targeted zones and districts increased from 3.4% in 2015 to 16.8% in 2017.

Several factors have contributed to these successes and achievements:
- Careful selection by CIP of project partners committed to and experienced in biofortification;
- Local agencies and village structures' interest and support;
- Availability of generic training materials from RAC that serve as the basis for capacity building;
- An understanding that VAD can be well addressed through biofortification.

The new skills acquired from training are appropriate and will be beneficial if the change agents and national institutions continue to apply them until they reach the end-user. However, the sustainability of the achievements will require ongoing research on OFSP to protect the productivity gains emanating from the improved varieties by shielding the varieties from new diseases and pests and to address the changes in the preferences of consumers and markets.

CIP has partnered with various NGOs that have performed well in their respective functions of training, organizing communities and influencing policy-makers. One key finding was that CIP was judicious in making its choice of complementarity partners in areas where it had low comparative advantage. This complementarity approach continued in the design of the Building Nutritious Food Baskets (BNFB) project.

The main lessons learned are that:
- Biofortification is necessary to get pro-vitamin A to children, particularly those in rural and far-flung areas

- To attain the RAC gains CIP needed partners with complementary expertise, such as HKI, and change agents from key government line ministries and training institutions

- Successful promotion of biofortified crops requires a rigorous process of cross-institutional collaboration, strong leadership and clear definition of roles at the country level.

RAC demonstrated the importance of reliable partnerships and complementary expertise. The lessons from RAC have been applied in the BNFB project.

BNFB represents a higher order system than RAC with its more complex goals, more commodities, more regions, more value chain actors and a more complex set of agents of change. This evaluation follows systems thinking and considers that for BNFB, every commodity is *sui generis*, that the process varies with the commodity's sector and country, and that for biofortified crops the critical factor is not biofortification per se but market development. It regards BNFB as a transitional step in the movement from a one-crop system with the use of OFSP for VAD reduction to a more complex system involving the utilization of a nutritious food basket for nutrition security.

The future will see several new factors come into play such as the introduction of competing (biofortified) staple crops, new potential value chains, and the bridging of technical, institutional and market gaps. The future beyond BNFB calls for developing policies and strategies at higher levels; identifying structures for planning; and managing national resources with the aim of ensuring nutrition and food security. Private sector actors can play a key role but are unlikely to do so until a supportive

environment is provided. In a broad sense, such a conducive environment encompasses large-scale awareness campaigns and the linking of farmers, processors and consumers to strengthen the value chain. There is also a need to promote contract farming and bulking of biofortified crops by farmers' groups to help large-scale seed entrepreneurs to have access to clean planting materials and produce in the quantities and of the qualities they want.

Assuming the role of a backbone organization, CIP – given its accumulated experience in biofortification, policy advocacy and capacity building – should in the future (1) embrace the idea of the need for improved linkages among agriculture, health and nutrition without sacrificing the needed technical work, (2) foster collaboration with cross-cutting CGIAR centers and programs such as Agriculture for Nutrition and Health and HarvestPlus, which have biofortification programs, though nominally, and (3) maintain or create partnerships to promote and sustain markets and value chains.

This report has recommendations that may be useful for governments, national and international organizations and private commercial sector enterprises involved in food value chains aimed at accelerating collective action in the fight against VAD and other forms of undernutrition through improved diets, incomes and economies in the rural areas.

1. Background

1.1 Introduction

Vitamin A deficiency (VAD) is of public health concern worldwide. According to the World Health Organization (2013), VAD affects about one third of preschool children globally (250 million children), with the highest rates registered in sub-Saharan Africa (SSA) at 48% and South Asia at 44%. An estimated 250,000 to 500,000 vitamin A-deficient children become blind every year, half of them dying within 12 months of losing their sight. VAD is caused by a habitual diet that provides too little bioavailable vitamin A to meet the physiologic needs. Rapid growth and frequent infections, which cause ineffective utilization of the vitamin, are also critical factors. Governments and their development partners have been relying on dietary diversification, food fortification and vitamin A supplementation to control the problem.

While vitamin A supplementation has helped millions, its delivery is expensive in isolated rural areas, which is where the poor live, and is difficult to sustain. Many foods that are good sources of vitamin A such as fruits, vegetables, meat, milk and fortified foods such as margarine, sugar and oil are only available seasonally, unpalatable for young children or too expensive for the majority of rural people who are at most risk of VAD. Orange-fleshed sweetpotato (OFSP) is an emerging cheap source of vitamin A particularly for remote rural areas where individuals have limited access to commercial markets and depend on crops produced at the household level. OFSP has the advantage of fortifying itself by loading high levels of minerals and vitamins in its roots and leaves. A 100-g serving, or about half a cup, of the boiled roots can supply the daily vitamin A requirements of a young child (400 retinol activity equivalents (RAEs)) and thereby help to eliminate or greatly reduce VAD. OFSP is rich in not only beta-carotene but also vitamins B and C and iron. In sub-Saharan Africa (SSA) the roots are eaten raw, boiled or roasted as a substitute for bread during breakfast, while the leaves are an important relish taken with different staples.

In pursuit of the goal to address VAD and considering the benefits of biofortification over other food-based interventions, the International Potato Center (CIP) and Helen Keller International (HKI), an international organization whose mission is to save and improve the sight and lives of the world's vulnerable populations, jointly implemented the Reaching Agents of Change project (RAC) from April 2011 to August 2015 in Tanzania, Mozambique and Nigeria as priority countries, and Ghana and Burkina Faso as secondary countries. This was a collaborative project funded by the Bill & Melinda Gates Foundation and aimed to increase awareness and advocacy for the successful utilization of OFSP in nutrition interventions to combat VAD among young children and women of reproductive age. RAC adopted an integrated approach with two overarching specific objectives:

- Policy: Advocacy for new investments (at least US$ 18 million) and policy reforms to include OFSP in national, regional and sub-regional policy agendas;
- Capacity building: Strengthening the capacity of national institutions and implementing agencies to design and implement technically strong, gender-sensitive and cost-effective interventions that drive the uptake of the crop.

Activities under the policy objective were led by HKI and backstopped by CIP. CIP was also responsible for the second objective. The main activities included multiplication and dissemination of OFSP varieties, building the capacity of implementing agencies to conduct training and write proposals for funding, and reaching out to communities with behavior-change messages concerning the benefits of utilizing OFSP to reduce VAD among vulnerable populations, in particular women and young children.

The seed systems component of RAC was implemented in Mozambique in the provinces of Maputo, Manica, Sofala, Tete, Zambezia and Nampula; in Tanzania in the Lake Zone, an important area for

sweetpotato production that also had OFSP programs, and the Eastern and Central zones; and in Nigeria in the four states of Kaduna, Kwara, Benue and Nasarawa.

The project relied on agents of change such as institutions and influential individuals in the ministries of agriculture, health or education; dynamic leaders of sweetpotato research; university professors; and leading members of farmer's organizations associated with the project to sensitize national governments, donors, NGOs and the private sector about OFSP and its benefits.

1.2 Goal and objectives

The main purpose of this post-implementation evaluation was to assess the relevance, effectiveness, efficiency, impact and sustainability of RAC and how these have enabled more households to access and consume OFSP. The evaluation also aimed at improving understanding about the communities' level of knowledge gained through various capacity building interventions and highlighting generic lessons to guide the promotion and upscaling of OFSP and other biofortified crops in future.

The direct users of the findings will be CIP and HKI, being the implementers of RAC. The indirect users will include sweetpotato scientists, researchers and breeders; nutrition and health care practitioners; farmers; processors; and policy-makers from the government, nongovernmental organizations (NGOs) and the donor community.

1.3 Structure of the report

This report is structured as follows: section 2 is on the design and methodology for the evaluation, section 3 presents the results, focusing on sweetpotato production, section 4 summarizes OFSP penetration and trajectory data in SSA, section 5 focuses on OFSP interventions since the start of RAC, section 6 deals with evidence on OFSP success, section 7 addresses the constraints for OFSP, section 8 is on BNFB and sections 9 and 10 are on the way forward.

Box 1: Why invest in orange flesh sweetpotato?

- Just one small piece (100 g or about half a cup) of a boiled medium-intensity root of the OFSP variety can meet the daily vitamin A needs of a young child (i.e. 400 retinol activity equivalents).
- OFSP is not only rich in beta-carotene, a precursor the body converts into vitamin A, but is also sweet, high yielding and drought tolerant.
- The beta-carotene contained in OFSP is retained in high levels during processing.
- OFSP is a viable means of helping those outside the reach of supplementation programs to produce their own vitamin A; e.g. OFSP is grown in areas where other sources of beta-carotene such as red palm oil, carrots and apricots are not common.
- OFSP grows well in marginal soils and matures early (in 3–4 months) compared with white sweetpotato, which takes 4–5 months.
- Incorporation of OFSP in school-feeding programs has shown to be impactful.
- Children like the sweet taste and orange color of OFSP roots.
- OFSP leaves are edible and high in beta-carotene.
- Cultivating OFSP on just 500 m^2 of land can supply the needs of a family of five people.

2. Evaluation approach, design and methodology

Given the challenge of drawing lessons from research in locations where experiences differ from those of the location of interest, this evaluation exercise used mixed methods involving a review of RAC literature, field visits and interviews with M&E officers from recent RAC-affiliated projects, field staff, national advocates, policy-makers from government departments and NGOs, representatives of training institutions, trainees, breeders, decentralized vine multipliers (DVMs) and individual farmers and processors. Annex 1 shows the main actors in the OFSP value chain as well as the key persons and groups consulted.

The evaluation used the logic model as its conceptual basis to identify distinct but closely linked phases in the process of the project's service delivery: inputs, processes, outputs and outcomes (Bickman, 1996). The particular value of this approach is that it has an underlying systems thinking that assists us to understand the complex interactions between these elements over time. The approach also draws attention to the way in which policy is implemented and services are delivered, and how the consequences of these actions are eventually expressed. Taken together, the mixed methodology and logic model assist in identifying the inputs (resources allocated to the project), activities (how the project was implemented), outputs (types of support and services provided), and final outcomes e.g. results and impacts. This goes beyond dealing with just the question of what works, to include consideration of why it works, under what circumstances and for whom (Pawson and Tilley, 1997). The evaluation framework also is underpinned by social justice principles, which emphasize the importance of participatory and collaborative research. In line with hypothetical systems thinking, the evaluation defined OFSP and other biofortified crops as a system for reducing VAD in the more remote areas of Mozambique, Tanzania and Nigeria through policy and institutional development, as defined by RAC and BNFB projects.

The field work took place from 23 August to 14 September 2017. The actual period of data collection was four days in Mozambique and Tanzania and five days in Nigeria. In addition to interviewing key persons, the assessor conducted focus group discussions with groups of farmers and traders and visited production sites, OFSP factories and open markets in the three countries. In Tanzania, the assessor visited Sokoine University of Agriculture (SUA) and interacted with facilitators and trainees during the TOT that took place 13–24 August 2017 and with some of the participants supported by World Vision and the BNFB project, to understand how the training would benefit them and their communities. Besides this, a structured questionnaire focusing on capacity building was emailed to the participants who attended the TOT courses on "Everything you ever wanted to know about OFSP" in the three countries during and after RAC to find out whether they cascaded the training to the grassroots communities in their respective organizations and communities.

The period for the field work was inadequate to collect a sufficient volume of quantitative data from specific individuals in each country. The primary source of data presented in this report, therefore, is qualitative interviews with the aforesaid stakeholders. Annex 2 presents checklists and interview guides that were used.

Despite the limited time provided for the task, the assessor has attempted to triangulate the various types of information collected and, in this respect found it useful to follow Lynn and Preskill (2016), who seek demonstration of rigor in (1) the quality of thinking, (2) credible and legitimate claims, (3) cultural context and responsiveness, and (4) quality and value of the learning process. The assessor had access to an independent expert for support and was familiar with the Malawian experience.

Throughout the entire data collection period, the assessor collaborated fully with and consistently debriefed the regional M&E officer and professional colleagues familiar with the work in the target countries about any issues emerging from the interviews as part of process to validate responses from

the interviewees. The preliminary findings of the evaluation were presented on 12 October 2017 at the second annual review and planning meeting of the BNFB project, where experts from CIP, the International Center for Tropical Agriculture (CIAT), International Maize and Wheat Improvement Center (CIMMYT), International Institute of Tropical Agriculture (IITA), Forum for Agricultural Research in Africa (FARA), HarvestPlus and national implementing partners provided their input. The assessor had face-to-face meetings with key experts and influencers, who mainly were those who were not available during the actual data collection period. These interactions provided additional information concerning RAC and on the introduction of multiple biofortified crops for the first time by CIP and it partners, what worked, lessons learned, challenges faced, current levels of collaboration and work anticipated in the years to come. Annex 1 summarizes the responses and experiences of the key players consulted.

3. Sweetpotato production in RAC target countries

Sweetpotato is produced in more than 110 countries in the world. Nigeria is the second largest producer globally after China, with annual production estimated at 3.9 million tons. Sweetpotato is grown in all 36 Nigerian states, with significant production in each of the six geopolitical regions and around a third of the total production concentrated in the north-central states. Tanzania is the second largest producer in Africa after Nigeria, generating 3.8 million tons from 759,542 hectares of land (FAOSTAT, 2016). FAO data indicate that 21.3 million tons of sweetpotato was produced in Africa in 2016 (FAOSTAT, 2016). In Mozambique, where CIP piloted its OFSP work and which has the longest experience with OFSP, sweetpotato is the third most important staple after cassava and maize. FAO data for 2016 show the annual production of sweetpotato in Mozambique to be 0.73 million tons, making it the fifth biggest producer in SSA. FAOSTAT compiles data on sweetpotato in general and, as such it is difficult to quantify the production of OFSP. In spite of this, RAC and the follow-up projects have contributed to the increase in sweetpotato production not only through advocacy, policy and capacity building work but also by actually putting vines in the hands of farmers to grow.

4. OFSP penetration and trajectory in SSA

The history of OFSP in SSA is well summarized in Low et al. (2017). Authors such as Hotz et al. (2011, 2012), Brauw et al. (2015), Grüneberg et al. (2015) and Andrade et al. (2016) also have extensively published research highlighting preliminary and contemporary work conducted by the CGIAR and government research institutions with funding from bilateral and multilateral donors.

The introduction of OFSP in SSA dates back to the early 1990s. In 1995, with funding from the International Center for Research on Women, CIP and the Kenya Agriculture Research Institute (KARI) began OFSP research as part of a broader effort to develop and test women-focused approaches for addressing VAD. The willingness to fund research of that nature was very low because the international community's focus was on vitamin A capsule supplementation. There was lack of evidence on food-based approaches as a remedy for VAD. Most of the sweetpotato efforts by CGIAR research institutions were limited to breeding OFSP varieties in Peru and sending them to SSA for evaluation. Several new OFSP varieties bred in Peru arrived in SSA in 2002 but performed poorly under the high virus pressure conditions. In settings with low virus pressure like Mozambique OFSP varieties were promising, and in April 1999 the first multisectoral stakeholder meeting was organized there to promote OFSP utilization.

Only two SSA countries, i.e. Uganda and South Africa, were breeding sweetpotato in the early 1990s. The Ugandan national program started breeding OFSP in 1991. The McKnight Foundation provided consistent financial support to the Ugandan program from 1994 through 2014, enabling Uganda to lead in OFSP breeding in East and Central Africa. Around this period, investment in OFSP remained low

due to the lack of a strong evidence base supporting investment in OFSP. In cognizance of this, OFSP efficacy studies were conducted in South Africa, Mozambique and Uganda between 2002 and 2005, and they showed significant improvements in vitamin A intake in children involved in the studies.

Together, the efficacy studies and the success of OFSP as a disaster-response crop for the devastating floods that occurred in Mozambique from February to March 2000, led to investments by USAID and the Government of Mozambique for disseminating OFSP as part of the development efforts in some provinces of Mozambique from 2002 through 2006.

4.1 OFSP scaling up work by CIP

In 2005, the CIP head of global sweetpotato breeding introduced the accelerated breeding scheme, which uses several sites at the early stages in breeding, permitting fast selection. This reduced the time from crossing to release to 4–5 years compared with 8–9 years in traditional breeding methods (Grüneberg et al., 2015). In 2005, the Rockefeller Foundation provided 4 years of support for breeding in Mozambique, which ultimately led to the release of 15 drought-tolerant OFSP varieties in 2011 (Andrade et al., 2016b). In 2009, the Bill & Melinda Gates Foundation funded CIP to the tune of US$ 22.5 million to lead the 5-year Sweetpotato Action for Security and Health in Africa (SASHA) project, the largest investment in sweetpotato research ever made in SSA. The grant supported the establishment of advanced breeding (population development) programs in three sub-regions to address virus resistance, drought tolerance, tuber quality (aiming for a non-sweet sweetpotato), seed systems research, and research on delivery models. It included establishing a value chain for developing a commercial OFSP-based, processed product in Rwanda and testing a model where pregnant woman attending antenatal care clinics received improved nutrition counseling and vouchers to redeem for OFSP planting material. The SASHA project was renewed for a second 5-year phase in 2014, with postharvest research substituting delivery system research. This core support enabled CIP, along with 26 partners, to launch the Sweetpotato for Profit and Health Initiative (SPHI), a multi-partner, multi-donor initiative with the goal of reaching by 2020, 10 million households in 17 target SSA countries with improved varieties of sweetpotato and fostering their diversified use (Low, 2011). A strong partnership was formed with the Alliance for a Green Revolution in Africa (AGRA) to support national sweetpotato breeding efforts in nine SSA countries over the next five years. Annex 3 gives details about the penetration and time trajectory of OFSP in SSA, focusing on the work done by CIP.

4.2 OFSP status in Mozambique, Tanzania and Nigeria

At the inception of RAC, Mozambique, Tanzania and Nigeria were at different levels of development with respect to OFSP activities. For example, owing to the work started in the early 1990s, Mozambique released eight varieties of OFSP in 2001, and in 2005 it received from the Rockefeller Foundation support for four years for breeding, which led to the release of seven more drought-tolerant OFSP varieties in 2011 (Andrade et al., 2016). When RAC started, Mozambique had 15 varieties of OFSP and several OFSP projects, including the 18-month Towards Sustainable Nutrition Improvement (TSNI) and Reaching and Engaging End Users (REU) projects by HarvestPlus, a major program looking at biofortification across several crops. The national agriculture production study conducted in 2015, the year RAC ended, showed that 32% of sweetpotato produced in the country was orange-fleshed and people ate it two to times per week (Ministério, 2015).

Improved varieties of OFSP first arrived in Tanzania in the late 1990s, mostly in the Lake Victoria zone, where sweetpotato is a primary staple food and is grown by 99% of the farming households. These varieties were distributed by CIP in all vitamin A for Africa (VITAA) partnership countries, namely Tanzania, receiving 9,259,950 cuttings; Uganda, 18,896,374 cuttings; Kenya, 12,093,920 cuttings; Mozambique, 4,621,185 cuttings; and Ethiopia, 1,691,920 cuttings. After being introduced in the Lake

Victoria zone, OFSP gradually spread to the Eastern zone of Tanzania. By the time RAC started, Tanzania had released its own two OFSP varieties, i.e. Mataya and Kiegea, and Ejumula, Jewel, UKG 05 and Kabode were in trials for release. Awareness on OFSP was generally low among policy-makers and investors across the country.

Nigeria is the largest root and tuber crop country in Africa, growing mainly yam, cocoyam, cassava and white sweetpotato. However, at the beginning of RAC in April 2011 OFSP was largely unknown in Nigeria and no variety had been released, although some on-farm and on-station trials were under way. Awareness among policy-makers and investors on OFSP was very low, therefore RAC's efforts in year 1 (2011–2012) focused on fast-tracking the release of varieties. In year 2 farmers participated fully in the assessment of proven varieties and field days, and in year 3, two OFSP varieties, Mothers' Delight and King J, were released. In year 3 the project also focused on intensifying the selection of more DVMs and multiplication and distribution of vines in the four targeted states of Benue, Nasarawa/Federal Capital Territory in Abuja, Kwara and Kaduna. The area under OFSP continues to expand, partly because the crop has the advantage of requiring little land and few inputs. OFSP is relatively easy to grow and provides more energy per hectare and over time than rice, maize or cassava or other root crops, and its short maturing period of three to five months, ability to grow under marginal conditions and flexible planting and harvest times also are driving its expansion in the country.

Although OFSP already existed in Mozambique and Tanzania before RAC, a large majority of farmers lacked it and were still growing traditional white varieties without beta-carotene or other crops. RAC scaled up the breeding and distribution of clean OFSP planting materials and consumption and value addition activities for this crop in these countries. Table 1 summarizes socioeconomic data from the Viable Sweetpotato Technologies in Africa (VISTA) project, a follow-up project of RAC, to exemplify the baseline situation for OFSP projects. Some 258 of the 549 baseline farmers in the VISTA project in Tanzania were sweetpotato growers and only 3 of these grew OFSP. From 2015 to July 2017 the VISTA project distributed 5,073,167 cuttings directly to 17,354 farmers, some 6,857 of whom were male and 10,497 female, and indirectly to 2,466 farmers, of whom 928 were male and 1,538 female. VISTA project reports indicate increased production and consumption of OFSP in its intervention areas from 3.4% in 2015 to 16.8% in 2017.

Table 1: Farmers' socioeconomic baseline data from VISTA project in Tanzania

Variable	Southern Highland Zone					Eastern Zone		Total
	Iringa	Mufindi	Chunya	Mbozi	Wanging'ombe	Gairo	Ulanga	
Interviewed	65	55	88	77	55	99	110	549
Growing SP (n)	16	21	54	58	42	38	29	258
Growing SP (%)	24.6	38.2	61.4	75.3	76.4	38.4	26.4	47
White-fleshed (%)	68.8	57.1	61.1	65.5	40.5	68.4	65.5	62.8
Yellow-fleshed (%)	31.3	38.1	38.9	25.9	59.5	36.8	34.5	38
OFSP (%)	0	4.8 (1)	0	0	0	5.3 (2)	0	1.2

According to HarvestPlus and Bouis and Islam (2012), a country's OFSP program may be in any of the following three stages:

- In the first stage, farm level consumption, a critical mass of poor farmers adopts a biofortified crop and feeds it to their families. Emphasis at this stage is on the farm level and specifically on increasing production by the household for its own consumption.

- The second stage involves market development to provide farmers with an outlet for their marketable surplus, thus reaching non-farming or rural households that are the net buyers of food. This stage is driven by the need to reach out to medium-scale producers and to develop local markets and demand for products made from biofortified crops, though still largely in the rural areas.

- The third stage aims for modern value chains to be produced. The private sector becomes the main driver of the diffusion process and it develops modern value chains to produce value-added tradable products.

Mozambique, with the longest involvement and experience in OFSP, is currently in stage two. Nigeria is a major sweetpotato producer, ranking second after China, but OFSP is new there, having been introduced by RAC in 2012. Tanzania is striving to get into stage two. The progress of a country into the next stage is contingent upon the continuation of investments by both its host and external governments, capacity building for the local structures, an enabling environment for different key actors, active involvement of the private sector, and effectiveness of awareness campaigns for most farmers and consumers to adopt the crop.

5. OFSP interventions by RAC and follow-up projects

5.1 Resource mobilization and investments in OFSP

This evaluation aimed to answer two questions regarding resource mobilization and investments:

- Of what use has been the investment money generated in Mozambique, Tanzania and Nigeria during RAC?

- To what extent have the investments resulted in projects that seek to address gender issues in relation to the access and consumption of OFSP?

At its very beginning RAC planned to generate new investments totaling US$ 18 million for OFSP activities in the three years of its life. Two main approaches were used to achieve this target:

- Engaging agents of change to sensitize governments, the private sector, donor community, and NGOs through national agricultural shows, brochures, mass media and other campaigns for them to invest in the production, consumption, marketing, and processing activities;

- Capacity building for local institutions to develop gender-sensitive OFSP proposals and submit them to various donors for funding.

Following the advocacy and awareness raising activities that took place before its end in August 2015, RAC's funding, at US$ 21.6 million, was 20% over its target of US$ 18 million, indicating that awareness and communications by HKI and CIP on advocacy for policy change and mobilization of resources to support programs on biofortification were effective. Mozambique's funding was the highest at US$ 13,342,550.50 followed by Tanzania's with US$ 4,033,501.50, Burkina Faso's with US$ 2,963,244, Nigeria's with US$ 1,262,479.42 and Ghana's with US$ 42,036.

As shown in Table 2, most investment came from the United Nations agencies, the private sector and local governments. The funding was used to support 52 interventions. Of the total funding, 77.8% was spent on vine multiplication and dissemination, OFSP production and processing; 7.4% on awareness and promotion in the mass media; and 14.8% on training.

Table 2: Breakdown of investment by donor category in Mozambique, Tanzania and Nigeria

Type of Donor	Mozambique		Tanzania		Nigeria	
	Total (US$)	%	Total (US$)	%	Total (US$)	%
National government	–	–	234,201	5.81	1,215,332.30	96.26
Local governments	–	–	111,147.50	2.76	15,972.77	1.27
External governments/UN agencies	10,792,550	80.88	3,593,100	89.08	–	–
NGO/foundations	40,000	0.31	–	–	–	–
Private sector	2,510,000	18.81	95,053	2.35	31,174.35	2.47
Grand total	**13,342,550**	100	**4,033,501.50**	100	**1,262,479.42**	100

Tanzania had the most diversified sources of investments and Nigeria the least, with almost all its investment coming from the federal government. The main external donors were the African Development Bank, the Department for International Development of the United Kingdom (DFID), the International Fund for Agricultural Development (IFAD), Irish Aid, Japan International Cooperation Agency (JICA), the United States Agency for International Development (USAID) and the World Bank. These same donors have been funding the post-RAC agenda to increase the uptake of OFSP and other biofortified crops. Five new OFSP projects ran by the national agencies surveyed in this evaluation received funding in the range of US$ 500,000 to US$ 12 million between 2015 and 2017. RAC trained these agencies and change agents in proposal development as well as the planning, implementation and monitoring of gender-sensitive projects. Table 3 provides a breakdown of the funding from donors to RAC-affiliated projects.

Table 3: Funds awarded by donors to RAC affiliated projects*

Country (project)	Period	Donor	Funding (US$)
Mozambique			
Integrated OFSP (Shingirirai)	2013–2018	Docus Aid	500,000
VISTA (CIP)	2014–2016 (Phase 1) 2016–2021 (Phase 2)	USAID	12,000,000 (2014–2021)
Tanzania			
FARM Africa (funding Sokoine University Graduate Entrepreneurs Cooperative – SUGECO)	2015–2017	Big Lottery	6,000,000
VISTA (CIP)	1 October 2014–30 September 2017	USAID	3,000,000
Building Nutritious Food Baskets (BNFB) project (CIP and partners)	1 November 2015 to 30 October 2018 (**in** Tanzania and Nigeria)	Bill & Melinda Gates Foundation	5,000,000
Nigeria			
Rainbow (CIP)	2014–2016	Government	819,289.34
CRS	2015 (ongoing)	USAID	300,000

* These figures are from only the projects consulted during the evaluation. They exclude funds mobilized by the current projects after their inception from governments, local NGOs and the private sector for awareness campaigns, training, sweetpotato production and marketing and other activities.

Besides multilateral and bilateral donors, host governments have been allocating resources in annual budgets for all the line ministries, national research institutions and provincial and district councils to continue with breeding work, farm trials, multiplication of clean vines, vine distribution and extension services. In Nigeria, it was the federal government that provided funding of US$ 819,289.34

(N134,500,000 then) for the Rainbow project, which was an offshoot of the RAC project. The Rainbow project has reached well over 40,000 households. The federal government is also funding the 10-day TOT training, covering full scholarships for participants since the 2016/2017 financial year. Most recently, the federal government has promised to provide US$ 130,000 for distribution of OFSP as an emergency-response crop to address the food insecurity situation among the internally displaced people in Borno State.

During the 2017/2018 fiscal year the Tanzanian government budgeted Tanzania shillings 11 billion (approximately US$ 5 million) for children's nutrition and health activities that include OFSP, translating into 1,000 shillings per child or US$ 0.44. Some provinces in Mozambique are prioritizing OFSP in the fight against VAD after the government declared it as a priority crop in 2016.

RAC expected that prior to its completion its work would achieve an increase in vitamin A intake of at least 30% among the targeted beneficiary areas in Tanzania and Mozambique and 15% in Nigeria. Ultimately the project hoped to benefit at least 600,000 households directly and 1.2 million households indirectly within five years after project closure. This forward-looking targeting banked upon the upcoming projects making incremental coverage and impact by reaching 93,580 direct farmers annually until August 2020. By the end of 2015, RAC had reached 132,098 farmers directly with vines.

The available data show the recent projects to be on track, after having distributed clean planting materials to an additional 177,876 direct beneficiaries (of whom 20.3% were women) in the past two years, thereby reaching 95% of the two-year target. Given that it is not possible to visit all the interventions and considering the difficulties in keeping precise records at all levels, it can be concluded that the number of farmers growing OFSP is much larger than the data indicates. Table 4 presents details about vine distribution during and after RAC.

Table 4: Vine distribution to direct and indirect beneficiaries (December 2011–July 2017)

Country (projects, donor, funding)	Vines	Direct beneficiaries			Indirect beneficiaries		
		Male	Female	Total	Male	Female	Total
Mozambique							
Integrated OFSP (Shingirirai, Docus Aid)		337	893	1,230			
VISTA (CIP, USAID)	7,377,251	27,578	9,193	36,771	55,157	18,386	73,542
OFDA		14,087	7,585	21,672	28,174	15,170	43,344
NIASSA OFSP		25,559	3,485	29,044	76,676	10,456	87,132
Tanzania							
NACCVC (Big Lottery)	1,200,000			1,200			1,606
VISTA (CIP, USAID)	5,073,167	7,838	12,583	20,421	928	1,538	2466
Nigeria							
Rainbow CIP (Government)	4,000,000			40,000			5,000
Distributed by CRS	2,753,800			27,538			
Total		75,399	33,739	177,876	160,935	45,550	213,090
RAC (2012-2014)	4,030,734			132,098			
Overall households reached (excluding RAC)				**309,974**			
% of Women				**19%**			

5.2 Policy framework

Through its advocacy work, RAC and its advocates and champions supported the promulgation and enactment of at least 19 policy and strategic documents. In Mozambique, the policy and strategic documents were:

- The Comprehensive Africa Agriculture Development Programme (CAADP)/Strategic Plan for the Agricultural Sector Development (PEDSA) investment plan;
- Socioeconomic plans for Inhambane, Maputo, Manica, Tete, Zambezia and Sofala provinces;
- Multi-Sectoral Action Plans for Chronic Malnutrition Reduction (PAMRDC) at the provincial level;
- The communication strategy under Multi-Sectoral Action Plans for Chronic Malnutrition Reduction (PAMRDC);
- National food security baseline survey assessment instruments;
- The National Child Feeding Policy;
- The National Home Gardening Program;
- The National School Feeding Program.

In Nigeria, the documents were:

- The Agriculture Transformation Agenda;
- The micronutrient prevention guidelines developed by the Ministry of Health;
- The Infant and young child feeding manual.

In Tanzania the documents included:

- The national agriculture policy;
- The Agricultural Sector Development Programme II;
- The national nutrition strategy implementation plan.

After RAC, the governments have continued to include OFSP in the new policies and strategies for agriculture, food security and nutrition to combat VAD. The priority policies in Tanzania advocating for increased consumption of OFSP and other biofortified foods are:

- The National Multi-Sectoral Nutrition Action Plan (NMNAP) for 2016–2021;
- The Tanzania Food and Nutrition Centre (TFNC) five-year strategic plan for 2014–2018;
- The Food and Nutrition Security Policy of 1992, which is in its final stages of review and promulgation.

One of the planned targets for the NMNAP is to contribute to the reduction in the prevalence of vitamin A deficiency among children aged 6–59 months by 7% by 2021. Among the activities for achieving this target, the NMNAP mandates the Ministry of Agriculture, Livestock and Fisheries to promote the multiplication of seeds, seedlings and cuttings of nutrient-rich crop varieties such as OFSP, high protein maize and cassava and vitamin A rich bananas, and distribute them to farmers. Among the other nutrition issues, the NMNAP emphasizes the promotion and consumption of biofortified and high nutrient value food varieties at the community level to increase nutrient intake. In line with these efforts, the government has committed US$ 115 million for the implementation of the five-year NMNAP and allocated US$ 5 million in the 2017/2018 financial year budget.

In Mozambique, food security and nutrition are national priorities in the following policies:

- The National Multi-Sectoral Action Plan of Action for the Reduction of Chronic Malnutrition (PAMRDC) for 2011–2020 and its Food Fortification Strategy, which aim to reduce stunting in children;
- Agenda 2025, which is prioritizing access to food with a view to improving living conditions and developing human capital;

- The Government's Five Year-Plan (PQG 2015–2019), which focuses on empowering women and men for gender equity and equality, poverty reduction, economic development and food security and nutrition;
- The 2013 National School Feeding Program, which oversees the expansion of school feeding to all pre-primary and primary schools, emphasizing local procurement, community participation and nutrition education.

Another policy of significance in Mozambique is the National Agriculture Investment Plan for 2014–2018, which recognizes biofortified crops as nutritious and vital in addressing micronutrient deficiencies. Item 39 of that policy commits the Ministry of Agriculture to the following actions:

- Undertake contract programs with specialized vine and seed companies to ensure the importation and local production of the most productive certified seed varieties and vines adapted to the areas of production;
- Support the production and dissemination of clean OFSP vine material from locally based sources;
- Provide production inputs in potential sweetpotato and potato production areas.

The policy estimates the total budget for supporting the production of OFSP and potatoes to be 1.533 million meticais (US$ 25,111.18).

The Mozambique National Strategy for Food Security and Nutrition (ESAN II) for 2008–2015 recognizes OFSP as a vitamin A-rich crop. This strategy is currently under review to develop ESAN III. Objective 4 of the revised ESAN is about increasing the production and consumption of nutritious crops, OFSP included. In 1998, the government created the Technical Secretariat for Food and Nutrition Security (SETSAN) under the Ministry of Agriculture. In consistency with ongoing initiatives to decentralize decision-making to the smaller administration units, SETSAN maintains provincial offices as well as a central office located in the capital city, Maputo. In addition to its coordinating role for ESAN II and PAMRDC, SETSAN is the national focal point for the SUN Movement. On 6 December 2017, the Council of Ministers (through Decree No. 69/2017) approved the creation of the National Council for Food and Nutrition Security (CONSAN). This development elevated SETSAN to a structure within the Council of Ministers and is a positive step towards establishing and sustaining high level commitment on food security and nutrition issues in the country. RAC found SETSAN already established and it partnered with it to influence policy change.

In Nigeria, RAC influenced the inclusion in national plans, guidelines and manuals of biofortification, and OFSP, as a food-based approach. The policies and strategic plans of significance include:

- The Nigerian Food and Nutrition Policy (2016–2020);
- The draft Nigerian Food and Nutrition Strategic Plan of Action;
- The Agricultural Sector Food Security and Nutrition Strategy (2016–2025) of the Federal Ministry of Agriculture and Rural Development's (FMARD) Innovative Agricultural Transformation Agenda;
- The Draft National Advocacy Brief prepared by the Federal Ministry of Budget and National Planning.

The FMARD agenda envisions two types of value chains as paramount to its success: (1) nutrition value chains, where the main outcome is improved intake of vitamin A and other essential nutrients by school children and children under five years of age and their caregivers, and (2) the diversified product value chain, where farmers, processors and marketers are linked up productively.

5.2.1 Impact of the policies enacted

The key impact of RAC'S campaigns on policy is that it positioned OFSP on top of the nutrition agenda, making it a central crop for biofortification programs. For example, before RAC the policies and strategies that had been approved by the Mozambique government for reducing malnutrition did not mention biofortification or the use of OFSP as one of the viable and cost-effective nutrition strategies. These included the Strategy and Action Plan for Food Security 2008–2015, the Strategic Plan for the Agricultural Sector Development (PEDSA) for 2010–2019, and the Action Plan for Multi-Sectoral Action Plan for the Reduction of Chronic Undernutrition in Mozambique (PAMRDC) for 2011–2015. The other documents included the Government's Five-Year Plan 2009–2014 and the Action Plan for the Reduction of Poverty (PARP) III 2011–2014. By implication, crops such as OFSP were not receiving adequate attention from donors, which affected investment in them. RAC, in partnership with SETSAN, embarked on advocacy for policy reformulation that resulted in the establishment of a communications working group and a working group on biofortification (BioSANWG) in 2013. Since then more than 15 important strategic documents have incorporated biofortification and two national programs now include OFSP as a strategic crop in Mozambique. The role played by RAC and other partners in advocacy led to the commitment by the Government of Mozambique to invest and support the production of OFSP through CAADP and the national investment plan for the agricultural sector.

In Tanzania issues of fortification were under the jurisdiction of the National Food Fortification Alliance (NFFA) established in 2003. Following advocacy efforts by BNFB, NFFA, at its ad-hoc meeting held on 28 June 2017, agreed to incorporate biofortification and revised its terms of reference. NFFA then formed the National Biofortification Task Force and instructed it to start work on 1 September 2017. The revised terms of reference state that the objective of the Task Force is "to provide to the National Food Fortification Alliance (NFFA) technical advice and recommendations on scaling up biofortification as a complimentary initiative for combating hidden hunger in Tanzania". The National Biofortification Task Force is composed of key actors from the government and NGOs, research institutions, academia and the private sector.

5.3 Seed systems

RAC trained government research institutions and provided them with foundation seed for farm trials, breeding and agronomic research, which resulted in the recent release of four new varieties in Mozambique to make a total of 19. Three other varieties are in the pipeline for official release in 2019. Tanzania has six varieties – Mataya, Kiegea, Ejumula, Kabode, UKG 05 and Kakamega – and nine others are in the pipeline for official release. Nigeria has two varieties, Mothers' Delight and King J, and plans to release two other varieties by February 2018.

RAC put in place an elaborate three-tier seed multiplication plan to ensure consistent and sustainable supply of OFSP seed for multiplication and production. This system is well established and working in all the three countries. The primary source is usually the research institutes that produce and supply foundation seed to the secondary multipliers, e.g. other research institutions or agricultural development programs at the regional or provincial level. The secondary multipliers in turn supply seed to tertiary level DVMs for further multiplication, all of which happens during the dry season, before distribution of the seed to farmers for planting during the rainy season. In Nigeria RAC modified this procedure and supplied foundation seed directly to DVMs, who multiplied it and supplied the vine and root producers. The agricultural development programs have limited capacity for dry season multiplication and were circumvented in this case.

To increase access to clean planting materials and decrease the risk of disease and virus contamination, RAC built the capacities of change agents on two innovative technologies for conserving seeds during the dry season, which DVMs have started using. In areas with high virus

pressure, trained DVMs are using net tunnels to maintain a stock of disease-free planting material sourced from research stations before bulking the vines in wetlands close to the beginning of the rainy season. In areas with dry periods lasting over four months storing small roots in sand and sprouting them in protected beds is being used successfully. This procedure is known as the Triple S (storage in sand and sprouting) method. One such sprouted root generates 40 cuttings for planting at the beginning of the rains. In Mozambique these technologies are being experimented with and used by DVMs in Niassa, Manica and Sofala, which are major sweetpotato growing areas. Other follow-up interventions such as the Kinga Marando project run by the Lake Zone Agricultural Research and Development Institute and CIP in Tanzania and the SASHA project in Nigeria also have adopted the technologies and are promoting them to farmers.

5.3.1 Decentralised Vine Multipliers (DVMs)

Earlier experiences by RAC had shown that mass distribution of vines through either a voucher or kiosk system was too complex to replicate, and so RAC chose to use a decentralized vine multiplication system (Low et al., 2013). It identified and trained DVMs to engage in multiplication and distribution of clean planting materials. The benefit of the DVM approach over other systems is that technical support is provided to small and medium-scale farmers who are capable of multiplying and marketing clean vines. Farmers are selected to become DVMs based on their previous experience with sweetpotato production, access to adequate land and reliable water for irrigation during the dry season, ease of their access by customers, and reputation in the community. After realizing that such selection criteria favored individual male farmers, RAC and its follow-up projects have been making deliberate efforts to identify existing farmer groups with a high proportion of women to become DVMs. Identification of DVMs is followed by training on vine conservation, pest and disease identification and management, agronomic management practices and rapid multiplication techniques (RMT). RMT consists of using separate multiplication beds, short three-node cuttings, close spacing (10 cm x 20 cm) and more intensive agronomic management. RMT is used to boost the production of vines for subsequent use as planting material rather than for root production. Multipliers learn how to keep different varieties in separate beds, to use labels showing varietal characteristics and to avoid mechanical mixing of different varieties during harvesting. Through observations of demonstration plots and information, education and communication materials they learn about the benefits of using quality planting materials.

To assess the sustainability of activities by DVMs in different projects, the evaluation asked the following questions:

- To what extent have the DVMs continued to multiply and distribute seeds?
- To what extent are men and women involved as DVMs after RAC project closure?
- What is the gender composition of those who have remained and those who have dropped out? What are the gender-related opportunities and obstacles?

The data obtained showed an increase in the number of farmers serving as DVMs in all the three countries for both sexes. The three projects visited and that had records had 147 DVMs (Table 5).

Table 5: DVMs from selected projects in the three countries

Country	Project	Total
Mozambique	VISTA	64
Tanzania	VISTA	30
Nigeria	Rainbow	53
Total		**147**

In Mozambique and Nigeria DVMs were mainly individuals multiplying vines for sale on 1–4 acres of land. In Tanzania most of the DVMs were working in groups, cultivating plots of 1–1.5 acres along rivers and in swampy areas to maintain vines during the dry season from June to October, slashing them regularly to allow sprouting of new shoots for production. Individual DVMs also had their own vine plots of 0.25 acres in most cases. Farmer group membership facilitated access to resources and suitable land close to water and fostered skill acquisition by new members through sharing of experiences. Examples of groups that partnered with RAC and were still vine multipliers at the time of the current evaluation are Madege in Gairo with 22 members, of who 14 were women, and Tunu in Geita district of Tanzania, which had a membership of 12, 8 of them women.

The decision of the DVMs to continue or not continue multiplying vines depended on several factors: the existence of a market for vines and roots, availability of equipment and water for irrigation, shortage of new clean seed after long dry seasons and personal circumstances such as loss of rented land for vine bulking. In the 2016/2017 season, DVMs in Tanzania were selling 20–30 cm long vine cuttings to other famers and local NGOs for 20 Tanzania shillings (US$ 0.0088), while in Nigeria farmers were selling a bundle containing 100 vines at naira 250–500 (US$ 0.69–1.38), depending on the location and demand. Most of the DVMs have become self-reliant, with women and the youth emerging as constant and dedicated multipliers after realizing the health and income benefits of OFSP. The evaluation recorded testimonies of DVMs making money and sustaining vine multiplication without external financial support. In most communities, DVMs stated that the demand for OFSP vines was high both within and outside their districts such that they were unable to meet it many times.

5.4 Capacity development for key actors

5.4.1 Capacity development for national institutions

Between January and June 2012, RAC identified national institutions to collaborate with in the delivery of the 10-day TOT course on “Everything you ever wanted to know about sweetpotato” on an annual basis during and after the project. Various agriculture research and management training institutions and universities were evaluated for suitability. The Eduardo Mondlane University in Mozambique, the SUA Department of Agribusiness and Agricultural Economics based in Morogoro in Tanzania, and the Agricultural and Rural Management Training Institute (ARMTI) in Ilorin, Kwara State, Nigeria were selected.

RAC worked through a mentorship process with these institutions to ensure that they had the right capacity to deliver the course. Before each 10-day course, a pre-training workshop was conducted where national facilitators were paired with experienced RAC, CIP and HKI scientists for the different modules. The team developed session plans and rehearsed the course delivery process. Also covered were the TOT delivery methodology, facilitation skills, adult learning methodologies, and gender issues in OFSP, among other topics. Clarification was made on how to use the course manual before the actual training, and the learning-by-doing activities were planned. The facilitators ensured that all training materials required during the course were available. The pre-training workshop took five days in the first round, but the duration was gradually reduced during the second and third rounds, based on evolving needs.

In Tanzania five-day workshops were held in November 2012 and July 2013, and a two-day workshop in March 2014. Five days were needed in the second round owing to the addition of a relatively large number of new national facilitators from various departments of the university, who constituted six of the 20 participants.

In Nigeria five-day workshops were held in November 2012 and September 2013, and a three-day workshop was held in June 2014. During the first workshop, relatively few CIP scientists were available

because it coincided with the 10-day TOT course in Tanzania, which was in its second week. Some CIP facilitators had to remain in Tanzania for that course.

In Mozambique the pre-training workshop took five days in the first round during July to August 2012 and two days in the second round in July and August 2013. No formal pre-training occurred during the third round but two new facilitators were coached individually.

The capacity of the national facilitators was strengthened further through the stepwise planning and delivery approach adopted for the TOT courses. Taken together, the workshops and the backstopping support enhanced the knowledge and capacity of the national institutions to organize, host and facilitate step-down training for change agents from the national implementing partners.

In addition to the three primary host institutions, RAC built the capacity of 51 national agencies in the three countries. Some of the trainees went ahead to build the capacity of their own institutions to design and implement gender-sensitive OFSP projects. Examples of such institutions were the Sugarcane Research Institute (SRI) in Kibaha, the Research Community and Organizational Development Associates (RECODA), the Agricultural Research Institute (ARI) in Hombolo and ARI–Kizimbani in Tanzania; Shingirirai in Mozambique; and Partnership for Child Development in Nigeria.

5.4.2 Delivery of the 10-day TOT course

RAC signed an agreement with each of Eduardo Mondlane University, SUA and ARMTI to deliver the 10-day TOT course during and after the project ended. The following steps were to be adopted to devolve the training to the three institutions:

- In year 1 the RAC team of CIP and HKI staff led the process of organizing and conducting the course. The three national institutions participated and provided support.
- In year 2 the training institutions took the lead while the RAC project team provided backstopping support.
- In year 3 the training institutions organized and conducted the course on their own, with RAC only offering them partial financial support. After RAC ended, the course was expected to be domiciled in the training institutions on a full cost-recovery basis.

In Mozambique the course was held in August 2012 and 2013 and June 2014 in Portuguese. In Tanzania it was held in November 2012, July 2013 and March 2014 in both Swahili and English. In Nigeria it was conducted in December 2012, September–October 2013 and July 2014 in English. The three institutions trained district level government and NGO agricultural extension workers who then cascaded the training to similar cadres at the village level for the final dissemination to farmers and traders (see Fig. 2). RAC offered full scholarships for 20 participants per TOT course and made provision for another 10 privately sponsored trainees.

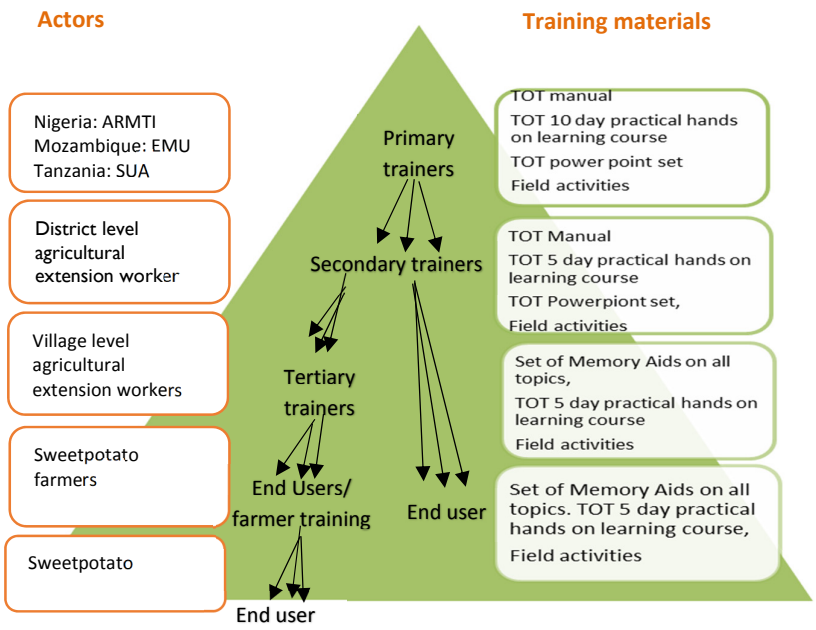

Fig. 2: RAC cascading approach to capacity building.

Before each 10-day course a pre-training workshop was conducted, where national facilitators were paired with experienced RAC, CIP and HKI scientists for the different modules. At the beginning of the training each participant received the TOT manual. The manual helped to guide the training and served as the key reference document. At the end of the training each participant received a branded CD containing all the training materials used by the facilitators during the course, including PowerPoint presentations, photos, recipes and other reference documents for use during subsequent step-down training.

5.4.3 Continuation of the TOT course by national institutions

5.4.3.1 Nigeria

This evaluation exercise involved consulting institutions identified by RAC to establish whether the 10-day TOT courses were still taking place in the three countries. The study found that ARMTI had institutionalized and integrated the TOT course fully in its curriculum. ARMTI is a parastatal organization under the Federal Ministry of Agriculture and Rural Development of the Federal Government of Nigeria. Situated in Ilorin, ARMTI is a center of excellence in agricultural and rural development management training and human resource development. By the time of this evaluation, ARMTI had 13 trainers – of whom 4 were women – and 7 were trained by RAC in 2012.

After RAC was phased out, ARMTI's first attempt to run the course in March 2015 on a cost-recovery basis was not successful because there were no applications with funding despite the efforts to extensively advertise the course and subsidize tuition fees in a bid to attract national participants. The second attempt in October 2015 yielded some success with six participants, one of whom was female. In the 2016/2017 financial year, the federal government provided funding of naira 16.5 million (then equivalent to US$ 54,635.76) for the training, covering transport fare, tuition, food, accommodation and stipend for the participants. ARMTI trained a total of 59 trainers in two cohorts, one from 21 November to 2 December 2016 and the other one in March 2017. The participants were from the Agriculture Development Program, universities, research institutes, NGOs and the private sector. They

were drawn from the six states identified as the main producers of sweetpotato, i.e. Kwara, Osun, Ebonyi, Kaduna, Benue and Nasarawa. Some 22% of the participants were female.

The participants took a pre-workshop test, which was also administered as the post-workshop test to assess the knowledge and skills gained. All the participants demonstrated significant improvement in knowledge and skills about OFSP at the end of the workshop (Fig. 3). A review of the action plans prepared by the trainees during the workshop showed that they also had gained the necessary knowledge to step down the training in their respective districts. Besides facilitating TOTs, ARMTI has been supporting the School Feeding Program, reaching out to more than 300 primary school pupils with OFSP meals every Wednesday and providing sweetpotato roots for the pupils to eat at home. That intervention and the TOTs impressed the federal government so much that although it had already released part of the funding for the 2017/2018 financial year, it decided to further support ARMTI. Annex 4 summarizes ARMTI's success story documented by CIP.

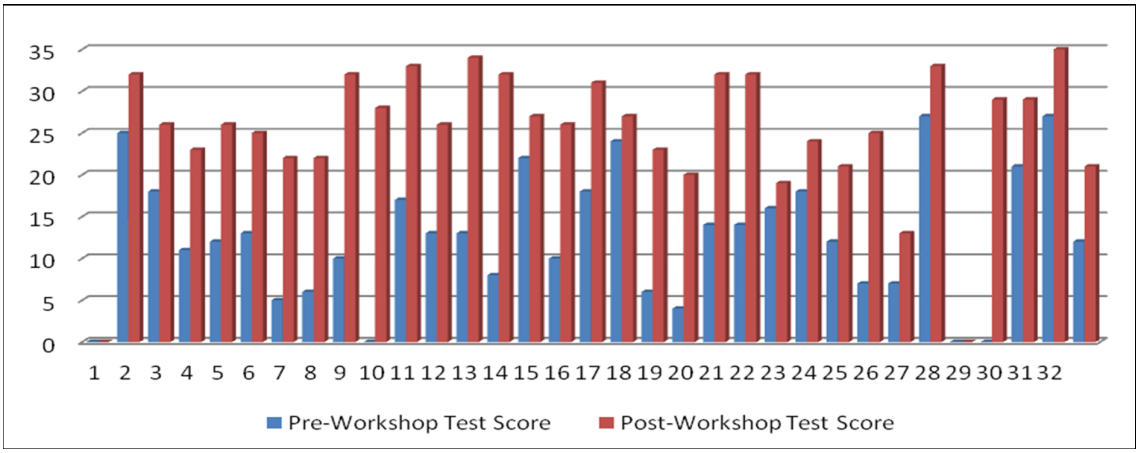

Fig. 3: Participants' pre-workshop and post-workshop scores.

Box 2: Topics covered during the 10-day TOT course

- Origin and importance of sweetpotato
- Nutrition and OFSP
- Gender and diversity aspects of OFSP
- Sweetpotato varieties and their characteristics
- Sweetpotato seed system
- Planning a vine dissemination program
- Monitoring and evaluation of OFSP dissemination program
- Sweetpotato production and crop management
- Sweetpotato pests and diseases and their management
- Harvesting, processing and post-harvesting management
- Entrepreneurship, marketing and value chain
- Adult learning principles

5.4.3.2 Tanzania

By the time of this evaluation, SUA had conducted one 10-day TOT course with sponsorship from CIP's VISTA project, for district agriculture, extension and nutrition officers. The course was split into two 5-day modules, which were offered 6–10 July and 18–21 August 2015. Thirty four participants attended module 1, of whom were 13 female, and 32 of them attended module 2, of whom 12 were female.

SUA conducted another 10-day TOT during 13–24 August 2017 for 27 participants (37% females), mainly district level, local government and NGO extension and health staff (Table 6). Some of the participants were supported by World Vision and the BNFB project. The aim was to build institutional and community capability in biofortified crops. All the course topics were covered during three sessions. The pre- and post-training tests showed that the participants acquired the necessary skills to step down the training. The highest score in the post-training test was 96% and the lowest was 50%, compared with 93% and 22%, respectively, in the pre-training test.

Table 6: Breakdown of participants in RAC TOTs from 2012 to 2017

Year	Nigeria			Tanzania			Both Countries
	Sex			Sex			
	M	F	Total	M	F	Total	Overall
2012*	12	8	20	18	12	30	50
2013*	17	11	28	13	10	23	51
2014*	21	10	31	16	7	23	54
2015§	5	1	6	20	12	32	38
2016+	25	7	32	3	3	6	38
2017+	16	5	21	17	10	27	48
Total (n)	**96**	**42**	**138**	**87**	**54**	**141**	**279**
%	69.6	30.4	100	61.7	38.3	100	100

*Conducted with RAC funding.

§Conducted on cost-recovery basis in Nigeria and funded by CIP's VISTA project in Tanzania.

+Conducted under 2016 ARMTI's capital project and cost-recovery basis, and for Tanzania funded by CIP's VISTA project for 2016. In the 2017 SUA TOT course participants partially sponsored by World Vision and the BNFB project.

5.4.3.3 Mozambique

Eduardo Mondlane University had not facilitated any training over the period September 2015 to August 2017. The respondents attributed this to funding problems associated with the national economic recession facing the country. Calls for self-sponsored participants had attracted little or no interest.

5.4.3.4 Impact of the training manuals developed by RAC

Training institutions considered RAC's "Everything you ever wanted to know about sweetpotato" training manual to be well developed, and they were still using them. Those interviewed suggested the following as sections that required revision to improve farmers' understanding and the application of the knowledge in real-life rural situation:

- Post-harvest handling (increase the content);
- Storage techniques that can be used at small and large scales to keep OFSP for long periods;
- Biofortification (to eliminate the confusion with GMO). Government policies in the three countries do not currently allow GMO products;
- Processing: standard units of measurements;
- Commercialization and marketing of OFSP.

The issue of GMO is important. As an example, in Nigeria the Catholic Relief Services (CRS), which has successfully included OFSP and yellow cassava in its projects supported by USAID, has encountered resistance to the crops by beneficiaries based on the misconception that the crops are genetically modified. The OFSP vines were purchased from the Rainbow project. CIP had to prepare a separate guide indicating that the biofortified crops being promoted were not GMOs, for CRS to address the misconception. Similar concerns among farmers and consumers were reported by the Tanzania Food and Nutrition Centre (TFNC).

5.4.3.5 Main challenges in delivery of 10-day TOTs

According to ARMTI,

> The design of the TOT course requires participants to step down the training to the grassroots in their districts and communities. Most of the participants from the three courses delivered by ARMTI post-RAC have struggled to step down the training attributing this challenge to inadequate funding support from their organizations.

When asked whether they faced any challenges concerning capacity building, SUA and Eduardo Mondlane University observed that securing funding to sustain the TOTs courses has been difficult, a situation exacerbated by economic recession and the inability of potential trainees to cover all their individual costs for the 10-day workshop.

5.4.3.6 Stepping down of training

After training the national institutions, RAC expected the cascading of the knowledge and skills to the grassroots to allow the wider uptake and utilization of OFSP. This evaluation found that the majority of people who had received TOT training as secondary trainers were continuing to train others in their organizations, districts and communities and figures from the 38 secondary facilitators indicate that a total of 71,602 people had been trained through step-down courses (see Table 7). Participants stated that:

> The course content and the style of the training are very good. I liked the group work exercise and the interaction of the facilitators and trainees. It made the class very active and most importantly it enabled us to share experiences to learn new ways of doing things (TOT participant from Agricultural Research Institute in Tanzania).

Generally, financial support was considered the main drawback:

> If I plan to train extension officers and farmers from my district I need money for lunch, per diem, stationery, venue and transport during and after the training to follow up or monitor progress. The local government that sent me to attend the TOT has no budget to support such activities, and in most cases we do these trainings informally with farmers. Trainers of end-users also require training materials such as processing equipment and start-up vines for distribution to the new farmers trained, and additional support such as backstopping services and information, education and communication materials (TOT participant from Tanzania).

Similar sentiments were echoed by trainers from Nigeria.

In Mozambique most of the step-down training events were funded by various projects run by different NGOs, Christian and farmers' associations and government departments. These included Samaritans Purse, CIP, Asociación Madre Coraje, HKI, Economic Agents, provinces, Christian Association Fund, Institute for Agriculture Research of Mozambique (IIAM), Olima Wo Suka project, Union of Cooperatives and Agricultural Associations of Lichinga, Agribusiness Consortium of Chimoio, Kenmare Moma Development Association and Niche Project, which is funded by the Dutch Cooperation.

Table 7: Stepping down of TOTs from 2015 to 2017 by trainers interviewed in the evaluation

District	Organization	RAC ToTs interviewed			Trainees trained by ToTs through step-down			
					Trainees	Sex		
		M	F	Total		M	F	Total
Nigeria	Government departments and research institutions	4	0	4	Agriculturists, extension officers, farmers and processors	245	250	495
	NGOs	0	3	3	Farmers	959	2,237	3,196
	Total	**4**	**3**	**7**		**1,204**	**2,487**	**3,691**
Tanzania	Government departments and research institutions	2	5	7	Agriculturists, extension workers, nutritionists, school pupils, farmers and processors	14,033	30,508	44,541
	NGOs	2	1	3	Farmers	7,613	12,018	19,631
	Total	**4**	**6**	**10**		**21,646**	**42,526**	**64,172**
Mozambique	Government departments and research institutions	**11**	**1**	**12**	Extension workers, nutritionists, students, farmers and processors	770	608	1,378
	NGOs	3	0	3	Nutritionists and farmers	607	1,620	2,227
	Private sector	4	0	4	Farmers	73	56	129
	Academia	2	0	2	**Students**	4	1	5
	Total	**20**	**1**	**21**		**1,454**	**2,285**	**3,739**
Overall		**28**	**10**	**38**		**24,304**	**47,298**	**71,602**

5.5 Gender mainstreaming in RAC activities

Throughout its lifespan, RAC ensured gender was mainstreamed in its operations. For example, gender was a major selection criterion for identifying course participants. The intention was to have female and male participants in almost equal proportions, for both women and men to have access to knowledge and skills about OFSP that would benefit their children. Tanzania had the most gender-balanced attendance in the 10-day TOT course and 6-day training course on project planning, implementation, monitoring and evaluation with females constituting 51.4% of the 3,000 trainees. It was followed by Nigeria, with 39% of the 415 trainees as female, and then Mozambique with females constituting 37.6% of the 1,019 trainees. The participants observed that the 10-day course was not attractive to females because it kept them away for too long from their household responsibilities.

Other strategies that RAC used to uphold gender equality in its operations included ensuring gender mainstreaming in the learning toolkits and other learning materials as well as in the log frames and monitoring indicators in the project proposals. Aside from this, during identification of DVMs, RAC made a deliberate effort to include women so that they too had access to quality vines. Routine monitoring data from the project shows that the household member obtaining OFSP from RAC's primary and secondary sites was 76.4% female in Mozambique, 49.6% female in Tanzania and 12% female in Nigeria, where OFSP had been newly introduced. Also, where necessary, RAC supported female commercial vine multipliers along with their male counterparts with foundation seed, irrigation equipment and linkage with buyers.

In Africa women are the main producers of sweetpotato and also make the decisions on food choices in the home. For OFSP, women dominate in all activities and men become involved when the scale of operation is large. The use of OFSP to combat VAD, therefore, makes sense because those most at risk are children in poor households where women are the dominant caregivers and decision-makers in food preparation. This central role of women also adds importance to the well-known link between

gender and nutrition and provides a unique opportunity for education and training of women in the utilization of OFSP from production through to cooking and serving in the home.

To ensure a gender balance, the TOT course covers all aspects of production and use of OFSP for both male and female farmers. Efforts have also been made by follow-up projects to involve school children in school gardens, where they gain hands-on experience in production of OFSP and ways of preparing it at home, and in school feeding programs.

5.6 Demand creation

The evaluation exercise found three main demand-creation strategies in use:

- Raising awareness among key stakeholders in the OFSP value chain, i.e. farmers, policy-makers, processors and marketers by disseminating messages in health clinics, markets and hotels; through road shows, field days and national agriculture fairs such as Nane nane in Tanzania; through the media; and at global or national events such as the World Food Day, Women's Day etc.;
- Promoting the crop as a source of income through sale of vines and roots;
- Making effort to enhance markets by linking DVMs, farmers, potential buyers and processing firms.

In both Mozambique and Tanzania, the VISTA project has embraced the entrepreneurs' capacity development on business skills (SECaBS) model to enhance investment in medium-scale sweetpotato seed and root production enterprises. That approach is contributing toward opening up markets for OFSP vines and roots in addition to increasing access to clean planting materials and incomes for smallholder farmers. Other interventions creating demand by promoting markets and processing of OFSP are the Rainbow project in Nigeria (see Fig. 4) and the Nutrition Awareness and Cash Crops Value Chain Project (NACCVC) of SUGECO in Morogoro, Tanzania.

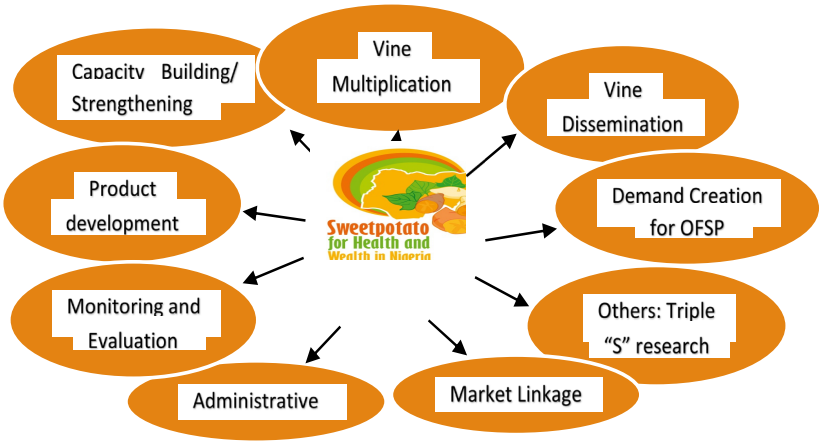

Fig. 4: Demand-creation activities of Rainbow project

The RAC design identified various innovative communication tools for the promotion of OFSP at the regional and country levels. These included fact sheets, pull-up banners, posters, brochures and a media advocacy kit on DVD. All the documents produced were uploaded to the sweetpotato knowledge portal for wide access. Besides this, OFSP technologies were included in an interactive television documentary in Tanzania running from March to August 2014. RAC also developed a photo story for the 10-day TOT course and produced a 19-minute video and a shorter 5-minute version on "The wonder root: orange-fleshed sweetpotato" for advocacy and promotional purposes. Fifty copies

of the videos were produced and distributed to stakeholders and were shown in various forums to promote OFSP and RAC objectives. The videos were uploaded to the CIP website.

Box 3: Country-level advocacy materials and training manuals

Country-level materials distributed to the advocates

Factsheets

- Why invest in OFSP in sub-Saharan Africa? (versions developed for Tanzania, Mozambique, Nigeria and Ghana)
- Can OFSP enhance food security in sub-Saharan Africa?
- What is vitamin A deficiency and what foods can help prevent it?
- Is there evidence that OFSP improves vitamin A status?
- OFSP as part of an integrated approach for tackling VAD
- Sweetpotato facts and fiction
- Why do women matter in OFSP programs?
- What should you know about growing OFSP?
- So you want to start an OFSP delivery project?
- Overview of the RAC project

Flyers

- Promote food-based approaches to combat vitamin A deficiency in (Mozambique, Tanzania, Nigeria)
- Promote a holistic approach to reducing vitamin A deficiency in (Mozambique, Tanzania, Nigeria)
- Invest in orange-fleshed sweetpotato for food and nutrition security (in Mozambique, Tanzania Nigeria)

Posters

- OFSP, natural orange and rich in vitamin A
- OFSP is a health food for the whole family
- Grow OFSP for heath and wealth
- Just one small root OFSP roots meets the daily vitamin A needs of a child under 5

Training manuals

- Everything you ever wanted to know about sweetpotato
- Engendered orange-fleshed sweetpotato project planning, implementation, and monitoring and evaluation

Investment guidelines

- Orange-fleshed sweetpotato investment summary guide targeting managers in subregional organizations such as COMESA or country level ministries
- Orange-fleshed sweetpotato investment guide targeting mid-level managers
- Orange-fleshed sweetpotato investment implementation guide for project implementers that provides examples on how investments in OFSP could best be made and what the costs are

5.7 Processing and marketing issues

OFSP roots have a short shelf life after harvesting and usually will start shrinking after two weeks, which makes processing at the home and factory levels all the more important. The “Everything you ever wanted to know about sweetpotato” manual that CIP, HKI and their partners developed includes content on processing and value addition.

Various projects that ran concurrently and post RAC adopted the OFSP manual for their trainings. Emerging projects are utilizing this resource material as well to come up with specific and contextualized manuals for training particular groups of stakeholders. A good example is the “Orange-fleshed sweetpotato community manual” and brochures developed by the Rainbow project in Nigeria.

5.7.1 OFSP processing at home

Various products can be processed from OFSP by cooking, boiling or frying. For example, OFSP roots can be peeled, chopped into small to medium chunks, cooked or fried and then served with fish, meat stew or vegetable sauces. The roots can also be made into mashed or mixed dishes after peeling, chopping up and mixing with pepper, salt and spices. Vitamin A in OFSP roots is absorbed by the body in larger volumes when OFSP is prepared with cooking oil. In cognizance of this, training of women, who have the responsibility of preparing food at home, has focused on frying of the roots and eating them together with other foods as part of the total diet.

Interventions on home processing of OFSP should have the goals of promoting the substitution of white-fleshed sweetpotato with OFSP in traditional cookery and educating mothers about novel OFSP products and other products they can prepare to bring in the much-needed dietary diversity.

5.7.2 OFSP processing by microenterprises

Conventional experiences with OFSP to date indicate that the probability of its adoption is greater if its promotion includes the development of microenterprises that utilize it in saleable products, adding value and bringing additional income into households and rural communities. In Mozambique, Tanzania and Nigeria small food firms are emerging and buying OFSP from farmers to process into value-added products such as flour, juices, bread and biscuits. As an example, Mozambique has six bakeries processing OFSP bread, three of which are in Beira Corridor and the other three in Maputo, and one juice, puree and biscuit processor in Chimoio district of Manica province, known as Zebra Farm. Zebra Farm's volume of sales for processed products for 1 April to 31 May 2017 was worth US$ 26,983. CIP's Scaling Up Sweetpotato through Agriculture and Nutrition (SUSTAIN) project, a three-year initiative that ran from 2013 to 2017 and was funded by DFID, donated a juice-making machine worth US$ 75,000 as one way of increasing outlets for surplus roots in the district.

In Tanzania, AFCO Investment Co. Ltd, based in Dar es Salaam, is one of the companies processing OFSP into various flours and supplying these to supermarkets in the city and surrounding districts. Other factories are TOSTI in Iringa, which is processing OFSP into crisps, and SUGECO in Morogoro. Matoborwa dries and packages fresh fruits, makes yellow-fleshed sweetpotato and banana crisps and par-cooked and dried sweetpotato roots or "matoborwa", in Swahili. Matoborwa supplies its products to Dar es Salaam supermarkets and exports some to Japan. To tap more into the Japanese market, Matoborwa has imported different sweetpotato varieties from Japan that are currently being screened at SRI–Kibaha for variety release and registration in Tanzania.

In most cases OFSP is sold raw in both rural and suburban markets, where it mainly used as a substitute for bread at breakfast or as a co-staple.

Processed products from OFSP

6. Evidence of success of OFSP interventions

This section examines the outcomes, successes and achievements made as a result of the activities that CIP and its well-selected partners, e.g. HKI and the agents of change from different government and humanitarian organizations, implemented in the three countries studied. A summary of the inputs, outputs, outcomes and successes of RAC regarding vitamin A intake, food security, diets is presented in Table 8.

Table 8: Program logic model for RAC

Key players	Activities/inputs	Outputs	Outcomes
Agents of change	Advocacy	Policies promulgated and enacted	Biofortified foods incorporated into strategies for VAD, increased investment and sustainability of interventions
Breeders	Breeding and farm trials	New varieties released	Access to clean planting materials
DVMs	Seed multiplication	Clean planting materials	Increased acreage, productivity and yields
Project managers	Collaboration with other NGOs; distribution of vine cuttings	A guaranteed market from relief agencies; free distribution of vine to farmers	Scaling up of OFSP and introduction of other biofortified crops
Institutions	Build capacity for TOT in national institutions	Number of trainings stepped down	Transfer of OFSP knowledge to the grassroots/more investments
Farmers	Producers	Number of farmers growing OFSP	Improved food security, incomes and diets
Traders	Transportation and marketing	Traders involved in OFSP	Increased trade and consumption
Processors	Value addition	Number of processors and saleable value-added products	Commercialization of OFSP
Retailers	Marketing of value added products	Availability of processed products of required quality	Increased sales and profits to remain in business
Consumers	End-users	Utilization of raw and processed products	Reduction of vitamin A deficiency prevalence

Box 4: Helping rural families increase the intake of locally produced vitamin A

In the words and testimonies of farmers, women groups and the youth, there is increased production and consumption of OFSP at home, at school and in clinics during antenatal visits, thanks to the work CIP and partners are doing.

In Osun state of Nigeria, more than 41,216 children from 174 elementary schools were consuming OFSP-enriched meals weekly as part of the school feeding program, thereby creating a stable root market for farmers and increasing vitamin A intake. According to Dr Jude Njoku, the national coordinator of the sweetpotato program and a senior agronomist at CIP, "Farmers in Osun state are growing the Mothers Delight variety [which is] very high in beta-carotene. Its dry matter is low but school children love it since it is sweet and not too hard." Mrs Olubunmi Ayoola, who is in charge of the Osun Elementary School Feeding and Health Programme, confirmed that children enjoy OFSP served at least once per week for lunch. ARMTI in Nigeria and Shingirirai in Mozambique had similar interventions and were providing OFSP roots for children to eat at home as well. In Tanzania the VISTA project distributed 1,000 vine cuttings to each of the 26 targeted primary schools in Mbozi district and one in Wanging'ombe for root production in the school farm.

Since only a 100-g serving (about half a cup) of boiled OFSP roots can supply the daily vitamin A requirement of a young child, the prevalence of VAD is anticipated to have become much lower than at the baseline situation. A 2002 study from South Africa showed that daily consumption of OFSP, which provided about two and a half times the recommended daily allowance (RDA) of vitamin A for four- to eight-year-old children, improved liver vitamin A stores. 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.

The Osun school feeding program serves OFSP at least once a week (credit: Osun Elementary School in Nigeria)

Box 5: Increasing food and nutrition security and rural incomes

Generally, OFSP has become one of the main crops supporting rural livelihoods in the three countries. Farmers spoke of the changes they had seen in their lives after they started growing, consuming and selling its roots and vines. For instance, Luize Zikaye in Mozambique was very proud of his involvement in growing the crop and said,

> All my livelihood depends on OFSP now. I reserve most of my land for this crop and use the money I get to buy maize. A 50-kg bag fetches MZN 650–700 (US$ 10.50–11.40) compared to MZN 500 (US$ 8.10) and MZN 300 (US$ 4.90) for the same quantity of white-fleshed sweetpotatoes and maize, respectively. With the money I got from OFSP last year, I paid lobola (dowry), purchased a plot at the market and 6,000 burnt bricks, which I will use to construct a tea tuck shop. I started growing OFSP on 1 ha of land and this year I planted it on 2.5 ha.

Also in Mozambique under the VISTA project, 15 DVMs from three districts realized US$ 18,560 (Table 9) from selling 2,017,645 vines to rural communities in the project districts. The varieties sold were Mataya, Kakamega, Ejumula, Kiegeya and Kabode released after RAC in 2016.

As another example, in Nigeria women were seen assuming different roles in the OFSP value chain, engaging as DVMs, farmers and processors working either individually or as a group. Mary Iheonu sold 12 bags of OFSP roots in March and April 2017 at naira 6,000 (US$ 16.50) per bag and made naira 72,000 (US$ 198.40). She also realized naira 670,000 from vine cuttings sold at naira 500 per bundle of 100 pieces, making a total of naira 742,000 (US$ 2,044.08). During the same time last year, one female farmer from Benue State earned naira 7 million (US$ 19,283.7) from OFSP vine and root sales to farmers and organizations, the first such amount in her life.

In Tanzania, Jane Mchusi, a 41-year-old widow living with six children, three of whom are in primary school, has farmed and traded in OFSP for the past three years. She cultivated 5 acres during 2016/17 and harvested 50 130-kg bags of OFSP. Besides selling raw sweetpotatoes in open markets, she makes flours, mandazi (doughnuts) and chapatti to sell to her community and at the Nane nane fair every year.

Table 9: Vine sales in the VISTA project, Tanzania

District	Slips / vines	Value (US$)
Chunya	371,100	3,374
Gairo	605,400	5,504
Iringa	71,445	650
Mbozi	73,600	669
Mufindi	614,900	5,590
Ulanga	281,200	2,775
Total	**2,017,645**	**18,560**

Data source: VISTA project, Tanzania

The examples given above suggest that there are huge opportunities for women as well as men and youth groups to benefit from the sale of both OFSP vines and roots. Nevertheless, there are outstanding questions about sustainability of these activities in future, particularly when the external support ceases. As noted by Rao and Huggins (2017) and observed during this evaluation, smallholder farmers who have to purchase OFSP vines need also to pay any transport costs to visit the seed multipliers if they do not live near one. Such costs can be unacceptably high, given that vines are not always available in the central markets. Vine and root sales by established seed and root enterprises are limited by the tendency of smallholder farmers to share these commodities. For example, instead of purchasing clean vines from multipliers, smallholder farmers will exchange planting materials with friends, neighbors and other farmers without any payment. Strangers or farmers from distant locations who have been put in touch with suppliers through the radio or by NGOs are the people charged for vines.

Box 6: OFSP interventions are reaching, empowering and creating employment for the youth

A case from Sokoine University Graduates Entrepreneurs Cooperative

The average age of an African farmer is 60 years despite the fact that 60% of Africa's population is under 24 years of age (AGRA, 2017; FAO, 2014). Where will the next generation of farmers come from? Who will teach them the skills?

SUGECO in Tanzania is training undergraduate and postgraduate students to become entrepreneurs involved in agricultural production of different crops including OFSP. SUGECO was founded in 2011 by SUA university students to promote agribusiness development and innovation amongst Tanzanian youth entrepreneurs.

By the time of this evaluation, SUGECO had 480 members across the country and was enrolling 80 graduate students annually as entrepreneurs in horticulture, roots and tubers, bee keeping, poultry and small ruminant production. The cooperative has also an internship program in which it sponsors graduate student entrepreneurs to travel to Israel where they work in farms for 11 months. Some 20 students were involved in 2015, 30 in 2016 and 30 in 2017 September. RAC found SUGECO already in this work and supported it over the years in different areas of capacity building, vine multiplication and other areas around the OFSP value chain. To become a member, one is required to come up with an idea and to develop a business plan. Testimonies by the youth involved in OFSP showed their great enthusiasm to grow the sweetpotato at a large scale not just for consumption but also for product development, commercialization and wealth generation along the value chain.

SUGECO has a processing incubator for flour blends, juices and biscuits, which the cooperative sells in retail markets and hotels within Morogoro. Through the NACC project in Kilosa and Gairo districts, SUGECO was supporting 1,200 smallholder farmers to scale up the production of OFSP and had constructed a community solar drier in Ibuti village (Gairo) for bulk drying of the sweetpotato before further processing and marketing. In these districts, SUGECO trained the farmers on good agronomic practices from land preparation to storage of OFSP in improved pits constructed with burnt bricks and thatch.

According to SUGECO, the demand for OFSP remains quite high and unmet, as farmers are producing it mainly for home consumption. Entrepreneurship in OFSP at scale needs a high level of passion and commitment, which is lacking in most of the youth. SUGECO said that currently most of the processors are small-scale farmers and women groups, but they lack the necessary capital and high level of expertise to boost the processing sector.

7. New constraints for OFSP

In spite of the successes achieved, RAC and its follow-up projects are not without challenges, as new constraints have emerged that affect the universal adoption and utilization of OFSP and even other biofortified products. For any of the biofortified commodities to move beyond local production, there is need for CIP and its multiple partners to address those challenges.

Consumers continue to prefer the high dry matter content of traditional white and yellow fleshed varieties despite their lack of beta-carotene

In all the three countries studied, farmers and consumers continue to prefer the traditional sweetpotato varieties with high dry matter and low water content. The high dry matter content in white-fleshed sweetpotatoes is valued or vital for filling the stomach of the consumer. OFSP is considered softer in texture after cooking even for varieties that breeders categorize as high in dry matter. Processors on their part say that OFSP absorbs a lot of fat or oil during frying and does not get crispy as desired. Research demonstrates that the fat in fried OFSP products makes the beta-carotene more bio-accessible than if the products are baked (Tumuhimbise et al., 2009). Steaming or using a little amount of water when boiling yields better results, but these are not traditional cooking methods

in the village set up. Sadly, the darker the orange color and richer in beta-carotene OFSP is, the softer the texture. The Tio Joe variety in Mozambique contains one of the highest beta-carotene levels at 34 mg per 100 g on fresh weight basis yet it is considered the lowest in terms of dry matter content compared with varieties such as Gloria, Jane and America, which have lower beta-carotene levels.

Perceptions on current varieties vary across countries, which complicates the problem. For example, the Resisto variety is very popular in Mozambique due to its taste, dark orange color, growth structure and high yields. However, it is considered watery in Tanzania and less watery than several cream-fleshed varieties in South Africa (Andrade et al., 2009). Plant breeding is going on to create OFSP varieties with high dry matter content and the preferred sensory characteristics to increase its adoption. Meanwhile, advocacy messages should focus on mindset and behavior change so that OFSP is not regarded as similar to or a replacement for white sweetpotato and so that it is adopted for its nutritional benefits, which are absent in the white varieties. The BNFB project provides an opportunity for farmers, processors and consumers to choose to increase the intake of vitamin A from consumption of a wide variety of vitamin A rich crops.

Table 10: A comparison of OFSP varieties grown in Nigeria

Characteristics		
Common name	King J	Mothers' Delight
Skin color	Pink	Light orange
Flesh color	Light orange	Deep orange
Dry matter content	39.3%	28.7%
Resistance to weevil	Moderate	Low
Resistance to virus	Low	Low

Seasonality, perishability and storage problems demoralize farmers and processors from investing in OFSP

Sweetpotatoes are generally available from May through October in the three countries. Different storage methods are being promoted for the roots: (1) pit storage containing layers of dry grass and leaves, (2) sawdust heap, (3) rack storage, (4) in-ground storage where at root maturity the vines are cut off, the soil hilled up to cover exposed roots and the cracks closed up, which can store the roots for two to three months, and (5) dry sand storage under a ventilated room at room temperature, which can store the roots for four months and longer.

Fresh roots can be stored in dry sand for five months, but this practice is not common in real life. Farmers prefer the most pit storage as it resembles the traditional structure used for storing white-fleshed sweetpotatoes, which they are used to. The main problem is that OFSP roots can be stored for only up to three months using this method before they wrinkle and rot. Maintaining the roots in the field after maturity results in heavy weevil infestation within as brief a period as one month.

CIP breeders and scientists are aware of the storage problem, but coming up with methods that can store fresh roots for long periods is complicated by the need to maintain the stability of beta-carotene during storage. A study by Jenkins et al. (2015) found that beta-carotene begins to decline after 12 weeks of indoor storage and 22 weeks of in-ground storage. Bechoff et al. (2011) found high losses of

carotenoids associated with storage of dried OFSP chips, leading to a recommendation that OFSP chips be stored for no longer than two to four months, depending on the variety.

Invigorating the processing and commercialization of OFSP at a large scale can in part help address the need for long-term storage of fresh roots. Well-organized contract farming, grading, curing and bulking of OFSP produce by farmers' cooperatives can help large-scale traders, food enterprises and marketers know where to buy the roots in the quantities and of the qualities they want.

Breaking into the urban market is the future growth opportunity for OFSP. Low et al. (2017) have identified three entry points for marketing OFSP: (1) promotion of the consumption of roots by developing varieties that meet farmers' and consumer sensory preferences and focusing nutrition messages on the health benefits of OFSP more widely, emphasizing how OFSP reduces the risk of vitamin A deficiency, (2) integration of OFSP as an ingredient in processed foods such as flour, bakery products and juices, and (3) more extensive use of vines and non-commercial roots in the animal feeds industry; e.g. the high protein content of OFSP leaves at 16% crude protein makes them an ideal dairy and pig feed.

In large scale undertakings, for instance, instead of storing fresh roots, OFSP could be processed into puree for incorporation into flour products to reduce the costs of importing wheat flour, or dried in different forms for storage in Purdue PICS bags for periods of three years and longer. The goal should always be the creation of a market development strategy that ensures significant home consumption of OFSP while still allowing the sale of the surplus to boost rural incomes and investments. More so, biofortified crops must be consumed on a routine basis, i.e. daily or at least multiple times a week to have a significant nutritional impact.

Traditional OFSP storage facilities used in Gairo and Kilosa districts, Tanzania.

Prolonged and recurring dry spells typical of the recent agricultural seasons are adversely affecting vine multiplication and continuous production by the farmers

Sweetpotato's primary multiplication starts during the dry season to generate vine cuttings for secondary multiplication during the rainy season. RAC promoted the use of net tunnels and Triple S methods to conserve OFSP vines during the dry season in readiness for planting. Follow-up projects are continuing to train DVMs on how to utilize these technologies at the community level, particularly in Mozambique and Nigeria. Despite the adoption of these innovative technologies, by the time of this evaluation most of the farmers were still relying on traditional methods of multiplying vines in wet lands, which are tedious and dependent on a very good supply of water. Therefore, vine multiplication was limited to small parcels of land of 0.25 acres to 1.5 acres. It was reported in all the three countries that because of this reason there were many times when the demand for vines was much higher than the supply, which negated the work of the campaigns and promotion activities undertaken. The erratic

rains and prolonged dry spells in the 2013 to 2016 agricultural seasons complicated the situation. The 2015/2016 season was the worst, characterized by El Niño drought that affected both vine multiplication and yield after planting. All the sweetpotato producing areas were heavily affected in the three countries: southern Mozambique, north central states of Nigeria and eastern and southern Tanzania.

Vine multiplication along wetlands by the Madege group DVMs in Tanzania. By the time of this evaluation in September 2016 the group was experiencing water shortages, as the river they were relying on for irrigation had dried up. The group noted that water shortages, attributed to poor weather conditions due to climate change, had been a major problem hampering vine multiplication and successful farm production of OFSP in the country.

8. Promoting a nutritious food basket through the BNFB project: A model for the future

Addressing VAD in remote areas through biofortification has started creating markets locally and in school feeding programs. However, increasing production depends on conquering more distant markets. This requires quality and sufficient quantity of OFSP roots, and reliability of supply to attract commercial agents and truckers. Using HarvestPlus' categorization of the stages of OFSP development, this evaluation considers the three countries studied to be in stage two or moving into it. BNFB, with its multiple crops and partners, is the stage three and is considered a transition to the future.

BNFB, a three-year project running from 1 November 2015 to 30 October 2018 and supported to the tune of US$ 5 million by the Bill & Melinda Gates Foundation, seeks to reduce hidden hunger by catalyzing sustainable investment for the production and utilization of biofortified crops, including OFSP, vitamin A (yellow) cassava, vitamin A (orange) maize and high iron/zinc beans. The intention is to demonstrate how multiple biofortified crops can together provide a diversity of choices and eventually help address VAD at scale. BNFB draws on complementary expertise for scaling up through a partnership involving CGIAR centers and programs, regional organizations and other public and private sector agencies to create a movement to eventually reach the target populations with biofortified food. The assumption is that BNFB scaling up is dependent on a supportive policy environment, strong institutional capacities and availability of proven technologies.

CIP is the BNFB lead organization and the collaborating partners are CIAT, with expertise in high iron beans; CIMMYT, with expertise in vitamin A (orange) maize; IITA, with expertise in vitamin A (yellow) cassava and vitamin A (orange) maize; HarvestPlus, as the global leader in biofortification and with experience in scaling up interventions at the country level; FARA, which is responsible for policy engagement and advocacy at the regional level; and national implementing partners in Nigeria and Tanzania including the government, the civil society and the private sector.

Discussions at BNFB's second annual review and planning meeting in Zanzibar 11–13 October 2017 to review its accomplishments, share lessons and plan for the final year showed that the project had made significant progress. Out of its 15 planned milestones, 3 had already been achieved, 11 were on course and only 1 was delayed. The specific achievements of BNFB as at October 2017 are highlighted below.

8.1 Policy influence

8.1.1 Nigeria and Tanzania

In the two years from November 2015 to October 2017, and with support from partner institutions and national governments, the BNFB project had influenced a total of seven policies, four of them in Nigeria and three in Tanzania. In Nigeria these policies were (1) the Nigerian Food and Nutrition Policy (2016–2020), (2) the draft Nigerian Food and Nutrition Strategic Plan of Action, (3) the Agricultural Sector Food Security and Nutrition Strategy (2016–2025) of the Federal Ministry of Agriculture and Rural Development, and (4) the Draft National Advocacy Policy Brief prepared by the Federal Ministry of Budget and National Planning. In Tanzania, the policies were (1) the Ministry of Agriculture, Livestock and Fisheries' Food Security Draft Strategic Plan, (2) the Tanzania Food and Nutrition Centre (TFNC) 5-year Strategic Plan (2016–2020, and (3) the Multi-sectoral National Nutrition Action Plan (2016–2021).

8.1.2 Regional level

At the regional level, the influence of the BNFB regional champion at the New Partnership for Africa's Development (NEPAD) led to the inclusion of biofortification in the African Union's Business Plan to Implement the CAADP-Malabo Declaration (2017–2021). Additionally, through the collaborative advocacy efforts of BNFB, HarvestPlus and AU, biofortification was included in the second AU Specialized Technical Committee meeting agenda and endorsed as one of the key strategies for combating hunger and malnutrition in Africa.

8.2 Resources mobilized in support of biofortification

From November 2015 to October 2017, the BNFB team and national advocates helped raise US$ 59,031 in Tanzania for supporting biofortification programs. This was made up of US$ 27,336 to support the two TOT courses on OFSP provided by the Enhancing Nutrition Services to Improve Maternal and Child Health (ENRICH) project and US$ 31,695 invested by the six district councils of Chunya, Gairo, Iramba, Bahi, Mkalama and Manyoni to support various activities on biofortification.

By October 2017 a total of US$ 1.53 million was pledged by partners for Nigeria, which included (1) US$ 1.4 million in the proposal submitted to DFID entitled "Nutrition sensitive kitchen garden interventions with OFSP and other vegetables—a sustainability strategy of the Women in Nutrition in Northern Nigeria (WINNN) Program", and (2) US$ 130,000 from FMARD as an allocation to fund OFSP vine and root production activities as an emergency response intervention to the food insecurity situation of internally displaced persons in Borno state. These funds were yet to be made available for implementation of the activities. A further US$ 3,000 was pledged by the chief medical director of University College Hospital to support a pilot run with OFSP in the menu of selected patients for six months. By October 2017, apart from these pledges, $394,031.10 had been raised for initiatives on biofortification in both countries, with Nigeria's share being US$ 335,000.

8.3 Capacity building for national agencies and institutions

The BNFB project has strengthened the capacity of at least 19 institutions implementing and supporting various projects on biofortification. In particular, the training has focused on awareness, benefits, production and utilization of the various BNFB crops. Nine of the institutions trained were from Nigeria, namely the four agricultural development programs of Enugu, Kogi, Ogun and Taraba states; the National Roots and Crops Research Institute, Umudike, and four seed companies (Premier Seed, Seed Co., Value Seed and Maslaha Seed). Ten of the institutions were in Tanzania: the Agricultural Research Institute (ARI), Selian; ARI–Uyole; ARI–Maruku; ARI–Hombolo; Wanawake Waumini Wakristo; TFNC; Sajaranda Bible College; and three seed companies (Meru Agro Tours, Tanseed International Ltd and MAMs Ltd).

The BNFB project has also made significant progress in updating the 10-day TOT manual, "Everything you ever wanted to know about sweetpotato" and in developing three new manuals, on "Introduction to biofortification", "Production and seed systems of high-iron (biofortified) beans", and "Production and seed systems, agro-processing and utilization of PVA maize". The project has developed a farmer-to-farmer training video on OFSP in Swahili for use in Tanzania in addition to producing a simplified step-by-step guide, working in collaboration with the Sugarcane Research Institute, Kibaha, to facilitate learning about OFSP in the country.

8.4 Key achievements in training and variety development of the BNFB project

- Well over 2,805 (1,409 male and 1,396 female) change agents have been trained through six TOT courses and 27 step-down courses on selected areas along the value chains of OFSP, high-iron beans and PVA maize. This includes 590 change agents in Nigeria, of whom 311 were male and 279 were female, and 2,215 in Tanzania of whom were 1,098 male and 1,117 were female. The total change agents trained from the project start in November 2015 to October 2017 were 2,997, of whom 1,556 were male and 1,441 were female.
- The National Performance Trial Technical Committee has approved and recommended for official release to the National Variety Release Committee two bean varieties, RWV1129 and MAC44. Eight other bush, high-iron and zinc beans (RWR 2154, KAB 06F2-8-36, KAB06F2-8-35, CODMLB 001, Ngwankungwanku, CODMLB 033, SMC 18 and SMC17) have been selected to move on to advanced yield trials at ARI–Maruku, ARI–Selian and ARI–Uyole.
- CIMMYT continues to support seed companies in Tanzania to conduct evaluations for possible release of new varieties. By October 2017, a total of 54 new hybrids were provided to MAMS, IFFA and Tanseed International companies for evaluation. Final selection for registration was awaiting the harvesting of the trials. CIMMYT has continued to increase the quantity of certified seed for the two released PVA maize varieties. It has produced 99 kg of parent lines, 11.6 kg of single crosses and 10 kg of Meru VAH517 hybrid, and made these available to Meru Agro Ltd to initiate certified seed production and establish demonstration plots.
- The SRI–Kibaha team has established three OFSP mother–baby trial sites in Dodoma and Singida and evaluated 11 OFSP varieties.
- In Nigeria, two PVA maize varieties were released in 2016 and 2017. The varieties, Sammaz 49 and Sammaz 52, were developed by IITA under the HarvestPlus Challenge Program. BNFB contributed to the fast-tracking of the release of these varieties. IITA evaluated about 15–20 PVA maize hybrids/open pollinated varieties across six locations in the country.

- Ten promising OFSP genotypes also were selected and multiplied during the dry season in Nigeria. BNFB supported on-farm trials on these in 12 locations of the country. Evaluation and data collection were going on and the results were expected to be submitted to the variety release committee by December 2017.
- By October 2017 more than 30,383 households in Tanzania and Nigeria were growing the four biofortified crops promoted by the BNFB project.

8.5 Commercial processing utilization of biofortified crops

In 2017 CIMMYT provided AFCO Investments Ltd in Tanzania with a small grant to pilot the processing of PVA maize products in three areas of Dar es Salaam. AFCO piloted the maize flour products in the target areas and sold about 970 kg of the flour in September 2017. In Nigeria, eight small-scale agroprocessors are producing and marketing OFSP products in retail shops in Abuja, Osun, Nasarawa, Benue and Oyo states. The products include complementary OFSP-based foods, OFSP juice and kunu, a local beverage, as well as OFSP bread and pastries.

The achievements made by the BNFB project demonstrate that different centers can work together at the local level in an effective and systematic manner. Several factors have contributed to the effective collaboration in the project:

- Careful selection by CIP of project partners who have commitment to and experience in different biofortification crops;
- Local agencies and village structures' interest and support;
- Generic training materials from CIP that serve as the basis for capacity building;
- A common understanding that VAD can be well addressed through multiple-commodity value chains and institutions.

This evaluation found the BNFB project to be one level above RAC in a system hierarchy. Its nutrition goals are more complex; its partnerships wider; and its points of interaction with policy-makers different. Moreover, each biofortified commodity has its CGIAR center and special requirements, and, as it is commonly known, donors fund their commodities or their centers not a process like biofortification. The implication is that more training is needed to enable the staff to promote all the commodities and value chains, and a diversity of value chain actors needs to be brought together in a "superplastic way" so that they can address all commodities and interests in the nutritious food basket.

9. Lessons learned and the way forward

CIP's pioneering work on biofortification of sweetpotato began with collaboration with CIAT, the International Food Policy and in two stages: Research Institute (IFPRI) and HarvestPlus proof of concept and reaching end-users. The work in the three countries that are the subjects in this study was at a commodity-specific level, but CIP has built capacity that has proved useful to other commodities, including white-fleshed sweetpotato. RAC developed training materials and its local trainers can work across commodities. It was aimed at a high level of policy influence to overcome production and market constraints. With the project's growth would come additional streams of revenue for the targeted communities. With higher incomes, populations would include more diversity in their diets and both food and nutrition security would be improved. BNFB is a multi-commodity and multi-center program that provides a transition to a more secure future. The exact way this future is achieved will necessarily be location and commodity specific.

Value chains and markets for OFSP are poorly developed and fragmented

In all the three priority countries of RAC, value chain actors for OFSP and white-fleshed sweetpotato are the same. They include input suppliers, farmers, transporters, traders, processors, retailers and consumers. In its design, RAC focused mostly on advocacy for policy change and resource mobilization and capacity building, not on linkages to markets or agroprocessing for value addition. It assumed that different actors would be willing to participate in the value chain voluntarily and that market links would be made through other initiatives. However, production has remained largely small scale on land sizes of 1 acre to 1.5 acres and for home consumption. Farmers give priority to cereals and other crops they perceive to have high market demand and higher profits. The low production of OFSP limits its supply to non-farming households in both rural and urban areas that are net buyers of food. It also prevents large-scale traders and marketers from making meaningful investments in it. In short, OFSP has not really penetrated the main urban markets for wider consumer utilization. It is available mainly in markets in its areas of production and only during the production season. Farmers, who serve as both producers and traders, lack market-related information on prices, value chains, competitors and credit. A large majority of them have no market contacts and face difficulties finding potential buyers.

Other issues include infrastructural inadequacies and behavior and attitude factors, with the general perception of sweetpotato as a women's and disaster-response crop owing to its drought tolerance. Traders in urban markets have better market information and stronger linkages with processors but bulking is a challenge because, like farmers, they operate as individuals. This, along with the production constraints at the farm level, limits the demand for OFSP processed products. The lack of financial support has resulted in low involvement of processors. Notwithstanding these bottlenecks and given the current interest in nutrition and the favorable policy environment brought about by RAC, the potential exists for an improved and well-functioning value chain environment and markets that will enable key players to derive greater benefits from their activities.

There is need in the future to strengthen the link between agriculture and nutrition and health by supporting farmers and enhancing partnerships and coordination with other CGIAR centers such as HarvestPlus and the Program on Agriculture for Nutrition and Health housed at IFPRI that has considerable in-house experience in policy and value chain development, in order to maximize the health and nutritional benefits of agricultural development.

Successful promotion of biofortified crops requires cross-sectional collaboration at the country level

After successfully implementing RAC, in BNFB CIP embraced a paradigm shift from one to multiple crops and value chain environment, both of which require strong leadership and clear definition of roles to enable multiple agencies with different expertise, knowledge and networks to work together in a synergistic manner. The need for effective coordination is particularly evident because most of the crops in the BNFB project are relatively new and have different ecological and protocol requirements. This evaluation found more than adequate guidance from RAC and the BNFB project that future interventions can learn from. For example, the operation approach of the coordination framework has improved relationships between the partner agencies, interagency communication and awareness on other biofortified crops. In addition, the activities of the projects, the commitment of the partner agencies to achieving results, and the partners' willingness to work outside of rigid operating hours have contributed to the successful coordination of the project at the country level.

This evaluator believes that the BNFB project has shown that every commodity is *sui generis*, the process for each crop varies with commodity sector and country, and for biofortified crops the critical thing is not biofortification per se but market development. The future will bring into play several new factors: competing biofortified staple crops, new potential value chains, and the need to bridge

technical, institutional and market gaps. CIP has accumulated experience, established many links and developed several manuals and TOT materials. The knowledge and resources produced have adaptability possibilities for other commodities and environments; for example, they can be used in institutional analysis and human capacity development aspects, and they are highly pertinent in maintaining CIP as the logical backbone organization in future biofortification programs.

10. Conclusions: evolution from RAC to BNFB

- CIP, along with its partners, has succeeded in proving that OFSP could be biofortified, that its pro-vitamin A is retained in traditional cooking methods, that consumed in modest amounts by children OFSP could reduce the danger of VAD, and that farmers (largely women) would maintain vines for planting and grow OFSP for consumption and local markets. CIP shared with HarvestPlus the 2016 World Food Prize for these achievements.
- The CIP experience in Mozambique was successfully repeated in Tanzania and Nigeria. OFSP is a valuable crop for food security and nutritional improvement among farmers in communities beyond the reach of large markets and public health services. It may not be the best or only way to combat VAD where markets provide diversified diets, enriched processed foods and higher incomes from other crops.
- Sustainability of the achievements will require maintenance research on OFSP to defend the gains in productivity from improved varieties against new diseases, pests and changes in market requirements.
- Scaling up of OFSP will not be a simple linear process. For this reason, BNFB is part of a higher order food and nutrition security system in which markets generate income for producers and supply diet diversity in food baskets.
- Resources are needed for maintenance research supporting current achievements and for scaling up the interventions to address the wider nutrition and food security goals mentioned in the many donor funded strategies.
- It is useful to consider BNFB as a transitional step in moving from a system where OFSP for VAD reduction is the goal to a more complex system where BNFB for nutrition security is the goal. The number of objectives is greater in the latter, the partnerships more complex, and the agents of change more diffuse. This evaluation looked for elements in BNFB that help build linkages among actors and at the levels of decision-making, financing and implementation.
- RAC succeeded in moving from resting on its success in the technical aspects of the project to the development of necessary knowledge and understanding of agents of change and building the capacity of individuals and institutions to promote biofortified OFSP. In doing so it developed linkages with other centers and NGO partners with similar interests.
- With additional resources from the Bill & Melinda Gates Foundation, BNFB began to collaborate more effectively with CGIAR centers and partner NGOs to raise the profile of biofortified crops while promoting biofortification as a useful tool in support of food security.

10.1 Recommendations for beyond BNFB

It seems clear that external funding is shifting to focus on the link between agriculture and nutrition and health. BNFB has been working on policy change, development of training materials and capacity development to integrate technical messages and build capacity of individuals and organizations for enhanced collaboration. The future beyond BNFB will call for enhanced programmatic resourcing and

identification of structures for planning and managing national resources to secure nutrition and food security. The specific recommendations for CIP, governments and national institutions, and the private sector are provided below.

10.1.1 Recommendations for CIP

- Embrace the necessity of improved linkages between agriculture and health and nutrition without sacrificing technical work. Low productivity in agriculture, particularly among smallholder farmers, is the main reason for the low penetration of biofortified products and their low intake, which contributes to undernutrition. Farmers should be supported to have access to the inputs they need to ensure high and sustainable production of quality biofortified food commodities. They need improved storage facilities to reduce the unacceptably high levels of postharvest losses and secure access to markets. Appropriate and affordable financial products ought to be developed, especially for smallholders and more so women farmers, who depend on their own production for most of their food and for whom increased productivity is a sure route out of poverty. This support is needed even more in the face of climate change to maximize the benefits of agricultural development and to make communities more resilient.

- Establish collaboration with cross-cutting CGIAR programs such as Agriculture for Nutrition and Health, and HarvestPlus, which has biofortification programs. Each of these programs has its own sphere of action and is unlikely to compete with CIP.

- Maintain or create partnerships, as with HKI and VISTA, to promote and sustain markets and value chains. Ensure effective and sustainable market demand and supply of biofortified crops for actors, i.e. seed multipliers, seed companies, processors, food manufacturers, retailers and consumers to increase the crops' uptake.

- Make more strategic investments to support biofortified crops' seed systems, value addition, marketing and quality assurance.

- Promote contract farming and bulking of biofortified produce by farmers' groups to help large-scale traders, food enterprises and marketers find and obtain OFSP and other biofortified crops in the quantities and qualities they want.

- Map out and link up seed suppliers, producers, buyers, traders and processors to open up markets.

- Link up with the World Food Programme's (WFP) Home Grown School Feeding Program to develop a framework connecting it with local smallholder farmer's production by creating an ongoing market for them.

- Develop a promotional strategy for biofortified crops and the new products processed from them by the food industry to create awareness and increase demand among different consumer segments. Target the promotional campaigns at consumers, large-scale traders, bakeries, manufacturers, restaurants and hotels, encouraging them to use these crops and products owing to their health benefits. Provide support to commercialize OFSP and other biofortified products through the development of viable products for urban markets.

- Develop robust monitoring and evaluation and knowledge management systems to track indicators of progress toward key outcomes. This will ensure that the lessons learned provide feedback in the planning and management of programs for scaling up.

10.1.2 Governments and national and international organizations

- Continue to fund breeding and research work to improve the dry matter content, shelf life and disease and pest resistance of OFSP. Endeavor to develop OFSP varieties that meet farmers and consumers' sensory preferences to accelerate their adoption.
- Improve collaboration with the private sector and provide the necessary technical, material and financial support it needs to actively venture into biofortification value chains and without worrying much about the risks.
- Focus policy advocacy on the removal of constraints (e.g. trade restrictions, transport infrastructure challenges etc.) and strengthening facilitating factors.

10.1.3 The private commercial sector involved in food value chains

- Explore new business models for producing improved planting materials for biofortified products at a low cost.
- Develop biofortified products that maintain pro-vitamin A content and appeal to consumer preferences.
- Partner with CIP, other CGIAR centers and public agencies to provide public nutrition awareness about OFSP and other biofortified crops. Use the orange color of OFSP and pro-vitamin A maize as the points of focus to communicate their advantages to consumers. Differentiate these crops from the traditional crops through advertisements and marketing activities to their increase demand.
- Ensure more extensive use of OFSP vines and non-commercial roots in the animal feeds industry. For example, the high crude protein content of OFSP leaves at 16% makes them an ideal dairy and pig feed.

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Annexes

Annex 1: Main actors in the OFSP value chain and key survey participants

Key players interviewed and their experiences with OFSP

Group	Mozambique	Tanzania	Nigeria
Advocates	Government on board for long time	High political will and support	Federal and state governments provide funds for OFSP
Managers	High penetration of OFSP; 32% of sweetpotato grown is orange fleshed and is consumed 2–3 times a week. Donor funding was the highest	OFSP is an important co-staple in sweetpotato growing areas. No country studies on OFSP	OFSP included in school meals; Mother's Delight variety is preferred the most
Government staff	Technical secretariat formed for food and nutrition security, chaired by the Prime Minister's office	National biofortification task force formed and working under the Prime Minister's office	No specific task force in place
Policy-makers	Leaders have developed multiple policies	Some relevant policies enacted	Two policies identified for 2016–2025
Breeders	Nineteen varieties have been released and three varieties are to be released in 2019	Five varieties have been released and nine are in the pipeline	Two new varieties are ready for release for a total of four
DVMs	DVMs have started using net tunnels and Triple S technologies. They have a market among relief agencies	DVMs work in groups and rely mostly on wetlands. Drought spells are a major drawback	Women DVMs dominate and make huge profits from vines and roots
Farmers	OFSP is early maturing and high yielding but easily infested by weevils in the field. Storage is difficult		
Traders	Markets are thin and poorly developed		
Processors	Value chains are fragmented and poorly coordinated. Demand for processed products is still low and only three processors exist in the country. Raw OFSP is available in supermarkets	Six processors are present in the country and OFSP products are available in supermarkets	One bakery exists, and most of the OFSP is eaten raw or cooked at home
Consumers	OFSP is low in dry matter; children like the sweetness and orange color, though		

Individuals, groups and farmers interviewed

Country	Interviewee	Position
Tanzania	Joyce G. Lyimo-Macha	SUA TOT Facilitator
	Baraka Paul Mashishanga	Agricultural Officer (SUGECO)
	Misibo Ntirankiza	Agricultural Officer (SUGECO District Coordinator)
	Dr Anna Temu	SUA TOT Facilitator
	Margret Nathaye	Principal Agricultural Officer (Nutrition Focal Point)
	Joseph Massimba	Project Manager (SUGECO)
	Christopher Mussa	Contact Person, VISTA Project
	Jane Mchusi	Farmer selling OFSP along the road
	Dr Elifatio Towo	Head of the Department of Food Science and Nutrition, TFNC
	Richard Y Kasuga	BNFB Senior Country Coordinator
Mozambique	Luize Zikaye	Farmer
	Rosa	Director (SHUNGUIRRAI Association)
	Vashko Joao	Technical Person (SHUNGUIRRAI Association)
	Eldre Jose	Agronomist
	Gaudencio Silota	Researcher
	Dercio Matale	Promotion (RAC)
	Eliah Munda	Senior Agronomist
	Maria Andrade	Country Manager
	Abdul Naico	Project Coordinator/ M&E
	Angela Loforte Remane	Lecturer (Plant Production Department)
	Claudia Lopes	Policy and Planning Director (SETSAN)
	Almeida Tembe	Technician (SETSAN)
Nigeria	A.U. Njoku	Former Chief Executive, ARMTI
	Kwara Agricultural Development Programme Meeting (Bamidtut Gabriel, Fasakin Oluwayemisi, Adu Chomunsile, Abdullateef Oriyomi, Abdullateef Kareem, Adewoge Rasheed and Adeola Adedogwi)	OFSP desk officer at Kwara Agricultural Development Programme, DVMs and farmers
	Iheonu Mary	OFSP vine multiplier and advocate/Federal Capital Territory desk officer
	Uba-Eze Ngozi	OFSP vine multiplier (farmer)
	Nasarawa Church Women Group (Dorothy A. Katampe and other members; Mrs Esther Oloniyo, Mrs Abigail Luther and Alice Austin)	Advocate fellowship (ECIWA)
	Olapeju Phorbee	BNFB Senior Country Coordinator
	Adeola Mojirade Ojo	Pastor, women leader and coordinator of group of teachers in the church, Deputy Director and researcher in Raw Materials Research and Development Council under Department of Agriculture
	Rose-Maria Ekene-Akanisi	Processor
	Festus Aigbedion	Processor, Heritage Potato Chips Company
	Mohammed Ibrahim Ali	Marketer at sweetpotato market, Maraba
	MMA Omonode	Mahauty Health Solutions Company
	Nasarawa Agricultural Development Programme:	Desk Officer, Sweetpotato

Country	Interviewee	Position
	John Ouyeattah (Other members: Gaius Gambo, Christopher Ayas Nuo Kamstakwa, Zuboru Ibrahim, Versco Aviza, Icheen Ngise Nicholas, Esther Adamu, Luka Musa, and Emmanuel Yakubu)	
	Dr Judy Njoku Wedu	Country Agronomist

ARMTI participants of group discussion

Participant	Sex	Position
ARMTI Committee, Nigeria		
Dr O.A. Oladunni	M	Acting Executive Director
Dr A.A. Adeyemo	M	Committee Member
Dr S.T. Toluyemi	M	Member
Olasore Ablodun	M	Chairman
Kingsley O Olurinde	M	Member
Odeseye Abudulhameed	M	Member
Abdullah Mohammed	M	Member
Onkpe Millicent	F	Member
Alakoso Abdul Kareem	M	Member
Aremu Adeola O	F	Member
Charles O. Farayola	M	Member
Mozambique		
Angela Loforte Remane	F	Eduardo Mondlane University
Tanzania		
Prof. Joyce Lyimo-Macha	F	Sokoine University of Agriculture

Trainers who responded to the capacity building questionnaire

Country	Name	Position
Mozambique	Abdorazaque Anza M. Muinde	Executive Director, OLIPA-ODES
	Adolfo Fernando	Agro-Livestock Technician and Field Officer
	Alberto Ndala	Field Technician
	Antonio Mulicote	Community Development Officer
	Erminia Maria Cossa	Average Agronomy Technique
	Ernesto Vasco Magaia	Technical Instructor Pedagogical N2
	Eugénio Paulo Bondem	Extension Worker
	Ezequiel Gomes	Program Manager
	Fernando Assane	Chief Department of Agrarian Extension
	Figueiredo Raimundo Lhongo	Project Officer (HKI, Tete)
	Gaudêncio Silota	Investigator
	Guilherme Paulo Damba	Coordinator of Scientific and Technical Council of the Zonal Center, Northwest Lichinga-Niassa
	Inacio Francisco Massingue	Coordinator
	Isidro Argentina Chemane	University Teacher
	Jaime Pechiço	Agronomist
	João Nhazio Bernardo Eduardo	Technician
	João Romão Sineque	Consultant
	José Mateus Nampunda Júnior	Planning and M&E Officer
	Magno Nhacolo	
	Orlando Mabureza Tuco-Tuco	Investigator
	Peter Lee Thumbo	Agro-Livestock Technician
Nigerian	Balarabe Umar	Asst. Director Crops Research (Adaptive)
	Adegoke Austin Adedamola	Principal Agricultural Officer
	Mrs Onaolapo Morenike.	Program Manager
	Ojetunde E. O	Department Director Extension
	Anim Jerry J	Agriculture Officer
	Dr S.U. Yahaya	Asst. Professor/HOD
Tanzania	Chrispine F. Mabwenga	Field Officer
	Catherine Gwandu	Agricultural Research Officer
	Domina Esther M.Nkuba	Nutritionist
	Josephine Ng'ang'a	Program Leader
	Mary Biswalo Yongolo	Agricultural Research Officer
	Oke Friday Osmond	Monitoring and Evaluation Officer
	Pius Zacharia Nhunda	Agriculture Officer
	Beatrice John Banzi	Agriculture Officer
	Ngato Pamba	Agriculture Officer
	Chrysanthus H. Funda	Agriculture Officer

Annex 2: Interview checklists and guides

Reaching Agents of Change Ex-post Evaluation
Key Informant Questionnaire

(For project managers, human resource staff, M&E officers, partners, field staff etc.)

Name of Respondent: …… **Position:** ……

Project Goal: To evaluate the relevance, effectiveness, efficiency, impacts and sustainability of RAC project that was phased out in August 2015 and document how current activities are enabling more households to continue accessing and consuming OFSP.

Section A. Project partnerships

1. What are the roles of your organization in the RAC Project after its completion in August 2015?
2. How do you describe the level of your organization's involvement in the RAC Project activities now?

Component	**Rating** 1 low, 5 high					**Elaborate**
	1	**2**	**3**	**4**	**5**	
Campaigns for OFSP						
Implementation activities						
Monitoring & evaluation						
Resource mobilization						

3. If your involvement is low in some areas, what are the reasons? What needs to be done then to address the problems faced [Please provide your answers in the space below]?

Section B: Relevance of CIP's RAC Project [Sept 2015-Aug 2017]

1. Has the RAC Project remained relevant after its completion in August 2015?

2. What makes it relevant now?

3. To what extent is the RAC project still suited to the priorities and needs of the target group(s)?

4. Is support to OFSP and other biofortified crops still seen as the best way to eradicate VAD at community and policy levels?

5. What key organizational, national and donor policies continue to support RAC?
   i. Organizational:
   ii. National Policy:
   iii. Donor Policy:

Section C: Implementation and performance of the project

1. In what areas has the RAC Project performed well and which activities have lagged behind over the past 2 years (Fill in the table below)?

Activities	Rank them in order and justify
Most successful activities	1.
	2.
	3.
Activities that lagged behind	1.
	2.
	3.

2. What needs to be done differently in future to accelerate continuation of activities after project completion?

3. What opportunities exist but are underutilized for one reason or the other?

Section D: Impact of the CIP project

1. What has been the gender, income and nutrition impact of the RAC Project over the past 2 years (number of people who have benefited from monetary resources mobilized, number of people trained using training materials and work aids developed, number of people who have received OFSP vines during this period, consumption and sale of OFSP vs. improvements in nutrition and rural economies etc.)? Quantify and disaggregate the results by gender. Provide necessary evidence of the achievements (e.g. M&E progress reports).

2. What would have happened if the intervention stopped after project completion in August 2015?

_____

3. What positive and negative changes have been observed (Sept 2015–August 2017)?

Change	**Example**
Positive change (intended)	
Unintended positive change	
Negative change	

4. What measures can be taken to reduce the negative impacts of similar programs in future, if any?

Section E: Coordination, effectiveness and efficiency of activities

1. Please tick Yes or No to the questions listed in the table below.

Question	**Yes**	**No**
Is coordination of biofortification activities effective among key actors (e.g. IFPRI, CGIAR, CIAT CIMMYT, IITA, Harvest Plus, FARA etc.)?		
Have you learned from or contributed to other biofortified programs?		
Are appropriate communication channels in place?		
Are administrative procedures satisfactory?		
Are stakeholders at different levels aware of program goals?		
Is the OFSP intervention run in an efficient manner (beneficiaries vs. cost)		
Are project activities carried out according to plan and design?		

2. Give specific comments for coordination, administration and efficiency of activities after the RAC project phased out.

3. What needs to be done to achieve collective impact by the key actors? For example, can 1) shared objectives, 2) leveraging of resources to meet common goals, 3) meaningful joint activities, and 4) having a strong backbone/lead organization help to accelerate performance? Please explain what can and cannot work in this regard.

Section F: Best practices learned to date

1. What best practices have been learned from the project over this period? (Fill in the table below)

An example of best practices	
What makes this practice different and innovative?	
How can this practice be replicated more widely?	

2. Give examples of behavioral changes seen after the project ended?

   i. Project staff:

   ii. Beneficiaries:

3. What exit strategies/phase-out plans are in place to allow long-term benefits of project activities?

Section G: Perspectives about OFSP

1. Has OFSP reached the scale we envisaged at the beginning of RAC Project (please explain and provide justification for your answers)?

2. Others argue that 'OFSP is perishable, agroprocessing and value-addition facilities do not exist in Africa, and there is a lack of prioritization of "nutrition" in government-run programs.' What is the situation in this country?

3. How well is research communicated to policy-makers e.g. Do policy-makers access and use research to inform policy?

Section G: Suggestions for future projects

RAC 2 (the Building Nutritious Food Baskets – BNFB) project seeks to reduce hidden hunger by catalyzing sustainable investments for the utilization of biofortified crops (vitamin A cassava, vitamin A maize, vitamin A sweetpotato and iron-rich beans) at scale.

1. What is needed to succeed with such a multi-commodity and multi-institutional program based on the experience from RAC 1 (Provide and justify your answers in the space below)?

2. If investors would ask you how much to invest and for what specific components is more funding required for the multi-commodity BNFB, what would you say (Please provide and justify your answers below)?

3. Howdy Bouis and Nurul Islam suggest three stages of biofortification: 1) adoption by a critical mass, 2) markets developed for a surplus, and 3) private-sector-driven scaling out. At what stage are we with the BNFB project? Which stages are behind and need extra effort in the months to come?

End of questionnaire

Thank you for your time and participation

Reaching Agents of Change (RAC) Ex-post Evaluation

Key Informant Checklist 2

[For DVMs, trainers, trainees, CIP managers, gender coordinators, field workers etc.]

RAC specific objective 1: Advocate for new investments (at least US$ 18 million) and policy reform and the inclusion of OFSP in national, regional, and sub-regional policy agendas in support of OFSP.

1. Of what use has been the investment money generated, e.g. US$ 13,342,550.50 in Mozambique, US$ 4,033,501.50 in Tanzania and US$ 1,262,479.42 in Nigeria?
2. To what extent have the investments mobilized resulted in projects and interventions that seek to address gender issues in relation to the access to and consumption of OFSP? What is the disaggregation of data by gender relating to the benefits from these investments?
3. How have the advocacy materials developed (fact sheets, flyers, posters and promotional materials e.g. t-shirts, bags, neckties) addressed gender issues related to production, access and consumption of OFSP?
4. What financial resources have been mobilized after project closure and who requested and provided the support?
5. Are these resources used in the most efficient and cost-effective manner to reach the intended beneficiaries?

RAC specific objective 2: Build institutional capacity of national implementing agencies to design and implement technically strong, gender-sensitive and cost-effective interventions that drive the uptake of OFSP.

Under seed systems, RAC facilitated the production of clean planting materials (OFSP vines) by decentralized vine multipliers (DVMs) for widespread distribution, including spearheading the release of two OFSP varieties.

1. To what extent have the DVMs continued to multiply and distribute seeds?
2. To what extent are men and women involved as DVMs after RAC Project closure?
3. What is the gender composition of those who have remained and those who have dropped out? What are the gender-related opportunities and obstacles?
4. Is there evidence that more households are obtaining and consuming OFSP because of the seed system that was established by RAC? Are there any similarities between men-headed and women-headed households regarding this?
5. What is the perception of trainers on the gender module that was developed? Does it add value? If so what value does it add? And how has it been used during training?
6. What materials from RAC have you used besides the gender module?
7. What is particularly useful in them? What is lacking?
8. In the light of your experience, what more do you need or how could they be improved.
9. If you were asked to intervene on behalf of biofortified cassava, wheat, rice, maize, or beans what additional materials would you need to have (and why)?

Reaching Agents of Change (RAC) Ex-post Evaluation

Lessons learned and best practices checklist

Coverage: September 2015–August 2017

[Participants: Project and Partner Staff]

Organization name: _____

Project name: _____

Project description_____

Date: _____

The lesson learning exercise will help project teams share their knowledge and experience with colleagues for the benefit of the entire organization. Continuous learning means avoiding unnecessary problems, unwanted outcomes and inefficiencies, as well as repeating successes.

Respondent's Name: _____

1. Please document three significant challenges faced in the past 2 years of RAC Project and the solutions offered, if any.

Challenge/lesson learned (present them in order of their importance)	Solutions/successes
1.	
2.	
3.	

2. What are the three main areas that need improvement:

Lesson Learned (present them in order of their importance)	Details and impact
1.	
2.	
3.	

Reaching Agents of Change (RAC) Ex-post Evaluation

Case Study Checklist

[Project Beneficiaries]

[Ask for permission to take photos to serve as evidence]

Questions

1. Please give a brief background on yourself and your household.
2. How have you been benefiting from RAC from Sept 2015 to date (Probe for more information)? What was the situation like before and after the project? What changes are there now attributed to activities that have taken place after the project ended?
3. What are the specific examples of success of the RAC Project for your household? How is the project still benefiting specific members of the household?
4. How different are you compared to households that are not benefiting from the OFSP intervention?
5. What would happen if this project had stopped completely in August 2015?
6. What about processing, value addition of OFSP and marketing? Have these activities benefited your household in any way? Please give specific examples. What are the markets for OFSP? Who buys? Where do they sell it?
7. What is working well and what is lagging behind? What are the challenges you are facing and how are you addressing them?
8. Describe your household before the RAC project.
9. What is your message to CIP? What are your recommendations for similar projects in future?
10. Ask for permission to visit their OFSP multiplication, production and value addition sites.

Annex 3: Penetration and time trajectory of OFSP in SSA

Year	Organizations	Theme	Events
Late 1980s to early 1990s	CGIAR centers	Research and agronomy	Breeding OFSP varieties in Peru and sending them to SSA for evaluation
Early 1990s	International Center for Research on Women, International Potato Center (CIP) and Kenya Agriculture Research Institute (KARI)	Research, extension and nutrition	OFSP research to develop new varieties and test uptake among women groups after receiving extension and nutrition education
	McKnight Foundation provided financial support to the Ugandan program from 1994 through 2014	Research/breeding work	During early 1990s, only two SSA countries were carrying out breeding work, Uganda and South Africa. The Ugandan national program started breeding OFSP in 1991
2001	CIP and Vitamin A for Africa (VITAA)	Nutrition	VITAA (coordinated by CIP in SSA) was created as a platform to raise awareness and exchange lessons from five countries – Uganda, Kenya, Tanzania, Mozambique and Ethiopia
2002	CGIAR centers	Research, agronomy, food security and nutrition	Several new OFSP varieties bred in Peru arrived in SSA in 2002 and performed poorly under the high virus pressure conditions
2002–2005	USAID and Micronutrient Initiative in South Africa; Towards Sustainable Nutrition Improvement (TSNI) project in Mozambique; and the Reaching End Users project (REU) implemented by HarvestPlus in Mozambique and Uganda	Efficacy studies	First OFSP efficacy studies were conducted among school children and mothers to measure vitamin A status. Vitamin A intake and status increased significantly in these studies.
	USAID, the National Institute for Agricultural Research (INIA), the Southern Africa Root Crops Research Network (SARRNET) and the Government of Mozambique	Research and food security	Distribution of OFSP as a disaster-response crop in 65 out of 128 districts of the country and as part of development efforts
2002	CIP	Agronomy	Toward the end of 2002 CIP introduced 42 new varieties of OFSP in SSA. These varieties were high in beta carotene and in dry matter (30–38%) and were high yielding
2005	CIP	Research and agronomy	Development of the accelerated breeding scheme (ABS), which uses several sites at the early stages in breeding, permitting faster selection. This reduced the time from crossing to release from 8–9 years to 4–5 years.
	Rockefeller Foundation	Research	Four years of support for breeding in Mozambique
2009–2014	Bill & Melinda Gates Foundation and CIP	Research, breeding and nutrition	Bill & Melinda Gates Foundation funded CIP to lead the implementation of the five-year Sweetpotato Action for Security and Health in Africa (SASHA) project, the largest investment in sweetpotato

Year	Organizations	Theme	Events
			research ever made in SSA (US$ 22.5 million). The grant supported the establishment of advanced breeding (population development) programs in 3 subregions to address virus resistance, drought tolerance and quality (a non-sweet sweetpotato); seed system research, and further research on delivery models
2011–2015	Bill & Melinda Gates Foundation and CIP	Policy, investments, demand creation, capacity building and nutrition	Bill & Melinda Gates Foundation funded CIP and HKI to implement the RAC Project in five countries of Africa
2014–2018	Bill & Melinda Gates Foundation and CIP	Research, breeding and nutrition	The SASHA Project was renewed for a second five-year phase in 2014, with postharvest research substituting delivery system research
2009–2020	CIP	Awareness, extension and nutrition	The SASHA support enabled CIP to launch, along with 26 partners, the Sweetpotato for Profit and Health Initiative (SPHI), a multi-partner, multi-donor initiative with the goal of reaching 10 million households by 2020 in 17 target SSA countries with improved varieties of sweetpotato to achieve widespread uptake that will significantly reduce malnutrition among young children
2015–2018	CGIAR centers	Policy, research and farm trials	The Building Nutritious Food Baskets (BNFB) project to reduce hidden hunger by catalyzing sustainable investment for the production and utilization of multiple biofortified crops

Annex 4: Success story of ARMTI documented by CIP

Accessed here http://www.sweetpotatoknowledge.org/files/sucesss_armti_cs6-ai/

"Take lead – take off" Approach to Capacity Development for Sustainability and Impact:

A success story of the Agricultural and Rural Management Training Institute in Nigeria

"Agricultural and Rural Management Training Institute (ARMTI) has partnered with International Potato Center (CIP), through the Reaching Agents of Change (RAC) and Jumpstarting Projects. These partnerships have helped to build the capacities of the staff that participated in these projects and helped ARMTI in achieving some of her agricultural and rural development mandates".

Dr. O. A. Oladunni, Ag. Executive Director, ARMTI, Nigeria

Figure 1 ToTs at ARMTI

The Agricultural and Rural Management Training Institute (ARMTI) is a parastatal organization under the Federal Ministry of Agriculture and Rural Development of the Federal Government of Nigeria. ARMTI is situated in Ilorin Kwara State of North Central Nigeria. It is a center of excellence for agricultural and rural development (ARD) management training and ARD manpower development in Nigeria in general. The work of ARMTI serves very well to demonstrate emerging impact and sustainability of the foundation laid by the Reaching Agents of Change (RAC) project's capacity development efforts.

Between 2011 and 2014, the International Potato Center (CIP) and Helen Keller International (HKI) implemented the RAC initiative that advocated for increased investment in orange-fleshed sweetpotato (OFSP), to combat vitamin A deficiency among young children and women of reproductive age and to develop institutional and community capabilities to produce and consume OFSP. To ensure sustainability, RAC strengthened the capacity of national institutions like ARMTI, Sokoine University of Agriculture (Tanzania) and Eduardo Mondlane University (Mozambique), and that of individual change agents. The aim was to enable them self-organize, drive their own agenda, mainstream the OFSP training program into their activities, and pass down the skills acquired to the end-users – the small-scale farmers.

The RAC project worked closely with ARMTI in planning and delivering the Training of Trainers (ToT) courses on "Everything you ever wanted to know about sweetpotato" using adult learning methodologies. This was achieved through a collaborative agreement that was successfully implemented between December 2012 and July 2014. The ToT course is a hands-on course that comprises of fourteen topics on sweetpotato knowledge along the value chain, including production, utilization and investment in sweetpotato.

To reach a critical mass producing and consuming OFSP, RAC applied a "cascading" model for capacity development, where experts (agriculturalists, nutritionists, health, marketing and

COMBATING HIDDEN HUNGER THROUGH NUTRITIOUS FOOD BASKETS

gender experts) attended a 10-day workshop facilitated by CIP, HKI, ARMTI and other national experts. These experts became the primary facilitators who in turn facilitated shorter and contextualized ToTs to various levels of audiences (secondary and tertiary). This upscaling approach ensured that the training was cascaded down to farmer trainers who finally trained the end users in their communities as illustrated in figure 1.

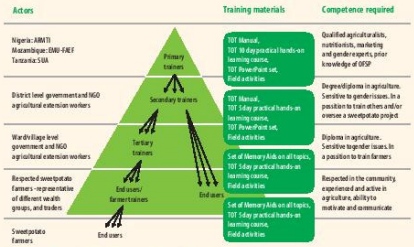

Figure 2 Cascading Approach to Capacity development

In the first year (2012); the RAC project specialists (CIP and HKI) led the process of organizing and conducting the ToT course while the national counterparts from ARMTI backstopped the process. In the second year (2013), the national counterparts from ARMTI took lead in organizing and conducting the training while the RAC project specialists backstopped. By the third year (2014), ARMTI's capacity was developed and they organized and conducted the ToT course on their own with the RAC project team acting as observers and only offering partial financial support as illustrated in figure 2.

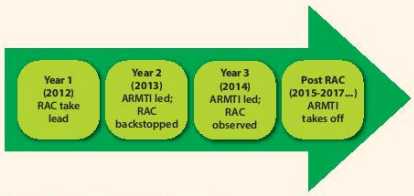

Figure 3 "Take lead – take off" Approach

'Take off' Post RAC

Post RAC project implementation (2014 onwards), ARMTI's capacity was fully developed and the ToT course was domiciled in ARMTI and they now took complete charge of running the course on a full-cost-recovery basis. ARMTI established and maintained demonstration OFSP plots for field practical exercises during the ToT courses. However, this was not without challenges; for example, in the first attempt to run the course in March 2015, there were no applicants (with funding) despite efforts to advertise the course extensively within and outside Nigeria and subsidizing the tuition fee specially to attract national participants. The second attempt in October 2015 yielded some success attracting six participants. This prompted ARMTI to become more innovative in mobilizing resources to support the course and ensure that the OFSP course remained a priority, and was fully integrated into ARMTI's programs.

ARMTI management developed a proposal to mobilize resources to run the course under ARMTI's Human Capacity Development Capital Project and submitted it to the Federal Government of Nigeria. These efforts yielded results and in 2016, when the Federal Ministry of Agriculture and Rural Development approved funding of 16,500,000 Naira (equivalent to USD 54,635.76 at a rate of $1 to N302), which was included in the 2016 ARMTI's Human Capacity Development Capital project. Through this support, ARMTI was able to run two more ToT courses – the first in December 2016, and the second in March 2017. In these two courses, ARMTI trained up to 53 (12 female) agents of change on "Everything you ever wanted to know about sweetpotato. This brings to a total 138 (42 female) agents of change (national and international) that have been trained through ARMTI between 2012 and 2017, reaching over 21 states of Nigeria (see table 1).

The national participants were mainly drawn from six states, which are high producers and consumers of sweetpotato i.e. Kwara, Osun, Ebonyi, Kaduna, Benue and Nasarawa. The first cohort of ToTs trained in December 2016 included four new States i.e. Kogi, Oyo, Abia and Kano States as well as Capital Territory; while the second cohort trained in April 2017 included Bauchi, Gombe, Plateau, Niger, Taraba, Anambra, Delta, Rivers, Akwa Ibom, Ekiti, and Ogun States. These new states have great potential for sweetpotato production and consumption and it is expected that more states will be included in subsequent courses to eventually cover all the states in Nigeria.

Table 1: Breakdown of ToT Participation 2012-2017

Year	Number of Participants	Sex		Nationality	
		M	F	Nigerian	International
2012*	20	12	8	20	-
2013*	28	17	11	24	4
2014*	31	21	10	22	9
2015**	6	5	1	6	-
2016*** 1st Batch	32	25	7	32	
2017*** 2nd Batch	21	16	5	21	-
Total	**138**	**96**	**42**	**125**	**13**

*conducted under RAC funding, **conducted on cost-recovery basis, ***conducted under 2016 ARMTI's capital project and cost-recovery basis

ARMTI plans to continue with this sustainable capacity development initiative and to attract more funding from the Federal Government of Nigeria; this way reaching more agents of change; impacting on local institutions and farmers to produce and consume the vitamin A-rich OFSP. Catalyzing demand and investment for OFSP while strengthening institutional and community capacities, is critical to addressing hidden hunger by reaching more households in Nigeria to produce and consume biofortified crops.

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Building Nutritious Food Baskets

The Building Nutritious Food Baskets: Scaling up Biofortified Crops for Nutrition Security seeks to reduce hidden hunger by catalyzing sustainable investment for the production and utilization of biofortified crops (Orange-fleshed sweetpotato (OFSP); vitamin A (yellow) cassava, vitamin A (orange) maize and high iron/zinc beans) at scale. The project is implemented in **Nigeria** and **Tanzania**, to demonstrate how biofortified crops can be scaled up through a multi-crop ("food basket") approach. BNFB draws on complementary expertise for scaling up through a partnership between CGIAR centers and programs, regional organizations and other public and private sector agencies to create a movement that will eventually reach the target populations. BNFB's hypothesis is that scaling up is dependent on supportive policy environment, strong institutional capacities and availability of proven technologies.