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Transforming Agriculture for Improved Livelihoods

Scaling up Dissemination and Adoption of Agricultural Technologies using Innovation Platforms—Lessons from Eastern and Central Africa

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Northern Zone Agricultural Research and Development Institute


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Abbreviations and acronyms

ACKWRCCS	Anglican Church of Kenya, Western Region Christian Community Services
ACMD	African Cassava Mosaic Disease
ADP	Area Development Programme (World Vision)
AEASA	Agricultural Economist Association of South Africa
AIC	African Inland Church
AFANET	Aboke Farmer Field School Network
AFRST	Agency for Sustainable Rural Transformation
AfDB	African Development Bank
AIS	Agricultural innovation systems
AKIS	Agricultural Knowledge Information Systems
AMPV	Projet d'Appui à l'Amelioration de la Production Vegetale
APSKO	Association des Producteurs de Semences du Kasai Oriental
APVC	Agricultural Product Value Chain
ARD	Agricultural Research Development
ARDAP	Appropriate Rural Development Agricultural Programmes
ASA	Agricultural Seed Agency
ASS	Appui au Secteur Semencier
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
BDS	Business Development Services
BMI	Body Mass Index
CBO	Community Based Organization
CBSD	Cassava Brown Streak Disease
CDM	Catholic Diocese of Muranga
CENADEFRUC	Centre National de Developpement de la femme rurale au Congo
CIMMYT	International Maize and Wheat Improvement Center
CIP	International Potato Centre
CML	CIMMYT Maize Line
CGIAR	Consultative Group for International Agricultural Research
CGIFD	Camkwoki Grassroots Initiative for Development
CREADIS	Community Research in Environment and Development Initiatives
CRS	Catholic Relief Service
DALDOs	District Agricultural and Livestock Development Officers
DED	District Executive Director
DETREC	Development Training and Research Centre
DRC	Democratic Republic of Congo
DONATA	Dissemination of New Agricultural Technologies in Africa
ECA	Eastern and Central Africa
FARA	Forum for Agricultural Research in Africa
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agricultural Organization Statistics
FCI	Farm Concern International
FFS	Farmer Field School
FPPM	Food Production, Processing and Marketing
FTC	Farmer Training Centre
GAP	Good Agricultural Practices
GFE	Grain and Flour Enterprises
GOK	Government of Kenya

GM	Genetically Modified
GMO	Genetically Modified Organism
Ha	Hectare
HEFO	Health Foods
HKI	Helen Keller International
IAR4D	Integrated Agriculture Research for Development
INERA	Institut National pour l'Etude et la Recherche Agronomiques
IP	Innovation Platform
IPTA	Innovation Platform for Technology Adoption
I.S.E.A	Institut Supérieur d'Etudes Agronomiques
ISTM	Institut Supérieur des Techniques Medicales
KACE	Kenya Agricultural Commodity Exchange
KARI	Kenya Agricultural Research Institute
KEPHIS	Kenya Plant Health Inspection Service
KH	Kenya Hybrid
KHCP	Kenya Horticultural Competitiveness Project
KIWAMMU	Kikundi cha Wakulimawa Mbegu Muheza
KST	Kolping Society of Tanzania
LZARDI	Lake Zone Agricultural Research and Development Institutes
M&E	Monitoring and Evaluation
MAHUDE	Majasio Human Development
MICS:	Multiple Indicator Cluster Survey
MNPSCL	Mid-North Private Sector Company Limited
MOA	Ministry of Agriculture
MoH	Ministry of Health
MOU	Memorandum of Understanding
MRHP	Mwanza Rural Housing Programme
MSME	Micro Small and Medium Enterprise Consult
MT	Metric Tonne
MMA	Medium Mid-Altitude
MNPSCL	Mid North private Sector Company Ltd.
MoAL&F	Ministry of Agriculture, Livestock and Fisheries
NAAPE	Nen Anyim Agro Processor's Entrepreneur
NARIs	National Agricultural Research Institutes
NARO	National Agricultural Research organization
NARS	National Agricultural Research Stations
NCPB	National Cereals and Producer Board
NEHCIP	Nabwabini Environmental Health care intervention project
NFFSN	Ngetta Farmer Field School Network
NgeZARDI	Ngetta Zonal Agricultural Research and Development Institute
NGO	Non-Governmental Organisations
OFSP	Orange-Fleshed Sweet Potato
OPV	Open Pollinated Varieties
PALWECO	Programme for Agriculture and Livelihood in Western Communities
PMCA	Participatory Market Chain Approach
PRESAR	Projet de Réhabilitation du Secteur Agricole et Rural
PS	Primary School
PMS	Primary Multiplication Site
PSTAD	Promotion of Science and Technology for Agricultural Development
PVS	Participatory Variety Selection
QDS	Quality Declared Seed

QPM	Quality Protein Maize
RAB	Rwanda Agriculture Board
RAILS	Regional Agricultural Information and Learning Systems
RDA	Recommended Daily Allowance
REFSO	Rural Energy and Food Security Organization
RUCEC	Rural Community Empowerment Centre
RFA	Radio Free Africa
RTNC	Radio Télévision Nationale du Congo
SENASEM	Service National des Semences
SIDO	Small Industry Development Organization
SLEM	Support to Local Economy in Mwanza
SMS	Secondary Multiplication Sites
SPVD	Sweet Potato Virus Disease
SROs	Sub-regional Research Organizations
SSACP	Sub-Saharan Africa Challenge Programme
TAHEA	Tanzania Home Economics Association
TBS	Tanzania Bureau of Standards
TCRS	Tanzania Catholic Refugee Services
TFDA	Tanzania Food and Drug Authority
TMS	Tertiary Multiplication Sites
TOSCI:	Tanzania Official Seed Certification Institute
ToT	Trainers of Trainers
TRAC-MINISANTE	Treatment and Research on Aids, Malaria, Tuberculosis and other epidemics
URCS	Uganda Red Cross Society
URCSL	Uganda Red Cross Society Lira Branch
USAID	United States of America International Development
VC	Value Chains
VITA	Vitamin A for Africa
VAD	Vitamin A Deficiency
WHO	World Health Organization
WS	Western Seed
WV	World Vision

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Foreword

How to address poverty and food insecurity through the increased use of research outputs is one of the biggest challenges facing agricultural research and development (ARD) practitioners in Africa. While there are numerous technologies able to increase agricultural productivity, their adoption is very low. Such low adoption translates into perpetual low agricultural productivity and insecure livelihoods. In the past, technology generation and dissemination methodologies have been dominated by top-down and linear approaches, where technologies are extended from research to extension and then to farmers. It is now realized that such linear approaches are not effective. This realization has caused practitioners to seek out alternative approaches to technology generation, dissemination processes and uptake pathways. Among such alternatives is the use of multi-stakeholder innovation platforms (IP), which are based on agricultural innovation systems (AIS) approach and value chain (VC) framework. However, many NARS stakeholders are facing the challenge of how to translate the theory and concepts around the AIS and IPs into practical operational models.

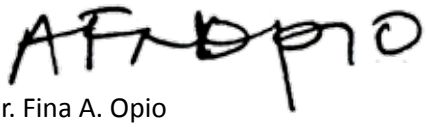
Between 2008 and 2013 the Association for the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), was coordinating and providing leadership in the implementation of a project called "Dissemination of New Agricultural Technologies in Africa" (DONATA) across six countries in eastern and central Africa. The approach in DONATA was the innovation platform for technology adoption (IPTA). At the start of the project, there were very limited documented practical experiences and lessons from which to draw guidance for the implementing teams comprised of national agricultural research systems (NARS). Therefore, an inherent objective in the project was to document achievements, experiences and lessons learned on how the IPTA approach was used to disseminate technologies on orange-fleshed sweet potato (OFSP) and quality protein maize (QPM).

The DONATA experiences, the synthesis of lessons and guiding principles presented in this book are therefore a contribution to the growing body of knowledge on the application of IP and value chain framework in AR4D in the region. The information shows how the DONATA project teams in ECA have used the AIS theoretical concepts to establish and manage innovation platforms to disseminate and scale out OFSP and QPM technologies. ASARECA envisages that stakeholders within the region will find the book useful in their efforts to increase the spread and impact of science and technology in smallholder agriculture.

About ASARECA

The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) is a not-for-profit sub-regional organization comprising 11 countries: Burundi, the Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, South Sudan, Sudan, Tanzania and Uganda. Its mission is: *To enhance regional collective action in agricultural research for development, extension and agricultural training and education to promote economic growth, fight poverty, eradicate hunger and enhance sustainable use of resources in ECA.*

ASARECA brings together scientists and other partners to generate, share and promote knowledge and innovations to solve common problems in agriculture in member countries and contribute to productivity and growth of the sector. Its partners include farmers, national, regional and international research, extension, and training organizations, public and private sector actors, non-governmental organizations (NGOs) and development agencies



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Scaling up Dissemination and Adoption of Agricultural Technologies using Innovation Platforms—Lessons from Eastern and Central Africa

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Introduction

One of the biggest challenges facing research and development practitioners in Africa is how to address poverty and food insecurity through the widespread adoption and impact of appropriate agricultural technologies. There are numerous technologies that are able to increase agricultural productivity, and improve food, nutrition and income security. However, adoption of many of the technologies is very low. The outcome of such low adoption of available proven technologies and practices is manifested in perpetual low agricultural productivity and insecure livelihoods. In the past, technology generation and dissemination methodologies have been dominated by a top-down and linear approach, with technologies being extended from research to extension to farmers. It is now recognized that the real world is increasingly complex and dynamic, with different types of risk including climatic conditions, market and economic unpredictability and social change. Moreover, it is known that there is increased interdependency and interactions between livestock and crops and between agriculture and other sectors. Also the heterogeneous range of stakeholders mean that innovation and knowledge could originate from many different sources and therefore agricultural research and development (ARD) practitioners would need to work with diverse stakeholders, at different levels and scales, sometimes simultaneously to be effective. This recognition has led practitioners to seek out alternative approaches to technology generation, dissemination processes and uptake pathways, including the implementation of innovation platforms (IP) based on an agricultural innovation systems (AIS) approach and value chain (VC) framework.

As ARD stakeholders look for and try out alternative approaches, questions and discussions about their effectiveness have come up as well as concerns about limited empirical examples to learn from, especially on how to operationalize these concepts. Critiques of the innovation systems approaches in particular, point out various challenges associated with them, for example: the different type of capacity strengthening required; the longer time-frame needed for partnering processes to take root; the high costs in bringing together multiple and diverse value chain actors (Spielman, 2006; Hartwich et al., 2007). They also note the challenges around measuring whether such an approach actually brings greater benefits (in terms of improved food and income security) to different types of farmers. An example of the quest for alternative ARD approaches is the Sub-Saharan Africa Challenge Programme (SSACP) proof of concept research on the integrated agricultural research for development (IAR4D) concept and innovation platform approach initiated by the Forum for Agricultural Research in Africa (FARA) and implemented by various Consultative Groups on International Agricultural Research (CGIAR) centers. From its inception phase and throughout implementation the SSACP created considerable expectations in terms of its potential as an alternative (ARD) framework that could bring together key disciplines and other elements important for sustainable productivity and livelihood of African smallholder farmers. This interest and discussion has prevailed among the community but little empirical evidence emerged in terms of both perceived benefits and practical experiences that could provide better understanding of how to implement this concept (Lynam J, et al. 2010).

1.1 Background to the DONATA project

This book presents practical experiences, which contrast the application of one type of innovation platform approach which was used to catalyze the adoption and scaling up of Quality Protein Maize (QPM) and Orange-fleshed Sweet Potato (OFSP) technologies in Eastern and Central Africa (ECA). The experiences are based on four and half years' implementation of a project known as "Dissemination of New Agricultural Technologies in Africa" (DONATA), which applied the innovation platform for technology adoption (IPTA) approach. DONATA was one of two components of a continent-wide programme known as "Promotion of Science and Technology for Agricultural Development in Africa" (PSTAD). The other component was "Regional Agricultural Information and Learning Systems" (RAILS). The two components were designed to complement each other whereby RAILS provided a web-based portal through which knowledge generated through DONATA would be disseminated widely. PSTAD was supported by the African Development Bank (AfDB), through the Forum for Agricultural Research in Africa (FARA). The sub-regional research organizations (SROs) managed and oversaw implementation of DONATA and RAILS in their respective sub-regions. Thus, the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) provided guidance, coordinated and oversaw implementation of DONATA in the eastern and central Africa (ECA) sub-region. FARA provided guidance and an elaboration of the IPTA approach at the inception of the project and arranged for experience sharing on the application of the approach across the sub-regions through regional workshops. During the workshops, M&E experts from the Natural Resources Institute (NRI) contributed to the discussions and lessons on establishment and running of the IPTAs in the different sub-regions.

In ECA, the national agricultural research institutes (NARIs) working with local partners who include non-governmental organizations (NGOs); community based organizations (CBOs); university; public extension and private sector were the primary implementers of DONATA at the country level. Technical backstopping from the relevant Consultative Group for International Agricultural Research (CGIAR) institutions was provided. Since in the ECA sub-region, DONATA was promoting QPM and OFSP technologies, the International Maize and Wheat Improvement Centre (CIMMYT) and the International Potato Centre (CIP) provided the technical backstopping respectively. The target countries for the promotion of OFSP technologies were Ethiopia, Kenya, Tanzania, Rwanda and Uganda, whereas for QPM technologies the Democratic Republic of Congo (DRC), Kenya, Tanzania and Uganda participated.

In ECA, the goal of DONATA was *increased production, consumption, and marketing of QPM grain and seed, OFSP fresh roots, vines, and processed products, which would bring about improved food security and nutrition as well as increased incomes, all of which would contribute to improved livelihoods of communities in the target countries.* This would be realized as a result of successful dissemination, adoption and scaling out of QPM and OFSP technologies, which would eventually contribute to increased productivity. The project used an approach referred to as 'innovation platform for technology adoption' (IPTA) to enhance the target communities' access to technology, especially quality seeds, information and relevant markets and also to build their capacities to utilize these.

An IPTA is a forum for partners with a common objective to improve agricultural production and services through analysis of constraints and planning of interventions using a value chain approach. The platform members in general are comprised of representatives of farmers and farmers' organizations, extension services, agro-processors, marketers, agribusiness, transporters and research. In this context, the multi-stakeholder approach was thought to offer an advantage in terms of providing a framework for interaction among stakeholders along the commodity value chain and in some cases even beyond the agricultural sector to other sectors relevant for impacting on livelihoods. Another advantage came from its underlying key philosophy in that it provides a space for information, knowledge and experience sharing and learning among the platform actors or stakeholders. The information and knowledge exchange and learning among stakeholders in turn would serve as a catalyst for

innovation such as production of new products, new ways of organizing producers and processes for them to access markets and other services and desired outcomes.

The experiences from DONATA contribute to an emerging body of knowledge on application and outcomes of alternative ARD frameworks such as the multi-stakeholder approaches. However, these lessons and experiences are at best examples of work in progress, which as noted in the SSACP evaluation report, more time and work is needed to continue learning about the IAR4D framework and innovation platform approach (Lynam J, et al. 2010). The experiences on establishment and evolution of the innovation platforms and the outcomes achieved add to this knowledge. For example, they show that the IP approach has advantages such as in reaching beyond the production phase of agriculture along the value chain, and even beyond the agricultural sector to other sectors such as health, nutrition and education. However, unlike the SSACP, DONATA was not conceived as an experiment to test the IPTA approach. Rather, it was implemented in the broader context of the PSTAD programme whose focus was promoting the dissemination and adoption of new and emerging technologies able to contribute to productivity and welfare of smallholder farmers. Therefore, the data collected and used in the country case studies are not sufficient to allow a statistical comparison between the IPTA methodology and the conventional R&D in terms of efficacy or cost effectiveness.

1.2 Organization of the book

The book is organized into three parts. Part I reviews some of the literature around the agricultural innovation systems (AIS) and value chain (VC) frameworks and how theoretical contributions have informed the application of the IPTA approach under DONATA project. It describes the AIS and VC theoretical frameworks and how these were applied in respective contexts of the two commodities to design, establish and implement the IPTAs.

Part II has 19 case studies, which provide an in-depth description of country experiences from DRC, Ethiopia, Kenya, Rwanda, Tanzania and Uganda on their application of the IPTA approach to disseminate and facilitate adoption of QPM and OFSP technologies. They examine different country and commodity experiences in the formation and evolution of the IPTAs and the achieved outcomes. The case studies are clustered into four themes derived from the functional areas or segments of the commodity value chain. These themes are *(i) Seed systems* whose focus is to address challenges associated with ensuring farmers' access to quality seed or planting materials; *(ii) Grain and root production*, which reviews issues around increasing QPM grain and OFSP fresh roots production; *(iii) Product transformation and marketing* where the focus is on value addition to produce products for home use, for agro-enterprise development and addressing issues on market access and marketing; and *(iv) Utilization of QPM and OFSP for nutrition and health,* which describes how the approach was used to enhance adoption for improvement of nutrition and health of target communities. Organizing the country experiences into these themes allowed a reflection on the IPTA approach and how it functioned to support dissemination and scaling up of technologies and innovations that targeted different nodes of the value chain and for achievement of various desired outcomes.

Part III draws an analytical synthesis of the different country experiences and discusses similarities and differences in the way the innovation platforms have functioned and supported scaling out and up of technologies for each crop and how these processes contributed to observed outcomes. Like Part II, the synthesis is also organized into the four thematic clusters. Part III also discusses the regional institutional coordination and capacity strengthening, which supported learning and innovation, and the reported functioning and performance of the platforms. It then pulls together lessons learned in order to bring out some key guiding principles on the application of this approach for dissemination and scaling out of technologies.

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PART I

Approach and Processes

2. Innovation Platform for Technology Adoption (IPTA): Approach and Processes[1]

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2.1. An innovation system: theoretical contributions

An innovation system has been defined as a network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect their behaviour and performance. The innovation systems concept embraces not only the science suppliers, but also the totality and interaction of actors involved in innovation. It extends beyond the creation of knowledge to encompass the factors affecting demand for and use of knowledge in novel and useful ways (World Bank 2006). In our view, the innovation system provides the conceptual framework and theoretical basis for the establishment and functioning of an innovation platform.

The innovation systems framework developed by Arnold and Bell in 2001 (World Bank 2006) focuses on six major domains. The first three consist of: the demand domain comprising producers (e.g. farmers) and consumers who are crucial as sources of innovation and in guiding the direction of innovation; the education and research domain, and the business and enterprise domain. These are linked by a fourth domain, which consists of the intermediate or bridging organizations that support the flow of knowledge between the other domains. The final two domains incorporate infrastructure related elements (e.g. banking and business support systems) and the external environment which provides the enabling conditions and incentives for innovation.

Spielman and Birner (2008) also describe an agricultural innovation system as consisting of similar interrelated domains. However, in their description they identify five domains whereby the producers and consumers (demand domain) are combined with agribusiness actors to form one domain, which they call the "business enterprise domain". In their perspective, this domain, which is an expanded form of the "demand domain", also includes the activities these actors undertake. Thus, Spielman and Birner see the business enterprise domain to be made up of value chain actors and the activities that use outputs from the knowledge and education domain. The value chain actors include input suppliers; agricultural producers; processors; market actors (wholesalers, brokers and retailers) and consumers. In their description of an AIS model, Spielman and Birner (2008) expound further on enabling environment and supportive domains. Besides policy, the enabling conditions include institutions, which can be formal or informal (practices, behaviours, attitudes) organizations-culture, learning, orientation and communication practices. The supportive domain of resources includes ecology; climate; land; capital; human resources; gender relations and other social dimensions. Fig. 1 shows the domains and their interconnecting linkages.

[1] An earlier version of this chapter, which included achievements and lessons, was presented at the FARA PSTAD Mid Term Review Workshop; 24-28 January 2011, in Accra, Ghana. In this book, this chapter focuses only on how the IPTA approach and processes were operationalized.

A key feature of an innovation system is the interaction among a range of actors, which can be from public and private sectors, and civil society organizations. The multiple directions of the arrows in Fig. 1 emphasize the necessary interactions among actors. These interactions produce a collective outcome around the technology, which may include innovation, adaptation and adoption (Porac et al., 2001)

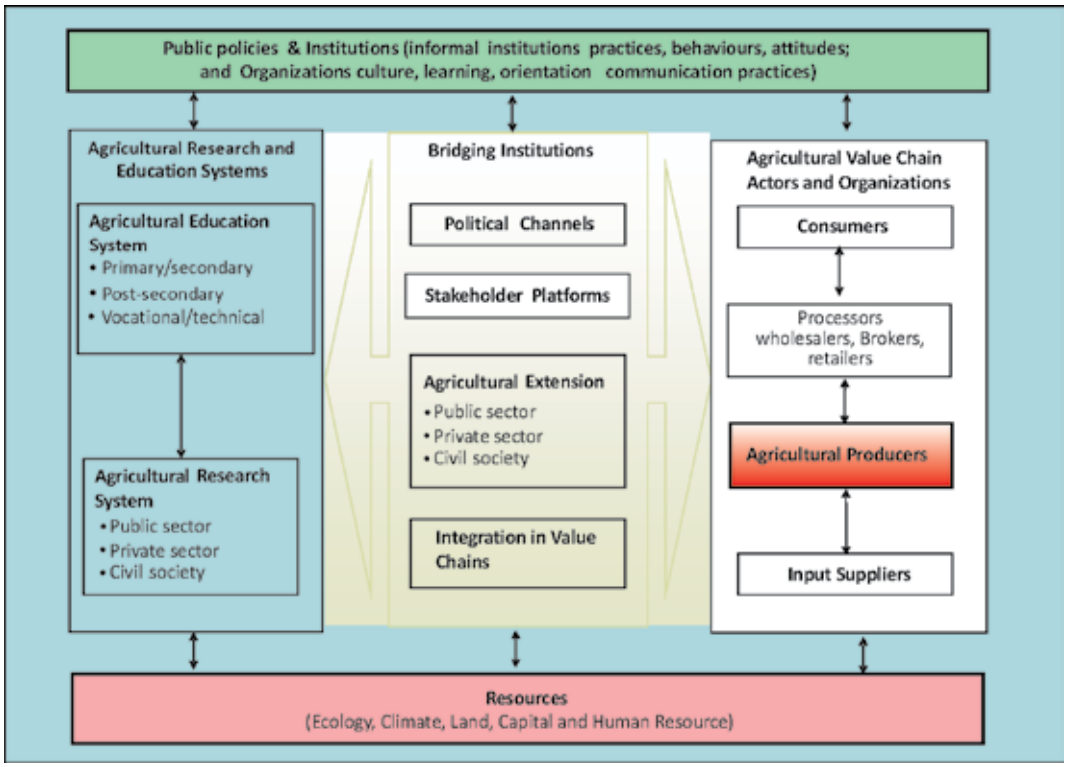

Figure 1. AIS framework (Spielman and Birner. 2008)

The actual actors and their functions depend on the context, drivers, and goal of the innovation system. There may be different drivers of the innovation system who could be market or non-market drivers. An agricultural product value chain (APVC) is an example of a market driven innovation process where the actors interact through the market. However, a market driven innovation system may not necessarily have as its goal to benefit small-scale farmers or have a pro-poor impact. Kaplinsky and Morris argue that in the context of globalization and the disjuncture between market integration versus the extent to which people gain, value chain analysis can identify where upgrading may have the most pro-poor impact (Kaplinsky and Morris, 2000). The Participatory Market Chain Approach (PMCA) (Bernet et al., 2006) is one pro-poor value chain approach, which differentiates itself from other approaches by its focus on stimulating innovation and long-term partnerships among farmers, market agents and service providers. In this way it emphasizes the importance of social capital formation. By social capital we mean the norms, values attitudes and beliefs that predispose people towards collective action as well as rules, procedures, precedents and social networks (Devaux et. al 2009). The interactions among stakeholders stimulate social learning, which in turn builds social capital and an environment for joint activities (McEwan, 2009). Hall et al. have also pointed out that the market alone is not sufficient to promote interactions for innovation and that the public sector and or intermediary organizations have a critical role to play (Hall et al., 2005a). Non-market drivers of innovation may include policy changes or incentives; access to information; finance; collective actions and social demand in addition to availability of technology. Nutritional benefits can also be a driver for innovation, although Hawke and Ruel have noted that there is limited experience with value chains being used explicitly to achieve nutrition goals (Hawke and Ruel, 2011). The World Bank has argued that an innovations systems approach and a value chain approach are complementary in that the innovation system

perspective provides a way of planning how to create and apply new knowledge required for the development, adaptation, and future profitability of the value chain (World Bank, 2006). A value chain approach provides the context for analysing opportunities for innovation however, it may focus more on market actors and the productive sector. If the value chain is conceptualized as the business and enterprise domain and part of a broader innovation system there can be linkages and knowledge flows through intermediaries to the other domains to influence macro economic factors, the political economy, and create conditions conducive to the further scaling up of a particular innovation or technology.

Building on earlier work within the agricultural knowledge information systems (AKIS) framework, an innovation systems perspective brings in not only a greater heterogeneity of actors from beyond the public sector, but emphasizes the importance of interaction, potential synergies and knowledge exchange among those actors for innovation to take place (Röling, N. 2009). This highlights the importance of identifying mechanisms for knowledge management (i.e. the generation, capturing, codifying, sharing and utilisation of knowledge) to support social processes of learning and interaction as part of partnership practice.

According to Hall et al. (2004) it is not clear the extent to which the interactions and social processes for learning are ad-hoc or require to be facilitated through specific mechanisms and learning tools. The potential practices and mechanisms depend on the level or levels that the partnership is working at, the type of partners and partners' organizational, social and cultural attitudes towards knowledge sharing and learning.

The Forum for Agricultural Research in Africa (FARA) is one of the key players in the international AR&D community that have been engaged for quite a while in developing and promoting integrated agriculture research for development (IAR4D) especially in the context of African agriculture research and development. The most significant of this work by FARA is the Sub-Saharan Africa Challenge Programme (SSACP) a proof of concept on IAR4D and the innovation platform systems approaches. The SSACP had a strong research focus aimed to generate practical lessons that could be used for scaling up the approach widely in Africa. The IAR4D framework uses an innovations systems approach to bring together diverse stakeholders as partners within IPs to support innovations aimed to improve productivity and livelihoods of target communities (Adekunle AA, et al. 2012). The promoters of the IAR4D argue that because the innovations to be supported through this approach vary with purpose and are influenced by both the initial context and the capacity of different stakeholders, the interventions are typically phased. They should start with initial engagement with stakeholders, where the focus is on building and supporting partnerships, creating a common vision and understanding problems and identifying opportunities. This is followed a planning, learning and assessment phase where activities include: *value chain and market analysis; developing action plans; identifying roles of partners; monitoring and evaluation to assess; developing actions plans for systems improvement, value addition and market opportunity; agreeing partner roles; innovation research and development; learning, assessing performance and capacity development; enhancing collaboration across actors and sectors.* The last phase is about ensuring sustainability and includes: *setting in place new innovations such as new products; ensuring ownership by local participants and ability to identify new opportunities; technical backstopping.* At the time of its evaluation the SSACP had documented experiences from the 21 pilot case studies to identify reasons for success and to learn lessons that could be used in other development initiatives (Adekunle AA, et al., 2012; Lynam JK, *et al*., 2010).

The innovation system, the IAR4D approaches and value chain framework (as reviewed above) provided the theoretical foundation that guided the interpretation and application of the IPTA approach to disseminate and scale up technologies in OFSP and QPM under the DONATA project in the ECA. In the next sections, we describe and examine the formation and evolution of the IPTAs. We analyse the types of partner configurations and institutional arrangements that supported learning, and innovation processes within the IPTAs. Based on the perceived multi-direction interactions among actors and the linkages across the AIS domains, we highlight key elements of successful uptake pathways and how these plus the learning and innovation processes in the OFSP and QPM platforms have supported technology and scaling up.

2.2 The IPTAs: initial concepts and approach

The "Dissemination of New Agricultural Technologies in Africa" (DONATA) project was conceptualized and implemented in the broader context of the PSTAD programme, whose overall aim was to strengthen the innovation capacity of AR&D actors in order to efficiently facilitate and catalyse adoption of successful technologies and best bet practices by end users in selected value chains across countries and sub-regions throughout Africa. Right from the inception of DONATA, the strengthening of innovation capacity of national agricultural research system (NARS) who include research institutes, universities, NGOs, farmer organizations; agribusiness and policymakers was pivotal to its success (CORAF/WECARD 2009). The Innovation Platform for Technology Adoption (IPTA) was selected and promoted across the DONATA target countries through the sub-regional research organizations (SROs) such as ASARECA in the ECA as the tool to be used towards this aim. The IPTA were to be established along segments of the value chain and through joint and inclusive stakeholder monitoring, evaluation, and learning and sharing of experience the envisaged strengthening of innovation capacity (that would in turn catalyse adopting) would be realized. Figure 2 shows how to set up the IPTA as outlined in a DONATA brochure updated by CORAF /WECARD (2009).

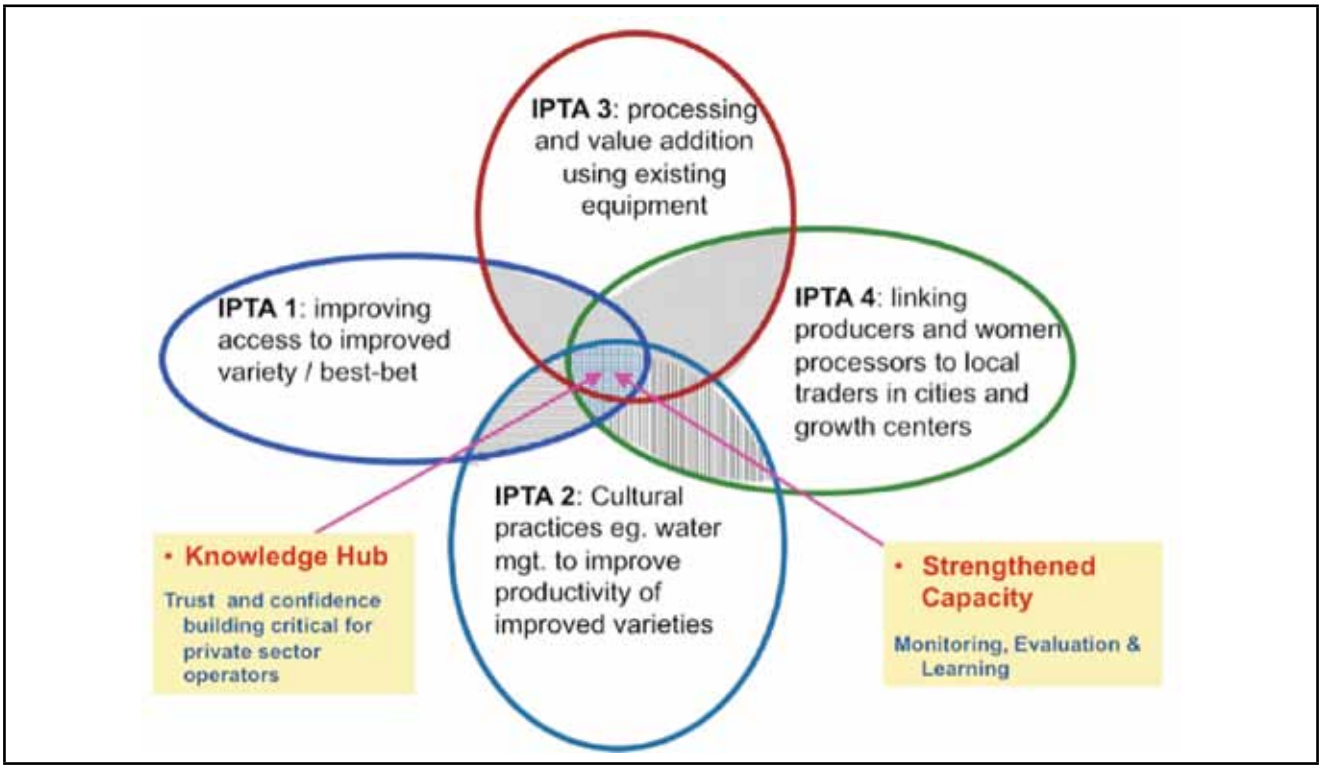

Figure 2: Innovation Platform for Technology Adoption (IPTA)- Value Chain

Source: CORAF/WECARD (2009), Updated DONATA Brochure

In the ECA sub-region, this initial interpretation of the IPTA tool along with the guideline to set up the platforms on segments of the value chain was used in the stages of Implementing DONATA. However, within the first year, considerable debate emerged among the DONATA ECA implementing community around whether there should be a blueprint for establishment and running of the innovation platforms. It was felt that a uniform way of establishing the platform could be counter-productive in light of the differing country contexts, the diversity of partners involved and the particular characteristics of the two crops –maize and sweet potato- selected for DONATA. Among the key issues in the debate were (i) that IPTAs be established on segments of the value chain as portrayed in Figure1, which defined the scope of a platform; (ii) the governance and management or

functioning of an IPTA. This primarily referred to whether IPTAs should have formal institutional partnering arrangements with designated officials to manage and coordinate the running of a platform. On this point it was also expected that the focal point NARI institution would have the role to coordinate and facilitate the multi-stakeholder interactions; (iii) the geographic coverage of a platform and (iv) whether a platform should have a fixed lifespan. The lifespan of an IPTA was an important issue because the guidelines in the DONATA brochure expected platforms to run for 2 years during which time experiences and lessons would be garnered and used for wide scaling out to other sites.

Based on lessons and experiences from the first year of implementation, various adaptations were made in the original ways in which the IPTAs were established. For example, due to demand from the value chain actors, especially farmers who wanted to experience benefits of the technologies from production through to utilization, new platforms were not limited to a segment of a VC, but spread across the chain. On the question of lifespan of platforms, it was realized quite soon that due to the complexities associated with implementing multi-stakeholder platforms and the nature of the technologies themselves it was realized that one year was too short to build trust among different VC actors especially with respect to marketing functions, for outcomes on the nutrition and health attributes of the technologies to be realized and for sufficient lessons to emerge. A similar conclusion was drawn from the implementation and evaluation of the SSA CP proof of concept on IAR4D framework and innovation platform regarding the duration needed generate adequate lesson form implementation of multi-stakeholder platforms (Lynam JK et al, 2010; Adekunle et al 2012).

Although DONATA was not designed as a research project with a formal experimental design to test the IPTA approach, still there was keen interest in the implementing partners- the focal NARI and CGIAR backstopping institutions and ASARECA- to understand whether the IPTA approach was feasible and practical within the ECA context. Thus, during implementation an action-research approach based on self-assessment was used to track how different country teams established, implemented and modified the way their IPTA worked. The managing and backstopping institutions (i.e. ASARECA, CIP and CYMMT) attended annual review and work plan meetings, and this provided opportunities to encourage reflection on the concept of IPTAs, their application and evolution. The platforms were encouraged to document their IPTAs establishment and processes through the regional/ continental experience sharing workshops and similar sub-regional cross-learning workshops by FARA and ASARECA; and training in value chains and innovation systems where selected IPTA members from different countries could interact, document and reflect on their processes. Other avenues used to support the platforms to reflect and document their experiences, notably for platforms in the OFSP component, included in–country inter IPTA visits and cross-country study visits and interaction with similar initiatives such as the Sweet potato for Profit and Health Initiative (SPHI) under CIP.

The 2012 continental experience sharing organized by FARA and facilitated by M&E consultants from NRI, where stakeholders had heated debates around the “definition” of an IPTA, how they should function and their future sustainability, contributed greatly to the documentation of lessons on this approach. It also helped to unravel some of the processes underlying the IPTAs and to reflect on the rich diversity of experiences across countries and commodities.

Therefore, the IPTA approach used in DONATA implementation in ECA is based on the AIS conceptual model as described under theoretical contributions where the linkages between the domains and the multiple relations among actors are key to enhancing access to technology, information and markets, and facilitating learning and innovation which ultimately contribute to adoption and scaling up. It also draws on the value chain framework for determining the IPTA partners and their roles in the platform.

An IPTA is a forum for partners with a common objective to improve agricultural production, income and services through analysis of constraints and planning interventions using a value chain approach. In the case of the DONATA project in Eastern and Central Africa (ECA), where the approach was being used to disseminate technologies in

OFSP and QPM, a key common objective, for example, was to ensure farmers had timely access to adequate amounts of quality planting materials such as vines and seeds of the varieties that were being promoted. Other common objectives that brought partners together to form IPTAs included the potential exploitation of value addition technologies to establish agro-enterprises; increasing the production of OFSP roots and QPM grain and linking producers to markets. The platform members in general comprised of representatives of farmers and farmers' organizations, extension, agro-processors, traders, agribusiness, transporters and research. From the AIS analytical framework in Fig 1, the IPTA members fit variously into the three vertical domains of research and education; business enterprise; and the bridging institution, while a value chain framework helps in identifying the members and their roles. The IPTA key purpose is that it provides a mechanism for information, knowledge and experience sharing and learning among the platform actors. It was envisaged that the information and knowledge exchange and learning among actors would catalyse innovation such as the development of new products, new ways of organizing and new processes for the procurement of goods and services.

In the ECA sub-region, a total of 49 IPTAs were established by the project across the six countries involved in DONATA. There are 21 platforms spread across Ethiopia, Kenya, Rwanda, Tanzania and Uganda engaged in the promotion and adoption of OFSP technologies, while for QPM, 28 IPTAs have been established of which 14 are in DRC with the remaining spread across Kenya, Tanzania and Uganda.

Table 1 shows the breakdown of the IPTAs indicating those used for promoting QPM and OFSP technologies and how they are spread across the six DONATA target countries in ECA. Other than in Ethiopia, where the platforms focused on seed systems, the rest of the countries involved in OFSP had their IPTAs focusing on the entire value chain. The choice to focus on seed systems in Ethiopia was based on an acute lack of planting materials across the southern region of the country where sweet potato production is concentrated, caused by draught and high incidence of sweet potato virus disease that wiped out planting materials. However, later the platform activities extended to other segments of the VC, so that beneficiaries could access and utilize a wider range of OFSP technologies. In the country implementing QPM, platforms are formed to address a felt constraint in a segment of the VC such as lack of seed of the preferred varieties, low QPM grain yield and lack of market access. Thus, some platforms focus on seed systems, some on increasing QPM grain production for household consumption and sale, while some focus on processing into different products and marketing. Like the OFSP platforms in Ethiopia, the QPM ones, though focusing on a specific segment of the VC, they too, over time, integrated other segments along the chain depending on stakeholder preferences.

While focusing on promoting the technologies for adoption by target end-users, the platforms were encouraged to reflect and document their IPTA processes and outcomes so that they could contribute to the knowledge on IPTA approach generated by other initiatives. The experiences from the DONATA platforms, while not based on a designed experiment with applicable counterfactual, provide practical lessons of how the approach could be used to disseminate technologies. They also point out challenges encountered and outstanding issues for further investigation.

Table 1: Number and distribution of innovation platforms in the target countries in ECA

Country	Number of innovation platforms and the commodity		
	OFPS	QPM	Total
Democratic republic of Congo (DRC)	-	14	14
Ethiopia	2	-	2
Kenya	4	6	10
Rwanda	4	-	2
Tanzania	9	5	14
Uganda	2	3	5
TOTAL	21	28	49

2.3 How the crop technologies influence the nature of value chain

The characteristics of a crop influence the type of value chains which develop; in particular the composition and configuration of actors in the platforms and the geographic coverage of an IPTA. The principal characteristics relate to: the place of the crop in local food systems and dietary practices, seed system characteristics, and level of commercialization. Because both QPM and OFSP have nutritional benefits, their specific nutritional traits also influenced the composition of partners in the IPTA.

Maize is a well-recognized major staple food and a source of feed in ECA. Therefore commercialization of grain and seed production is common. The seed system for maize in ECA with exception of a few countries such as DRC or South Sudan is fairly developed and to a large extent commercialized. In countries where the seed system is not yet developed, farmer-to-farmer exchange for open pollinated varieties is practised and upgrading these practices into formal commercial seed system is not as complex as is the case for vegetatively propagated crops such as sweet potato. Also, both grain and seed are not as perishable and bulky as sweet potato roots and vines. This makes maize easy to store, handle and transport. Therefore, it is possible to establish platforms that focus on specific nodes and actors along the maize value chain and also for platforms to cover larger geographical areas than for sweet potato. Another distinguishing feature, which has bearing on the platform operations and, in turn, the partner composition, is the relative short maturity period for maize compared to sweet potato. This facilitates quicker transactions along the value chain. For example, within one year, the cycle from seed production to grain and even some product transformation can be completed.

Sweet potato as a vegetatively propagated crop, the seed (vine cuttings) are normally obtained from the previous crop from one's own or a neighbour's field, and so the commercial sale of vine cuttings is not common. The sweet potato plant has a low multiplication rate (e.g. 1: 15-20) and the cuttings are bulky, perishable, and can transmit pests and diseases. The fresh roots are also bulky and perishable and therefore distribution and sale is predominantly carried out in local and informal markets. All these factors have implications for the development of a sustainable and commercially viable seed system for sweet potato, the development of the OFSP value chain and in turn the characteristics, composition, functions and geographic coverage of an IPTA. Thus, for example, due to the high perishability and bulkiness of both roots and vine cuttings, the platforms established to promote OFSP covered the entire value chain, had a district as the geographic coverage unit and involved more local traders as members of IPTAs than was the case for QPM.

2.3.1 The influence of the nutritional characteristics of the crops on formation of the platforms

Similarly, the nutritional aspects of QPM and OFSP, especially in terms providing cheaper sources of protein and vitamin A in the human diet respectively, had a strong bearing on the platform composition. As has been argued, establishing strong linkages between agricultural research and development practitioners and key actors in nutrition, health and education sectors is crucial for the effectiveness of interventions that aim to impact on nutrition and health (FAO 2012). Both QPM and OFSP platforms included actors from the health, nutrition and education sectors, which is uncommon practice in ARD.

Maize in general is deficient in essential amino acids (lysine and tryptophan) needed for normal growth and vitality (FAO, 1993). Most households in ECA that rely on maize as a major staple food have limited access to sources of protein such as meat, milk, fish and eggs (and sometimes beans) which often results in malnutrition. It also affects the quality of animal feeds. Therefore, feed producers resort to soybean and fishmeal as the main sources of protein in feeds. This makes the feeds expensive and subsequently the final animal products end up costly to consumers. Quality protein maize was developed through conventional breeding to address the protein deficiencies in conventional maize. In ECA, a number of QPM varieties have been released and are commercially available. However, these varieties have not reached many of the intended users such as small-

scale farmers and feed processers in the region. Therefore, the DONATA project selected the QPM technologies for dissemination and scaling out. The fact that both Hybrids and Open Pollinated Varieties (OPV) varieties of QPM are available also affects the platform composition and its operations. Where OPV QPM varieties were being promoted for uptake, the involvement of private seed companies in platforms established to deal with seed system issues was not critical. However, in some cases even if hybrids were being promoted, the stage of development of seed systems' institutions and infrastructure in a country would also influence the structure and functions of a platform. For example, in DRC where private seed companies are not present in the project sites, the platforms did not include seed companies as partners. Rather some individual farmers who showed capacity to produce quality seed in large quantities took that role in the platforms.

The place of sweet potato in diets and food systems varies across East and Central Africa. In Rwanda and parts of Uganda it is an important secondary staple with an estimated annual consumption of 73 kg per capita in 2009 (FAOSTAT 2013). Around the Lake Zone of Tanzania and Kenya it is an important supplementary staple or snack food. With its low input requirements and short maturity period, sweet potato has always been recognised as a food security crop. In many countries (with the exception of southern Ethiopia) it is considered as a "woman's crop", implying that it is a "low-status" crop which only poor people consume. However, with unpredictable climatic patterns affecting maize and rice production, and increasing disease pressure on cassava and banana, the recognition of sweet potatoes' importance not only for food, but also for income is growing. Orange-fleshed sweet potato (OFSP) varieties with high beta-carotene have been conventionally bred by selection for the content that is important in reducing Vitamin A deficiency.

An estimated 27 million children in Eastern and Central Africa (ECA) under the age of 5 were Vitamin A deficient (low serum retinol) in 2007, with a prevalence of around 40% (UNSCN, 2010). Levels of vitamin A deficiency are highest in drier areas, where the diversity of micronutrient rich foods is lowest. The causal link between compromised vitamin A status and increased child mortality is well-established (Sommer and West 1996). Orange-fleshed sweet potato varieties exist that have high levels of beta-carotene, the precursor to vitamin A, in the roots. Only 125 grams of most OFSP varieties can supply the recommended daily allowance of vitamin A for children and non-lactating women (300-700 µg retinol activity equivalents). Even at low yield levels (e.g. 5 tons/ha), a family of five could generate an adequate annual supply of vitamin A from a 500 square meter (0.05 ha) plot. All types of sweet potato contribute significant amounts of vitamins B, C, E, and K to the diet. In addition, vine tops have excellent micronutrient contents and adequate protein content (quantity and quality) for use as feed or food. Sweet potato generates large amounts of food per unit area per unit time, superior to other major staples (Woolfe, 1992).

2.4 Formation of the IPTAs

The formation of the innovation platforms for DONATA in ECA was organized around the concept of the value chain. In both the QPM and OFSP sub-projects the implementing partners also adopted the rationale and concepts underlying the IPTA approach[2] derived from the innovation system perspectives but adapted them to fit the commodity and country characteristics. Therefore, there are some variations in the way the platforms were formed between countries and commodities, and how they evolved over the four and half years of implementing DONATA.

2.4.1 Drivers influencing IPTA formation

In ECA the selection of the crops for the DONATA project was based on their nutritional advantages and food security potential. These attributes of OFSP and QPM were a key driver to the IPTA formation. Stakeholders

[2] The IPTA was intended to serve as mechanism for stakeholders who have a common objective of improving agricultural productivity to use value chain analysis and identify gaps, challenges, opportunities, solutions, actions and activities and implement them through linkage to the relevant service providers (DONATA Flyer, FARA 2010).

perceived to have an interest in the nutrition of vulnerable groups at risk of malnutrition or micronutrient deficiency such as children less than five years, pregnant and lactating mothers, people living with HIV (PLHIV) were identified. Other drivers were the opportunities to establish small and medium agribusiness enterprises (SME) through exploitation of the value addition technologies, and by forging linkages with food and feed processors. However, in some cases, what appeared to be constraints or obstacles to adoption and scaling out of the technologies served as drivers or entry points for platform establishment. For example, constraints associated with ensuring timely access of quality of seeds/vines of preferred varieties of QPM or OFSP served as drivers for establishment of platforms that addressed seed system issues to alleviate these constraints.

Thus, the most distinguishing features in initial IPTA formation and operation depended on whether the platform was established to cover: (i) the whole value chain; (ii) a value chain segment - for example seed supply. Facilitation and provision of services to the value chain actors are key activities in a platform, and the providers of these services and functions form part of the IPTA partners. Such services include training, advocacy and lobbying, monitoring and evaluation and marketing functions. In addition, IPTAs covered a specified geographical area, usually a district or a ward depending on the country.

2.4.2 Identification of value chain constraints

For both crops the first step in the formation of platforms was identification of the critical constraint to enhanced promotion, dissemination and adoption of the technologies. In most countries, this process involved consultations with key stakeholders and drawing on existing knowledge about the two commodity value chains in the relevant target countries and localities[3]. The nature of the issue that was deemed to be a critical constraint influenced the formation and composition of the IPTAs. In all the six countries, and for both QPM and OFSP, insufficient availability of seed (or vines) was identified as the critical constraint (PRAPACE, 2005). With the exception of Ethiopia where severe drought, pest and diseases had wiped out sweet potato including OFSP, and DRC where QPM varieties were yet to be formally released, researchers had released varieties of these two commodities. However, there was not enough seed (vines) to support the promotion and dissemination of these varieties and for farmers to have access to quality seed. Thus, in all countries the initial focus was on the seed input node of the value chain – even if their long-term vision was for addressing key issues/constraints that affected the whole value chain. Given the low multiplication rate for sweet potato, most OFSP target countries concentrated their efforts in the first one and half years on setting up IPTAs to work on the seed system. Whereas, for QPM, because of the short period needed to generate large quantities of seed and link that to the other segments of the value chain, it was possible to form platforms that concentrated on distinct nodes within the first year of implementation. The various activities and experiences related to this are explored in more depth in Part II.

2.4.3 IPTA composition, governance and management

Using the generic definition of a platform derived from the AIS framework, the DONATA platforms were comprised of multiple and diverse actors who, depending on whether the IPTA was meant to cover an entire value chain or just a segment, included all or a selection of the following actors: farmers (groups), public extension, NGO/CBO, private sector (which ranged from processors, seed companies, traders, seed multipliers and media), local government, health and cultural institutions, and research. It should be noted that the IPTA member composition was not static. Rather, it was dynamic and changed depending on the constraints and opportunities identified and the general evolution of the value chain. Similarly, there is no blueprint for IPTA governance and management structures and processes. Some IPTAs are governed through elected committees and have constitutions, which define their operational procedures. In some cases, letters of understanding are used,

[3] Ideally, a value chain analyses in each country for each commodity followed with a stakeholder participatory verification and endorsement of the critical issue (issues) to further promotion and adoption of QPM and OFSP technologies. However, such analyses were not part of the project activities.

which specify roles and functions of partners. However, other IPTAs operate on informal flexible arrangements. How the different governance and management structures and processes worked in the platform activities and outcomes is discussed in country case studies in Part II.

2.5 Uptake pathways

Within the platforms, information and technologies were disseminated to end-users through a combination of different uptake pathways. Uptake is the acceptance and promotion of research outputs by institutions along an uptake pathway and their eventual adoption by end users. Uptake pathways are defined as institutions and processes by which technologies reach end users. They normally include organizations, for example: research institutions; civil society groups which include NGOs; CBOs; farmer cooperatives, associations and farmer groups; government extension services; private sector actors (such as seed companies or traders); the media etc. Farmer groups normally serve as entry points in uptake pathways and for facilitating farmer-to-farmer dissemination and uptake. Because of the nutrition and health benefits of QPM and OFSP technologies, schools, health and nutrition centres, orphanages and hospitals were key parts of the uptake pathways used in the platforms.

Activities or processes carried out as part of uptake pathways included the production and distribution of seeds/ planting materials and dissemination of information and products and the channels that are used. Such channels included mass media (radio, television, web-based information portals), demonstration plots and farmer field schools, among others. As IPTAs evolve and mature, they may gain more confidence in piloting alternative uptake pathways. The initiative for this may have come from individual platform members, or from the IPTAs self- reflection. The details on the diversity of uptake pathways and how they influenced uptake and adoption of technologies are in the country case studies in Part II. However, from this broad definition it follows that the IPTA is itself an uptake pathway since it facilitates access to technology, information and knowledge and provides a forum for reflection, learning and innovation aimed at achieving adoption and impact.

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PART II

Country Experiences

Theme 1: Seed Systems

Introduction: Key constraints and issues in the seed systems for QPM and OFSP

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A key constraint to the scaling out of the benefits of bio-fortified crops such as orange-fleshed sweet potato (OFSP) and quality protein maize (QPM) is the availability and accessibility of adequate quantities of quality seed (PRAPACE 2005). In most countries the "formal" seed system for cereal crops, and in particular maize, is already well developed and operated by the private sector. However, the challenge even with maize seed systems is that the quantity of high quality certified seed from the private sector can only supply a handful of farmers, so farmers cannot rely on a consistent supply, and therefore depend on planting their own saved seed. In Tanzania for example, available data from the Agriculture national sample census 2007/2008 show that for most food crops that are priority for food security including maize and sweet potato, farmers rely on informal sources for their seed with certified seed accounting for only about 5.3%, though with a lot of variations between (NBS 2012). For maize, where some of the seed used is for hybrids, about 13% of total seed used is certified (World Bank 2012). In turn farmers' demand for seed is unpredictable, making it difficult for the private sector to sustain profitable enterprises. This situation is compounded by the uneven coverage of seed company distribution outlets in most countries in SSA. Another factor which needs to be recognized is that a number of the improved maize varieties are open pollinated (OPV) and therefore not attractive to the private sector since farmers can use seed saved from a previous crop without significant yield reduction. Indeed, some of the QPM varieties available for transfer and dissemination are OPV. Although OPV seed can be produced through organized farmer groups or community-based seed initiatives, evidence from studies that have evaluated these efforts indicate that they are unlikely to be sustainable. Inadequate technical expertise among farmers; weak institutional linkages to research and seed agencies, as well as lack of attention to marketing issues were cited as key factors that contribute to the limited success of most farmer-group or community-based seed production systems (Wiggins and Cromwell 1995; Onim, M. and Mwaniki, P. 2008). In addition, (and in contrast to OFSP) with QPM there is no visible trait, which can distinguish this nutritionally superior variety from other maize seed. Therefore, for the successful dissemination and scaling out of the adoption of QPM, ensuring the availability of quality QPM seed across the target areas either through community-based seed systems or the formal seed sector was a key challenge.

In contrast the sweet potato seed system is predominantly farmer based, the vines are easily propagated and often regarded as "common property"; and to date there has been limited private sector involvement. As a vegetatively propagated crop, sweet potato-planting material cannot be stored, so farmers must have a live crop from which vines can be cut for propagation. In areas where there is a bimodal rainfall system with "short" and "long" rainy seasons, the plant can survive the short dry season so that farmers can easily source planting material from their own mature crop (Gibson, Mwanga et al. 2009). In these areas, planting material is freely available and rarely sold.

In areas where a unimodal rainfall system predominates, the dry season is longer. Here, farmers face the challenge of how to maintain planting material through a prolonged dry season, unless they have access to low-lying areas with some water, which they can use to conserve the planting material or grow an off-season crop (Gibson, Mwanga et al. 2009). In areas such as these, purchase of planting material is more common. The break in the growing season also means that the cycle of disease and pest build up in the plants can be broken.

There are several methods by which farmers conserve sweet potato planting material during the dry season (Bashaasha, Mwanga et al. 1992; Namanda, Gibson et al. 2011). However, the predominant method is for farmers to wait for ground-keepers (i.e. roots which have been deliberately or accidentally left in the ground) to sprout after the first rains. This means that farmers wait 6-8 weeks after the start of the rains for roots to sprout for limited quantities of vines to be cut for planting. Some earlier surveys have looked at the constraints which farmers face in obtaining sweet potato planting material in general, citing inadequate quantities at the start of the planting season. However, few studies have looked at the trade-offs which farmers deal with when sourcing seed in terms of price, source and quality. While inspection and seed certification systems are in place for grain crops and in particular maize; for the vegetatively propagated crops such as sweet potato researchers have predominantly managed quality assurance. There has been limited work on understanding how farmers understand quality; and while it is known that farmers will purchase small quantities of new varieties, which they will then multiply further themselves, less is known as to whether farmers are prepared to pay for clean seed of varieties which they already have.

Therefore sweet potato farmers re-cycle their planting material from one season to the next. However, vines sourced in this way are more likely to be infested with insect pests and diseases. This situation reflects the second major challenge for sweet potato seed system: namely that diseases and pests can be transmitted in the planting material. Sweet potato Virus Disease (SPVD) is one of the most important diseases of sweet potato and can cause a yield loss of 30%-60% (Barker, Andrade et al. 2009) The major pest is sweet potato weevil. Both SPVD and the weevil can be transmitted through planting material. The accumulative effect is that the area under sweet potato remains limited, the productivity is low, and the potential contribution which sweet potato could make to improved food and nutrition security and strengthened livelihoods is not realized.

The following country experiences recount how the different IPTAs in ECA worked to provide sufficient and high quality OFSP and QPM seed of the “preferred” varieties to farmers. Equally important, is how the different IPTAs planned to have the seed systems developed under DONATA sustained.

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Sweet potato seed multiplication systems in western Kenya: Use of Innovation Platforms

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Introduction

The most critical constraint in sweet potato production in Kenya is the shortage and timely availability of planting material. A baseline study conducted in western Kenya showed that over 86% of farmers who had heard about the orange-fleshed (OFSP) could not plant it because of scarcity of planting material (Salasya et al. 2010). Sweet potato is a vegetatively propagated crop grown in a 4-6 months cropping cycle, each started with new cuttings. The cuttings are in most cases poor quality because they accumulate and harbour pests and diseases from one generation to the next (Karyeija et al., 1998). The prolonged dry periods experienced in some parts of Kenya, make it impossible for sweet potato to survive as an actively growing plant. This leads to late planting and limited area planted as farmers are forced to wait for sprouts from roots of the previous crop to produce mature cuttings. This may take as long as one to two months into the rainy season and thus exposing the subsequent root crop to end-of-season drought. The situation is further aggravated by the lack of a formal seed system and the low multiplication ratio of sweet potato (Bashaasha, 1995). The planting materials are also bulky with short shelf life making it expensive to transport large quantities to areas far from the source. Farmers obtain planting material from their previous crop or through farmer-to-farmer exchanges. The quality of planting material is greatly compromised under this system. The sale of planting material in Kenya has traditionally not been common making it unattractive for entrepreneurs to invest in it as an enterprise (Ndolo, et. al. 2012). Thus in Kenya as in most East and Central Africa (ECA) countries, commercial seed companies are not interested in producing sweet potato seed, as they find it unprofitable.

The Kenya Agricultural Research Institute (KARI) in collaboration with the International Potato Centre (CIP) has developed a number of technologies related to sweet potato seed systems that can enhance the production and utilization of the crop. These technologies have not reached many users. A four-year project called 'Dissemination of New Agricultural Technologies in Africa' (DONATA), whose aim was to promote proven and emerging technologies was started in 2008. In western Kenya, this project focused on promotion of orange-fleshed sweet potato (OFSP). The objectives were to develop a sustainable system for continuous and timely multiplication and distribution of quality planting material using innovation platforms. The hypothesis was that availability of adequate quality planting material at the onset of rains would lead to early planting and increase the volume of fresh roots for household consumption and for sale in local markets as well as to provide raw materials for processed products to satisfy the market demand. The Innovation Platform (IP) approach has elements that promote early and sustainable technology adoption. IPs involves multi-level, multi-stakeholder interactions that facilitate identification, understanding and addressing of complex challenges. IP processes facilitate successful innovation and provide an opportunity for implementing introduced innovations.

What was done?

Establishing a seed multiplication system:

The DONATA project was implemented through Innovation Platforms for Technology Adoption (IPTAs). Three IPTAs were established in Busia, Bungoma and Kakamega Counties in western Kenya. The IPTAs were composed of a range of stakeholders along the OFSP value chain (Research, Ministry of Agriculture, farmer associations, NGOs, private sector) as indicated in Table 2. The Bungoma and Busia IPTAs were formed in 2008 during the launch of the DONATA OFSP project in western Kenya. The Mumias IPTA was formed in 2011 to cater for the project activities in Kakamega County. In each platform, a partner was nominated by the members to coordinate the IPTA. The coordinating organization was responsible for the day-to-day implementation of the IPTA activities, compiling both technical and financial reports as well as chairing of the IPTA meetings. The IPTAs had informal MOUs, which stipulated the terms and conditions of their engagements, reporting protocols and solving misunderstanding among partners and exit strategies. The IPTAs were dynamic as some partners left the platform and new ones were brought in based on the need. For example, the Chairman of Bungoma Farmers Association, which was representing the farmers in the IPTA left after only one year. The IPTA brought in a processor, a farmer field school representative and a trader in the second year when it was realized their roles were needed. Interaction among IPTA partners occurred during IPTA meetings and participatory monitoring of project activities. Interaction among the IPTAs occurred during annual project workshops, exchange visits and special meetings of three IPTAs to address emerging issues.

The three IPTAs were to address issues along the entire OFSP value chain. Initial activities were based on OFSP variety Ejumula due to its higher beta-carotene content compared to SPK004 (Kakamega 4) which farmers had been used to. The initial cuttings of Ejumula were obtained from a small-scale seed multiplier in Busia district.

All the platforms started with production of planting material using a three-tier system i.e., primary (PM), secondary (SM) and tertiary (TM) multiplication. The primary multiplication sites (PMS) were established at KARI-Kakamega, Alupe sub-centre and Yala swamp and managed by KARI-Kakamega scientists. Materials from the PMS were used to establish SM sites, which were managed by the Busia and Bungoma IPTAs. Two different seed multiplication approaches were used by the IPTAs. Table 2 provides details on the name, location of the innovation platforms, the partners involved and their roles in supporting scaling out, adoption and impact of OFSP technologies in Kenya under DONATA project.

The Bungoma IPTA established SM sites using farmers' groups. The IPTA facilitated 10 farmer groups who established 0.4 hectares each for multiplication of OFSP vines. Group members managed the SM sites. The average number of farmers per group was 25, 62% of whom were female and 38% male. One member of the group donated the land where the SM sites were established. When vines were mature, cuttings from group plots were given free of charge to each group member to establish individual tertiary multiplication sites (TMS). The TMS were used for both subsequent vine multiplication and root production. Each member of the group sold vines to 4-5 farmers in the neighbourhood who were not group members.

In the Busia IPTA SM sites were established on land rented by the platform using project funds. They obtained planting material from the PMS in Alupe sub-Centre and used it to establish 10 SM sites. Materials from here were distributed to 20 farmer groups or individual vine multipliers who established TMS. Cuttings from the group farms were given to group members and the rest sold to other farmers.

After the second year, the demand from farmers for vines of a variety called Ejumula began declining. This was attributed to: (i) a decline in the variety's productivity attributed to its susceptibility to the sweet potato virus disease, and (ii) the creamy skin colour of the variety. Sweet potato buyers and consumers in the region prefer varieties with pink or red skin colour. As a result, CIP facilitated the introduction of two new OFSP varieties (Kabode and Vita) from the Uganda breeding programme. They were introduced in form of tissue culture plantlets. A seed multiplier in Busia did the first multiplication of the two varieties. The multiplier was given

sixteen cuttings of each variety, which he propagated using the rapid multiplication techniques (RMT). The RMT is a method used to speed up the multiplication of vines either at secondary multiplication sites (SMS) or primary multiplication (PMS) level. Vines are cut into very small pieces (25-30 cm with 3 nodes) and planted very close (20 cm by 10 cm). Small cuttings are harvested every 6-8 weeks and planted in other plots to multiply the material further. By April 2010, the new material had been multiplied to 0.6 hectares. Vines of these two new varieties were given to the IPTAs to establish new SMS. Some of the vines were sold to individual root growers and a number of institutions.

The RMT is one of the seed systems innovations that farmer vine multipliers, their group members and other stakeholders in the IPTAs were trained on its application. Below is Mrs. Bernadette Olamyba from Bungo IPTA on her small plot where she multiplies vines using RMT.
In order to ensure continuous availability of quality of planting material, the project contracted Genetic Technologies International Ltd (GTIL), a private tissue culture laboratory in Nairobi, to multiply virus free cuttings of Kabode and Vita varieties.

The tissue culture plantlets from the laboratory were hardened by Kenya Plant Health Inspection Services (KEPHIS) at Muguga and released for field multiplication after testing them for virus diseases. Two seed multipliers in Busia and one multiplier in Bungoma Counties multiplied the plantlets in the field. KARI scientists inspected the sites regularly to ensure that quality was maintained. The sites established using the tissue culture derived planting material were also used as PMS. Materials from here went through the three-tier vine multiplication system.

Other innovative approaches were used by the IPTAs to reach more farmers and provide them with planting material. The Bungoma IPTA, for example, used the agriculture and 4-K club members in six primary schools to multiply planting material in the school gardens. The IPTA trained students and teachers on techniques for production of quality vines. Each student was given 100 cuttings to take to their parents for further multiplication. Follow-up visits to a number of students suggested that most of them multiplied the cuttings in their homes.

The Bungoma IPTA expanded its membership by bringing into the platform the secretary of the Farmer Field School (FFS) network in Bungoma district. The aim was to use members of the network to provide training to farmers as well as to further multiply the planting material. A flour processor in Busia made contractual arrangements with six farmers to produce roots. Each of the six farmers was given a total of 180,000 cuttings free of charge to grow the roots. The farmers were supposed to produce roots and sell them to the processor but also return to him the same amount of cuttings they received. The processor also linked farmers to markets for planting material.

The Mumias IPTA was created as offshoot of the Busia platform. It was started later by one actor who had moved from the Busia IPTA. They began planting sweet potato-using seed they received from the PMS at KARI-Kakamega research centre. They emerged to be fully involved in seed multiplication of Kabode and Via varieties.

Creating demand for vines: In order to ensure growth and sustainability of the vine multiplication and distribution, the IPTAs realized the need to create demand for vines. To achieve this, IPTAs conducted a number of promotional activities to publicise the availability of planting material. These included on-farm demonstrations, field days, exhibitions, meetings in the chiefs' barazas (meetings organized by the local provincial and county administration leaders). The Bungoma IPTA painted five bus sheds along the Webuye-Malaba road with the orange-colour and writings depicting the importance of OFSP and established multiplication fields close to the sheds for those who might be interested. The Bungoma IPTA also used important occasions such as the World Food Day to promote the growing of OFSP and to publicise the availability of planting material. In Mumias, an FM radio station is a member of the IPTA. The IPTA has taken advantage of this to promote the growing of OFSP. In one of the radio talks, two members of the IPTA were allocated 30 minutes' airtime to talk about OFSP. It is estimated that the listenership of this FM radio was about 500,000.

Table 2: IPTA location, partners and their roles in scaling out OFSP technologies in Kenya

Name location & year established	Partner	Roles in platform
Bungoma IPTA, Bungoma County (2008)	Kenya Agricultural research Institute (KARI)	• Overseeing project implementation • Compilation of technical and financial compilation of reports • Capacity building of IPTAs and ToTs.
	Ministry of Agriculture	• Training of farmer groups • Identification of farmer groups • Promotion of OFSP
	Community Research in Environment and Development Initiatives (CREADIS)	• Coordinates Bungoma IPTA • Community mobilization • Supervision of seed & root production • Promotion of OFSP technologies • Training of ToTs and farmer groups
	Majeso Human Development (MAHUDE)	• Establishment of SMS and TMS
	Farmer Field School (FFS) representative	• Training of FFS network
	Processor	• Capacity building in processing
	Trader	• Linking root producers to market for fresh OFSP roots • Promoting OFSP in local markets
	KARI	• Capacity building
Busia IPTA, Busia County (2008)	Rural Energy and Food Security Organization (REFSO)	• Community mobilization • Seed multiplication • Capacity building • Coordination of Busia IPTA
	Farm Concern International (FCI):	• Linking seed producers, root producers and processors to market • Provision of market information
	Anglican Church of Kenya, Western Region Christian Community Services (ACKWRCCS)	• Group Mobilization • Linking OFSP to faith organizations
	Appropriate Rural Development Agricultural Programme (ARDAP)	• Responsible for seed multiplication in Nambale Division • Responsible for post-harvest processing in Busia IPTA
	Siwongo OFSP Flour Processing Company	• Small scale processing of OFSP • Linking processors to urban markets
	KARI	• Capacity building of IPTA
	Ministry of Agriculture (MOA)	• Linking OFSP to extension service programmes
Mumias IPTA, Kakamega County (2011)	Anglican Church of Kenya, Western Region Christian Community Services (ACKWRCCS)	• Coordinating Mumias IPTA • Group mobilization
	Rural Community Empowerment Centre (RUCEC)	• Coordinating planting material multiplication in Kakamega County
	Nabwabini Environmental Health care intervention project (NEHCIP)	• Linking OFSP to Health facilities
	Kholera Kick-Hunger CBO	• Representing CBOs in Mumias IPTA • Coordinate root production
	Munami brothers youth group (a CBO)	• Linking OFSP project to youth groups

The two members provided their mobile phone numbers and also told listeners to contact the nearest Ministry of Agriculture office or the nearest KARI centres for more information. The Mumias IPTA also developed radio tapes containing important information on OFSP including planting material multiplication. The tapes were played during the first 15 minutes of farmer group meetings. This has enhanced the capacity of the group members in the multiplication of OFSP planting material. Some of the group members are being used by the Mumias IPTA as trainer of trainers (TOTs).

Figure 3: Mrs. Bernadette Olamyba, a member of a farmer group in Bungoma IPTA at her multiplication plot in 2010 using RMT

Capacity building: The capacity of TOTs and farmers was enhanced through training on different aspects of planting material production, multiplication and maintenance. The training emphasized the importance of using clean seed for propagation, identification of pests and diseases, rapid multiplication and conservation of planting material. The project has developed a draft Vine Multiplication Manual, which was used to train 48 TOTs who later trained 663 farmers. Trainees were also introduced to business enterprise development for the sale of planting material.

Conservation of planting material: The major problem affecting OFSP is loss of planting material caused by prolonged drought. Most of the OFSP varieties are susceptible to prolonged dry periods. 65% of farmers normally conserve planting material by leaving them in the field without harvesting until the onset of the next rains. Nearly 30% of farmers in Busia, Bungoma and Kakamega Counties conserve planting materials in wetlands. The Kenya Horticultural Competitive Project (KHCP) has facilitated production and commercialization of OFSP in Western Kenya by providing low volume "Money-Maker" treadle pumps to enable seed multipliers to irrigate their crops during the dry periods. A few farmers are also now conserving planting material in small nurseries within their homesteads.

Achievements

OFSP planting material is now readily available: The use of IPTAs in the multiplication of OFSP planting material has greatly improved the availability of these materials to farmers. The platform established 6.2 hectares of planting material at the PMS. These materials were used to establish 20 hectares of planting material in four years at the SMS level. Cuttings from the SM sites have cumulatively established 280 hectares under TMS. The project has delivered 86 million cuttings and established 2,575 ha of OFSP for root production. It is estimated that 13,000 farmers had been directly reached with planting material of the OFSP varieties by end of 2012 (Ndolo et.al. 2012).

OFSP information flow has improved: In the past farmers who were interested in planting OFSP could not access seed of the varieties their choice. At present the three tier seed multiplication system of PMS, SMS and TMS promoted within the IPTAs has made it possible for farmers to know the type of varieties available, how and where they can be found. There are now networks of seed multipliers at the SMS level who are linked to the PMS and root producers. Since the IPTAs were made up of different actors in the OFSP value chain, it is now possible for the different players to know what is going on in the seed system and the sources of planting material.

OFSP seed multiplication enterprises are now thriving: Although seed multiplication as an enterprise has not been common in Kenya, sale of planting material has now become a reality. Three farmers for example, sold vines worth US$8000 in one season (Ndolo, et. al., 2012). The main buyers of planting material were institutions, NGOs and farmer groups. A total of 60 farmer groups and 25 individual farmers are currently involved in commercial production of OFSP planting material.

OFSP can now be planted in the long and short rains: Most of the farmers in Western Kenya used to plant sweet potato in the second rains because of lack of planting material during the first season. The practice was for the farmers to stop harvesting their fields between the months of January and April when the weather is dry. Farmers then waited for two months into the rains before the sprouts from the previous crop were ready. A few farmers would start to plant in the months of June and July just to multiply seed for the second rains. Timeliness in seed availability has now changed and more farmers are now planting OFSP during the long rains because there are specialized seed multipliers. This has led to more area planted; a longer production period and more OFSP roots produced for both the fresh root and processed product markets. It has also led to consistent supply of roots on the market.

OFSP seed system is developing: The involvement of the research institution in IPTA activities has contributed significantly to the performance of the OFSP seed system. From the research institution, IPTAs have access to better OFSP varieties than before. Farmers are now getting planting material of new varieties faster than they used to do before. The quality of seed has greatly improved, resulting into planting of bigger areas and thus higher production. The seed system has also seen other innovative ways of seed production being evaluated. For example, the introduction of net tunnels in the seed multiplication system should play an important role in improving seed quality. The IPTA has established informal seed inspection by KARI; this has further contributed to improvement of vine quality.

Improved coordination and networking: Institutionally, the use of IPTA has played a big role in getting the seed system working by improving coordination and communication among the chain actors in the seed system. There was also increased collaboration with the other development agencies like the Kenya Horticultural Competitive Project (KHCP), One Acre Fund, Ministry of Health and NGOs working with support groups for people living with HIV and AIDs.

The innovation platform approach is being adopted by other development agents: The use of innovation platforms as a vehicle for disseminating technologies has been so successful with OFSP that it is being adopted

by other projects. The promotion of NERICA rice production has adopted the innovation platform approach. The KHCP has also adopted the approach. At national level, Government is considering adopting the approach for disseminating agricultural technologies.

Challenges

Sustaining a campaign of continued use of clean planting material: Farmers may not be willing to continue paying for planting material when vines become readily available in communities. It is likely that farmers will resume the old practice of re-cycling planting material, a situation that may result in a build-up of pests and diseases and subsequently lowering of crop yields. Therefore, the IPTAs need to find ways of sustaining the clean plant material campaign so that farmers continue using such materials, even when it necessitates that they buy them.

Maintaining a balance between growing OFSP and the old varieties: Most of the current OFSP varieties are early maturing and shallow rooting. They are therefore more prone to drought and weevil infection. Complete replacement of the old varieties with the OFSP may not be desirable for both the cropping systems and food production. It is therefore important for farmers to continue growing their other preferred varieties alongside the OFSP varieties. However, they need to be helped in balancing the two types as each has good attributes that complement each other.

Sustainability of coordination and communication: The other challenge is how the existing coordination and communication among the actors in OFSP value chain will continue without the project support. It may be important for IPTAs to find innovative ways of raising funds to support their activities when project support ends. This may be through organizing seed and root producers to form associations, which will give them strength to solicit for funds from other sources or through association membership fees. In addition, the IPTAs can register and transform themselves into value chain facilitators and provide services to other organizations at a fee or act as a broker to bring the partners together on a cost recovery basis.

Lessons learnt

Specialised seed suppliers for sweet potato are the key to sustained production: It has been learnt that the traditional method of sourcing sweet potato vines cannot lead to sustained production of the crop. Although specialised seed production has not been a norm for sweet potato, it is the only way through which the crop can be produced continuously. Therefore seed multipliers still require technical and business development support, to continue providing this important function.

Farmer beliefs can easily change if commercial opportunities for a product are made available: Well-coordinated OFSP root production activities increased demand for vines, making them a commercial product in western Kenya. Farmers are now taking vine multiplication as a serious business enterprise. The sale of planting material has become a reality unlike before when this was a taboo in most communities in western Kenya.

Local by-laws may be necessary to maintain farming enterprises: Some farmers conserve planting materials in wetlands. Unfortunately, these are the same areas where animals are grazed during the dry season. Some farmers have resorted to fencing off their multiplication plots. There is need for by-laws to ensure that the use of different types of land is regulated.

Promotional campaigns for OFSP should not be done at the expense of old varieties: The new OFSP varieties under dissemination have good nutritional properties but also have their disadvantages. For example they have poor in-ground storability, which limits their adoption by farmers who practice piecemeal harvesting. They are also prone to drought and weevil infestation. Therefore it is important to explain these characteristics to farmers and encourage them to maintain a range of different varieties to meet their other needs.

Profitable enterprises are attractive to both men and women: Through the IPTA activities, men have come to realize that sweet potato production can be a profitable enterprise and are getting more involved in its production than before. Men and women are performing production tasks jointly, and more land is being allocated to sweet potato production. These changes also highlight the need for discussion at household level about the allocation of income from these enterprises. In our IPTAs, training sessions for sweet potato enterprises include both men and women, and the topics of resource allocation and sharing of benefits are included for sensitization and debate.

IPTA experiences can create synergies: Cross learning among IPTA partners has allowed farmers to access more knowledge and practical ways of doing certain things. This has enhanced wide dissemination of the planting material, and the production technologies of sweet potato.

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Clean planting material production and dissemination of orange-fleshed sweet potato varieties in Southern Ethiopia

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Background

The improvement of orange-fleshed sweet potato (OFSP) varieties started twelve years ago in Ethiopia in order to combat vitamin A deficiency (VAD), which is prominent in rural populations. Consequently, four OFSP varieties were released, namely, Koka-12, Guntute, Kulfo and Tulla (Assefa et al., 2007). Planting material of these varieties was produced in Hawassa Research Centre in southern Ethiopia and disseminated for production through government agricultural extension systems. However, dissemination of these varieties encountered several challenges. In general, the main challenges to sweet potato production in Ethiopia include recurring drought, sweet potato weevil, sweet potato butterfly and the sweet potato virus disease (Tewodros et al., 2011). In addition to these, OFSP dissemination is challenged by its unfamiliar taste and colour, especially in traditional sweet potato growing areas of the south where white-fleshed sweet potato (WFSP) varieties are very popular. Because of these challenges, the improvement work and planting material production and dissemination of OFSP required new approaches. This fortunately coincided with the launch of the Dissemination of New Agricultural Technologies in Africa (DONATA) OFSP project in Ethiopia. The primary objective of this project in Ethiopia was to promote root production and utilization of OFSP varieties through production and dissemination of clean planting material of OFSP varieties through the Innovation Platform for Technology Adoption (IPTA) approach along the value chain. Consequently, two IPTAs were formed in Ethiopia based and coordinated in Areka and Hawassa Agricultural Research Centres, respectively.

What was done

Two IPTAs were formed, namely Hawassa IPTA and Areka IPTA and were formed around Hawassa and Areka Agricultural Research Centres. Membership of Hawassa IPTA included Hawassa Research Centre, Tulla-Hawella Woreda Office of Agriculture, Commercial Clean Vine Producers, Boricha Woreda Office of Agriculture, GOAL Sidama programme (NGO), and Farmers' Training Centres (FTCs) in the Peasant Associations (Lowest government administrative unit) of the Woredas. The members of Areka IPTA included Areka Research Centre, Boloso-Sore Woreda Office of Agriculture and FTCs in the Peasant Associations of Bolosso-Sore Woreda. Hawassa IPTA was coordinated by Hawassa Agricultural research centre and Areka IPTA was coordinated by Areka Agricultural research centre. Both IPTAs were managed by meetings on quarterly basis. Also both IPTAs undertook learning and experience sharing visit to each other on annual basis.

The IPTA formation was based on the sweet potato value chain actors that included research centres, extension department, commercial vine producers, non-governmental organizations and farmers (figure 5). The largely informal sweet potato seed system in Ethiopia has recently seen some small private limited companies joining to produce sweet potato vine as a business and these are helping to bridge the gap in planting material availability. The IPTA members had different roles to play to achieve project objectives. Research Centres produce clean

material through tissue culture, rapid multiplication, in fields under Primary Multiplication Sites (PMS) and Secondary Multiplication Sites (SMS). GOAL Sidama, a non-governmental organization, distributed free vines to farmers for root production and for conserving their own planting material for planting in subsequent seasons. Also, the clean planting material produced at Areka Research Centre and FTCs under the Areka IPTA, was directly distributed to farmers for root and vine production. In order to diversify OFSP varieties grown in Ethiopia, more varieties were introduced from other East African countries and are undergoing adaptation testing by the research centres.

Production and distribution of clean planting OFSP materials

Cleaning OFSP varieties from viruses and their micro-propagation using tissue culture: OFSP varieties Kulfo and Tulla were selected by the national sweet potato improvement programme in Hawassa Agricultural Research Centre for promotion under the DONATA project in Southern Ethiopia. These however had to be cleaned of viruses. With support from the International Potato Centre (CIP) they were sent to Kenya Plant Health Inspection Service (KEPHIS) tissue culture facilities and cleaned of viruses. The cleaned tissue cultured plantlets were brought back to Ethiopia, and hardened in the Biotechnology Laboratory facilities at Holleta Agricultural Research Centre. From Holleta, the hardened and clean plantlets were brought to Hawassa Research Centre.

Rapid multiplication of clean planting material of OFSP varieties at primary multiplication site: The tissue cultured and hardened, clean OFSP plantlets were put under rapid multiplication at Wondo Genet by Hawassa Research Centre. The objective of this activity was to multiply, obtain and supply clean planting material to OFSP producers in the shortest possible time.

Secondary multiplication of OFSP clean planting material: The clean planting materials produced at the research-managed primary multiplication site (PMS) were further bulked in secondary multiplication sites (SMS) at Areka Research Centre and Elfora farm (Hawassa Research Centre) still under research management. In some cases, clean planting material from the SMS was given or sold directly to commercial vine producers and model farmers in the IPTA operation areas who managed tertiary multiplication sites (TMS). Some of the TMS were supported by the NGO GOAL Ethiopia. Clean planting materials from TMS were distributed to farmers' training centres (FTC) and to members of NGO supported groups based around model farmers.

Distribution of clean planting material of OFSP varieties to farmers:
Farmers received OFSP planting materials from different sources. Some received planting material from model farmers close to farmers training centres (FTC) while others received vines from commercial vine producers. In Hawassa IPTA, farmers obtained vines through the non-governmental organization GOAL Ethiopia who bought vines from commercial producers or SMSs using money provided by DONATA project. The scheme of OFSP seed system in Ethiopia by DONATA is summarized in Figure 4 below.

Capacity building and awareness creation of OFSP production and utilization technologies

The extension agents and NGO field staff at Woreda (district equivalent) level within IPTAs were trained as trainers of partners in clean planting material and sweet potato production. They also trained development agents and model farmers on how to produce clean planting material and sweet potato roots. Furthermore, Woreda office agriculture extension agents and NGO field staff from Hawassa and Areka Research Centres were trained as trainers in clean vine and root production in addition to utilization of OFSP. Mass media (FM radio, television, newspapers) was prominently used to disseminate information on OFSP production and utilization. In addition, field days, leaflets, agricultural exhibitions and fairs were also employed.

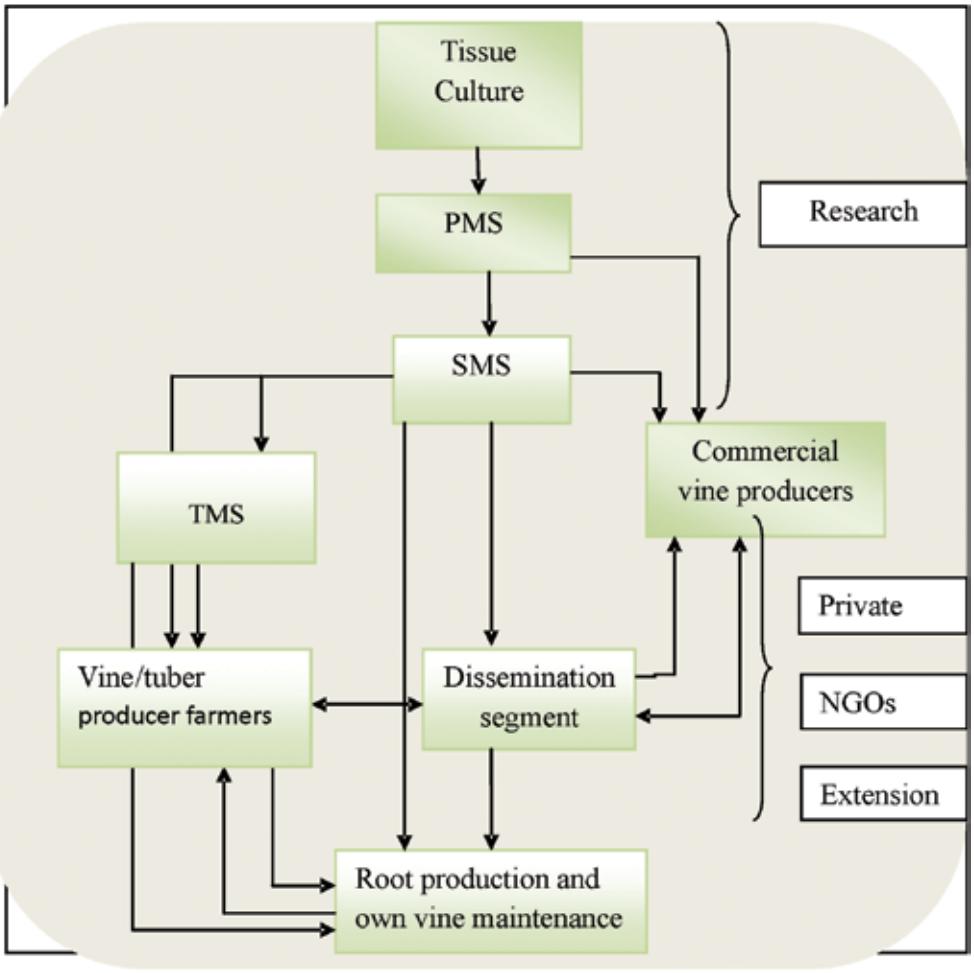

Figure 4: Illustration of OFSP seed system in Ethiopia

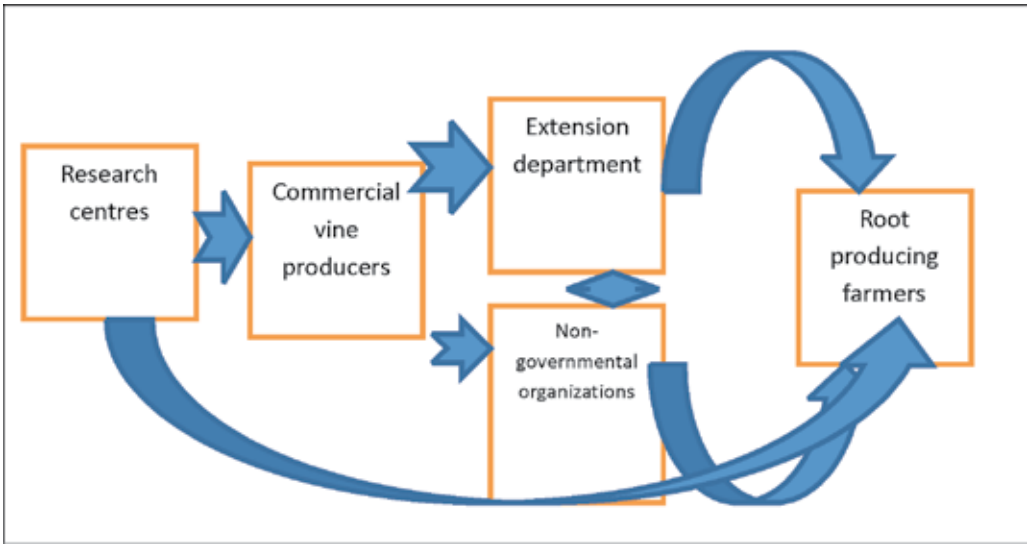

Figure 5: Value Chain of Orange-Fleshed Sweet Potato in Ethiopia

Achievements

Sweet potato varieties cleaned of viruses: Two recently released improved OFSP varieties were cleaned of sweet potato viruses and enabled clean planting material production of OFSP varieties in research centres and commercial vine producing farms.

Clean OFSP vine cuttings produced and widely distributed: Over 30 million clean vine cuttings of OFSP varieties were produced from PMS, SMS and commercial vine producer farms and distributed among farmers in IPTA areas. These clean planting materials were sufficient for planting over 540 ha of land and benefited more than sixty thousand farmers in IPTA areas.

Increased capacity in sweet potato seed systems and production: One M.Sc. student from Hawassa Research Centre was trained in sweet potato seed systems.

Figure 6: Farmers undergoing training on OFSP seed and tuber production technologies at Areka Research Centre field.

In addition, over 140 men were trained in sweet potato root and clean vine production while 100 women were trained in OFSP root utilization. At Areka IPTA, 270 men and 50 women farmers were trained on root and clean vine production, and OFSP root utilization (fig.6). At this IPTA, 32 development agents from Bolosso-sore Woreda were trained as trainers. As a result of the training, commercial seed enterprises developed around Hawassa IPTA. Some of these enterprises include Sunshine plc., Izra plc., and Muluneh plc. These vine-producing enterprises were sustained through the project operation period and continued to produce vines for sale even after the DONATA project finished. Due to the success of vine production, several new enterprises have been established.

Jobs were created: New employment was generated in order to create awareness of OSFP based technologies in local newspapers, FM radios, field days, agricultural fairs and exhibitions from both Hawassa and Areka centres.

In addition to the vines distributed to DONATA IPTA members, over 10 million OFSP clean vine cuttings were disseminated to non-IPTA operated areas through NGOs such as: World Vision; Concern Worldwide; Save the Children; Inter Aid; Vitta; FAO and SNNPRS bureau of agriculture through the national sweet potato improvement programme in Hawassa centre. This was in recognition of the importance of sweet potato as disaster mitigation and recovery crop and the role of OFSP in combating Vitamin A Deficiency (VAD) in the community.

The tissue culture laboratory at Areka centre was supported through training of technicians, and the provision of hardening facilities provided by a sister project to produce clean planting material of sweet potato.

Challenges

The two OFSP varieties currently under promotion are susceptible to drought: A lot of the crop is lost during the dry season. This could have been mitigated by irrigation during dry periods if farmers had access to small-scale irrigation. Unfortunately, these facilities were only available at the primary and secondary multiplication sites managed by the research centres, and a few private multipliers.

Limited modes of OFSP utilization: The utilization of both white and orange-fleshed sweet potato varieties is limited to consuming boiled or steamed roots. This discourages large root production for fear of possible marketing problems of the excess produce. Consequently, this resulted in reduced demand for clean planting material, which further discourages the clean planting material production for sale and thereby hampers OFSP root production. Other activities in the project promoted diversified use of OFSP, in particular its inclusion in traditional dishes such as injera and kocho.

Low acceptability of OFSP in traditional areas where the crop is grown

The characteristics of OFSP negatively affect its acceptability by communities in the traditional sweet potato growing areas. First, the relatively low dry matter content of OFSP varieties and absence of sweet potato processing facilities adversely affects their acceptability in some communities. Second, the communities are unfamiliar with the taste and colour of OFSP. These attributes limit acceptance and adoption of OFSP varieties and, in turn, demand for planting materials.

Lack of processing facilities

The lack of processing equipment inhibits agro-dealers and other private firms in getting involved in sweet potato production and utilization activities, which would increase demand for seed.

Lessons learned

OFSP varieties are susceptible to drought: The OFSP varieties under promotion are susceptible to drought and cannot survive long dry seasons in the absence of irrigation facilities. This necessitates the development of drought tolerant OFSP varieties or installations of irrigation facilities to enable producers to sustain production of clean planting material across the dry seasons. This will ensure that enough clean vines are available for planting immediately in the rainy season after the dry season. That is to say: most farmers face a shortage of clean planting material of sweet potato immediately after the dry season. However, production of clean planting material in the dry season is very difficult without irrigation facilities. However, some traditional approaches do exist like keeping planting material under enset and coffee trees, but such a scheme does not provide sufficient planting material at the right planting time. Also, most vine producers lack irrigation facilities and produce a large amount of planting material at the actual root production season. Producers of planting material contribute less to root production and their vine market is not sustainable because of low demand in the dry season compared with the rainy season.

The taste of a new variety greatly influences its adoption rate: The adoption of OFSP varieties was slow in traditional sweet potato producing areas because of their unfamiliar and different taste. There is, therefore, need to diversify means of utilization of these OFSP varieties to counter these unfamiliar characteristics and create more marketing opportunities for OFSP.

Quality of clean planting material of OFSP deteriorates with time: As the generations of vine advance, the quality of clean planting material of OFSP deteriorates, especially due to viruses. Therefore, measures to ensure that planting material remains clean should be put in place. This may require involvement of institutions such as the Ethiopian Institute of Agricultural Research and the Ministry of Agriculture and Rural Development.

Free planting materials may slow down development of a sustainable seed system: In Ethiopia, formal sweet potato seed system involves government bodies and non-governmental organizations particularly in the vine acquisition and dissemination segment. These agencies buy vines and distribute them to farmers without charging any fee. This approach possibly hampers the establishment and development of a sustainable seed system in the long term.

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The role of seed systems in improving orange-fleshed sweet potato production and dissemination: Using the IPTA approach in the Lake Zone of Tanzania

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Background

One of the key challenges for production in many countries is the timely availability of enough clean planting materials at the beginning of a planting season. Farmers tend to obtain planting materials from their own fields, fellow farmers, friends, and relatives or buy from areas where planting materials are specifically conserved (MacKnight, 2005). To counteract shortage of sweet potato planting materials, some farmers establish a mother garden either near their homes, in the wetlands especially after harvesting rice or near water sources like rivers and lakes. Later, they cut vines from the mother gardens and use them to establish new fields. This practice is common in areas where there are two rainy seasons in a year. However, the benefits of sequential planting are limited by the low multiplication ratio for sweet potato (1:20). This ratio is very poor compared to that of cereals such as maize (1:300) (Moyo et al., 1998). This can even be lower depending on the variety planted, management level and soil fertility status of an area. In areas that experience a unimodal rainfall pattern, most of planting materials are lost due to drought, especially if no effort (such as regular watering) is made to conserve the materials. Both situations mentioned above are applicable to farmers in the Lake Zone of Tanzania.

In the Lake Zone, a few farmers purchase clean sweet potato planting materials at the beginning of the rainy season (Mafuru et al., 2009); although it is not common in the area and there is no formal seed system in place. Sweet potato planting materials are conserved in small plots for easy management however, this practice cannot produce sufficient quantities of planting materials that are normally required at the beginning of a rainy season. For this reason therefore, the expansion of sweet potato root production is highly affected by shortage of clean planting materials (Kapinga et al., 1995). Another factor contributing to the shortage of sweet potato planting materials in the Lake Zone is the high prevalence of sweet potato virus diseases in the fields. This is because most of the varieties grown by farmers including the orange-fleshed sweet potato (OFSP) varieties are susceptible to sweet potato virus disease (Ndunguru and Kapinga, 2007).

Given the importance of the crop in the Lake Zone, efforts were made to provide clean planting materials of OFSP varieties at the beginning of the planting seasons. The Innovation Platform for Technology Adoption approach (IPTA) was adopted as the most suitable approach to avail sufficient clean planting materials to farmers and other stakeholders of the Lake Zone of Tanzania in a timely manner. The approach brings together and harnesses synergies of the different stakeholders involved in OFSP technology dissemination and utilization. The approach ensured the involvement of stakeholders in seed and root production, processing, utilization, marketing and capacity building in sweet potato value chain.

What was done

Different stakeholders in the Lake zone including Lake Zone Agricultural Research and Development Institutes (LZARDI) at Ukiriguru and Maruku, Local Government (Bukoba Rural, Missungwi, Ukerewe and Sengerema); non-governmental organisations (NGOs); Business Development Services (BDS); service provider institutions; religious institutions (Churches); media; private sector such as traders and processors; community based organizations (CBOs); other institutions such as primary schools; prisons; hospitals and farmer groups were mobilized to form IPTAs in the project's target districts. The IPTAs were formed to enhance efficient implementation of seed production activities along the seed value chain.

Nine platforms were formed in the four districts of Misungwi, Ukerewe, Sengerema and Bukoba Rural. In each IPTA, farmers were organized in groups for OFSP vine production, root production, processing, utilization and marketing. Each IPTA convened meetings twice a year to discuss the progress of activities and agree on future strategies. While seed multiplication activities were critical to stimulate the other segments in the value chain, in turn, linkages to root producers, processors and traders were also essential to ensure a consistent demand for planting material. The IPTAs therefore had a diversity of actors with each stakeholder having their role to play (Table 3). Also the number of IPTAs in a district depended on the location of the villages and type of actors involved

Different stages of seed multiplication were carried out to ensure that enough planting materials are available close to farmers. These included Primary, secondary and tertiary multiplication stages (PMS, SMS and TMS respectively). Primary multiplication was done at the research station. At this stage there was close follow up on the management of the multiplication field by using all recommended planting material multiplication procedures, including close spacing (20 x 10 cm), proper weeding, rouging of diseased plants, fertilizer application and irrigation where necessary. The PMS fields were located in an isolated area and were kept clean through frequent visits, with care taken to avoid contamination. Some of the materials were multiplied using fleece nets for protection against whitefly and aphids the major vectors for sweet potato virus diseases, though in a small quantity. The materials from the PMS were used to establish secondary multiplication fields. The quantity of materials distributed was recorded by researchers in collaboration with extension staff. In the secondary multiplication stage, the materials were multiplied at a large scale on a commercial basis.

Distribution included farmer groups and government institutions such as prisons, schools and trained individual farmer entrepreneurs (under the supervision of project partners to avoid mixing of the planting material and to maintain disease-free quality). The technology used for PMS and SMS to increase planting material was Rapid multiplication technology (RMT) which aims to have a lot of planting material in a short time from a small area by using closer spacing and three-node cuttings under intensive management. The planting materials from the secondary stage were used to establish tertiary multiplication fields. The amount of planting materials distributed from SMS was recorded by extension staff so as to understand the amount distributed in each IPTA. The materials from the secondary sites were distributed mainly by NGOs and respective district councils in each IPTA. In the tertiary multiplication stage, the multiplication was done by individual farmers or groups of farmers depending on the available land. At this stage the materials were planted at a wider space (100 x 30 cm) in order to produce planting materials and roots. There was also regular monitoring of the fields by researchers and extension staff. The planting materials were maintained by farmers using the recommended practices and the distribution of the materials was from farmer to farmers through selling or given free to fellow farmers.

Planting materials were first grown at the PMS at either Maruku or Ukiriguru research stations where genetic purity and plant health were maintained by researchers through regular roguing out of off-types. After two months, planting material from the PMS was supplied to the SMS, which were managed by farmer groups or institutions. The materials from SMS were bulked up and then used to establish the TMS in farmer groups or individual farmers. Before the crop under SMS was harvested the IPTA identified farmers or farmer groups to

receive the vines to establish TMS at the start of the main planting season (November/December). Farmers established sweet potato multiplication plots on either a group member's field or on a hired plot. The plot sizes ranged from 0.1 ha to 2.5 ha per group depending on land availability. Extension workers visited farmers regularly to offer technical backstopping. In addition, the established fields were monitored on a quarterly basis by researchers to ensure quality of planting materials. The quantity of planting materials distributed was recorded and distributed to farmers in other districts and regions like Shinyanga, Dodoma, Musoma for seed and root production.

Table 3: Name of IPTAs and their composition

Location	Name of IPTA	Composition of IPTA	Year of establishment
Misungwi	Mbarika	Seed multipliers, root producers, root traders, Misungwi district Council, LZARDI, Tanzania Home Economics Association (TAHEA) and media (TV and radio)	2011
	Usagara	Seed multipliers, root producers, root traders wholesalers and retailers, processors, Misungwi district council, LZARDI, Small Industry Development Organization (SIDO), Mwanza Rural Housing Programme (MRHP), Support to Local Economy in Mwanza (SLEM), Tanzania Home Economics Association (TAHEA), Tanzania Bureau of Standards (TBS), Tanzania Food and Drugs Authority (TFDA) and the media [Star TV, Independent Television (ITV), Tanzania Broadcasting Cooperation 1 (TBC1) and Radio Free Africa (RFA)], Super markets (SITTA and LAVENA), International Potato Centre (CIP), Tanzania Bureau of Standard (TBS), Tanzania Food and Drugs Authority (TFDA)	2009
Sengerema	Mwangika	Seed multipliers, root producers, root traders, Sengerema District Council, TAHEA, Business Development Services (BDS) and media (Sengerema FM radio and Star TV)	2011
	Ngoma	Seed multipliers, root producers, root traders (wholesalers and retailers), Sengerema Hospital, primary school, processors, BDS, Sengerema District Council, TAHEA and media (Sengerema FM radio and Star TV)	2011
Ukerewe	Ukerew A	Ukerewe District Council, Ukerewe Prison, TAHEA, vine multipliers and root producers and media (Star TV and RFA radio)	2009
	Ukerewe B	Ukerewe District Council, TAHEA, vine multipliers, root producers, Ukerewe health centre, primary schools, processors and media (Star TV and RFA radio)	2011
	Ukerewe C	Vine multipliers, root producers, retailers at Nansio town market and media (Star TV and RFA radio)	2011
Bukoba	Maruku and Kanyangereko	Seed multipliers, root producers, root traders, Bukoba District Council, KOLPING Tanzania, Lweru ADP and media [Television (Star TV, TBC1) and radio (Kasibante FM, FADECO radio and RFA)	2009
	Bugabo and Bukoba town	KOLPING Tanzania, Partage, seed multipliers, root producers, root traders (wholesalers and retailers), processors, Bukoba district council, MAYAWA, BUWEA and media [Television (Star TV, TBC1) and radio (Kasibante FM, FADECO radio and RFA)	2011

Five OFSP varieties: Ejumula, Carrot Dar, Kabode, Carrot C and Jewel were selected for multiplication from several varieties that were available at research stations in the Lake Zone. These were selected because they contain high levels of beta-carotene, are accepted by farmers and their adaptability to different locations in the Lake Zone.

Training on OFSP planting material multiplication was conducted for each farmer group. The topics covered were on rapid multiplication of sweet potato planting materials, sweet potato agronomy, and sweet potato planting material conservation, pests and diseases identification and management.

Achievements

Availability of clean OFSP planting materials: In areas where OFSP seed multiplication was done, the problem of scarcity of planting materials at the beginning of the cropping season has been solved. Using the IPTA approach farmers were organized into groups. A total of 18 seed system farmer groups were formed (2 groups per IPTA). These were responsible for meeting the seed requirement in and outside the IPTA wherever planting materials were required. The farmer groups were dealing with seed multiplication using secondary seed multiplication nurseries and were able to produce clean OFSP planting materials throughout the year. This was achieved by establishing secondary seed nurseries in the wetland and along near the lake Victoria shore where irrigation was done. This was practised in an area with unimodal rainfall pattern like Misungwi, Sengerema and Ukerewe districts. In an area where there was bimodal rainfall pattern, such as Bukoba district, sequential planting was done to ensure the availability of clean OFSP planting materials throughout. Farmers either bought planting material or accessed them freely from groups involved in seed multiplication. Also, the farmer groups received training on seed multiplication and thus were regarded as source of information to fellow farmers in the area.

Increased OFSP vine production: The development of a three-tiered seed system to ensure timely availability of adequate quantities of clean planting material was realized. At the end of the project, the area under seed multiplication was estimated to be 187 ha under primary, secondary and tertiary multiplication sites. Approximately 22,215,600 vines equivalent to 66,646,800 cuttings (25-30 cm used for planting) were harvested during the project period (Figure 7). These were distributed to 4985 households each with 0. 25 an acre and fetched about USD $117,093 of vine sales. This enabled the timely availability of OFSP planting materials.

Among the four IPTAs the highest quantity was recorded for Misungwi IPTA with a total of 8,330,850 followed by Bukoba with 6,386,985 and Sengerema with 4,720,815 vines while the lowest amount was recorded in Ukerewe (2,776,950). Producing sweet potato vines in the wetland or irrigated land had been reported to be one of the common strategies implemented by farmers in Tanzania for the purpose of having enough planting materials at the beginning of the season (Namanda et al., 2011). Therefore, the reasons for the higher amounts in Misungwi IPTA followed by Bukoba IPTA were due to the fact that in Missungwi the production sites were located along Lake Victoria which enabled farmers to water their crop during the dry spell thereby producing sweet potato vines throughout the year. Bukoba was the second highest producer due to the presence of bimodal rainfall pattern. This also encouraged farmers in Bukoba to produce planting material throughout the year. The reason for the low amount in Ukerewe was due to the fact that most farmers depend on cassava as their major staple food.

Thus, the IPTA approach supported the development of strong leadership among the groups, which enabled farmers to be organised and participate in timely production of OFSP vines. The strong leadership was complemented by training with a total of 313 (96M: 217F) TOTs trained in seed systems technologies who then trained 4,956 farmers (3450F:1506M), NGOs, (TAHEA, Partage, World Vision and KOLPING) as well as local government authorities from Mara, Dodoma, Dar es Salaam, Shinyanga regions and churches such as the African Inland Church (Geita) and the Mennonite Church in the Coastal Region were involved in vine business for their farmers.

Successful mobilization of institutions and farmer groups in OFSP vine production: Many institutions, farmer groups and individual farmers got involved in the production and dissemination of sweet potato vines. Institutions that took on OFSP vine production included two research institutions, eight primary schools, one health centre and one prison. Forty-eight farmer groups and individual farmers were also involved. In Bukoba IPTA fourteen farmer groups and five primary schools received training on seed multiplication, management and conservation and were used as secondary multiplication sites. In Sengerema IPTA, 18 farmer groups and three schools were involved in multiplication of OFSP, while in the Ukerewe IPTA, one CBO, one prison and eleven farmer groups participated in seed multiplication and production of OFSP roots. In the Misungwi IPTA, seven

farmer groups took part in OFSP seed production at SMS and dissemination of planting material to TMS with farmers groups, individuals, NGOs.

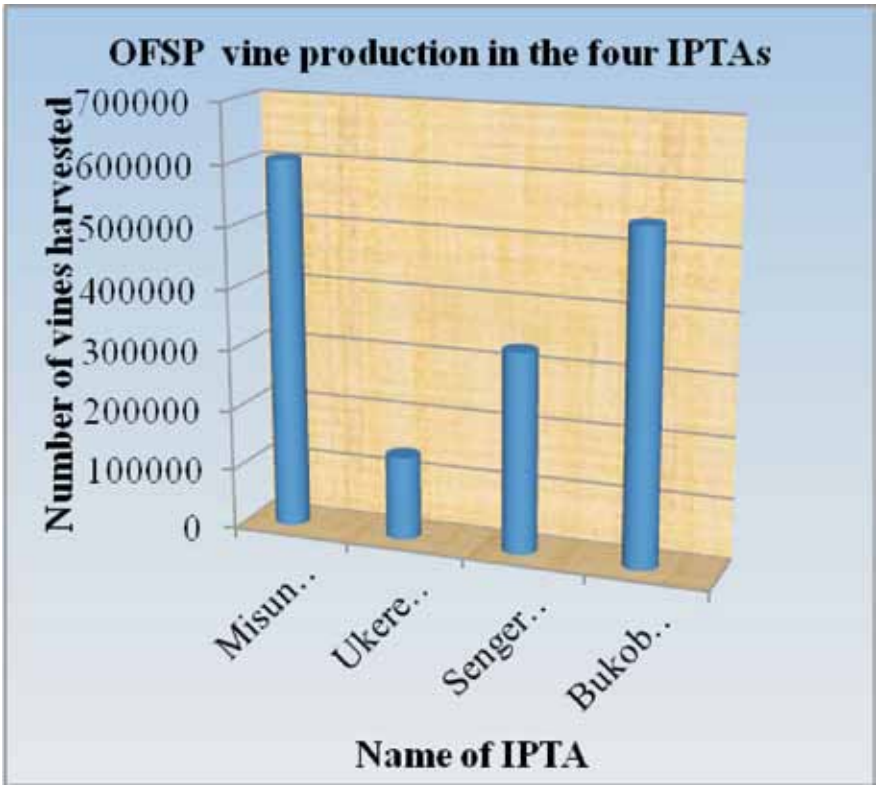

Figure 7: OFSP vines production in the four IPTAs

Figure 8: Primary multiplication plot for OFSP in Mwanza Tanzania

Involvement of school children in dissemination of OFSP planting material: A large portion of OFSP planting materials obtained from multiplication sites established at schools were given to school children to take and plant them at their homes. This was done to serve mainly three purposes. The first was to enable school children to eat OFSP in their homes and thus benefit from the nutritional superiority of these varieties. Secondly, they were used as channels to take the technology into their homes. Thirdly the OFSP technologies for both vine multiplication and root production were the source of income for their schools. To ensure that school children planted the given planting materials, the extension officers, researchers and the teacher responsible for agricultural activities in the respective school randomly selected at least 10 school children and visited their homes. It was observed that 8 out of 10 school children supplied with OFSP planting materials managed to plant and maintain sweet potato at their home. Thus, this helped to make OFSP planting materials available to communities in the project districts.

Scaling out and up of OFSP technologies in the Lake Zone: Formerly, OFSP production was limited to research institutions and a few areas where on-farm research activities were conducted for example Mwasonge in Misungwi district and three villages (Maruku, Byeju, Izimbya) in Bukoba Rural with a combined total area of 41.6 ha planted to OFSP. However, the results obtained from this project show that the use of IPTA approach to develop the seed system has facilitated the scaling out of the area planted with OFSP both in terms of hectarage, villages, district and regions. For example, during the project period the total area planted with OFSP in the Lake Zone was 153.7ha of which Sengerema had the largest area of 44.4 ha followed by Bukoba Rural with 37.9ha and Misungwi with 36.7 ha. The lowest acreage of OFSP was planted in Ukerewe IPTA (34.7 ha) (Figure 9). The improvement in the availability of seed has increased the total area under OFSP root production in the Lake Zone.

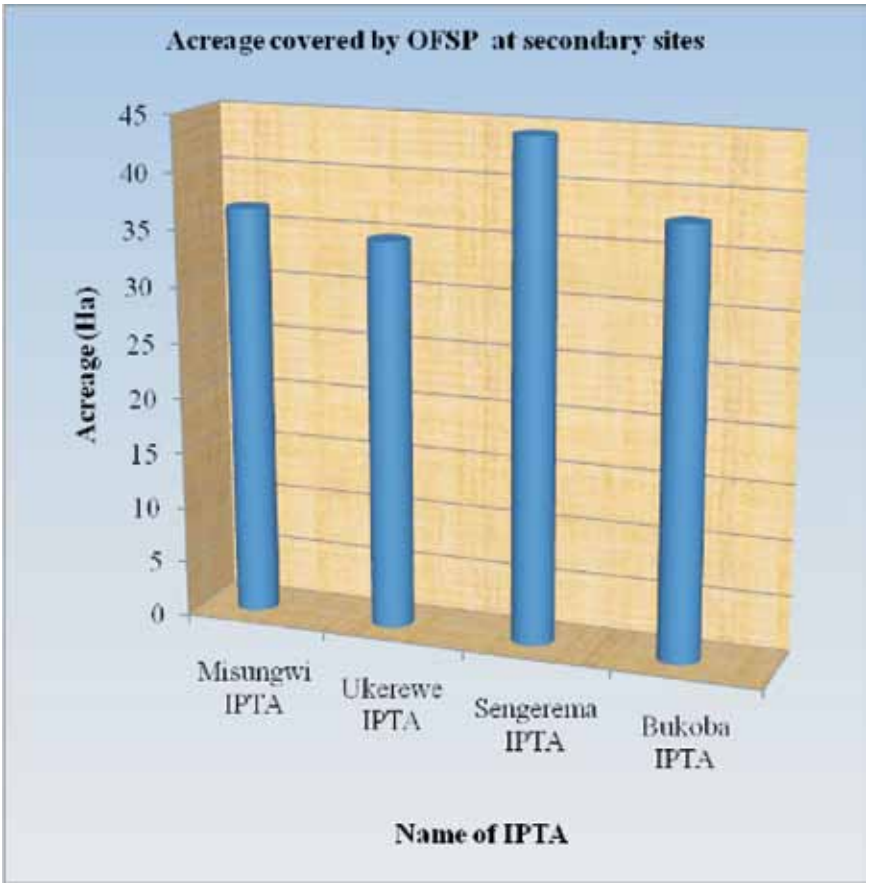

Figure 9: Number of hectares for OFSP production in the four IPTAs Lake Zone (2009 – 2012)

Table 4: Area covered with OFSP seeds at SMS and percentage change

SN	Name of district with IPTAs	Area before DONATA Intervention (ha)	Area after DONATA Intervention (ha)	Percentage increase per district (%)
1	Misungwi	17.4	36.7	110.9
2	Bukoba rural	14.2	37.9	166.9
3	Ukerewe	2.0	34.7	1635
4	Sengerema	0	44.4	100
	Total	35.6	153.7	331.7

Improved household food security: The increase in OFSP acreages in the project district also resulted in the availability of sweet potato roots as food (Figure 8 & Table 4). The sweet potato is a food security crop (due to the fact that it is a short season crop) furthermore, its piecemeal harvesting nature and ability to perform in marginal areas means that the participating farmers were able to get enough food throughout project intervention period. Orange-fleshed sweet potatoes (OFSP) are particularly nutritious, with nutrient content for vitamins A and C, folate, iron, copper, calcium, protein and fibre, and they are an excellent source of the carotenoid, β-carotene, a vitamin A precursor. Orange-fleshed sweet potato varieties that have high levels of beta-carotene, the precursor to vitamin A are valuable: only 125 grams of OFSP varieties can supply the recommended daily allowance of vitamin A for children and non-lactating women (300-700 µg retinol activity equivalents). Even at low yield levels (e.g. 5 tonnes/ha), a family of five could generate an adequate annual supply of vitamin A from a 500 square metre (0.05 ha) plot planted with respective OFSP variety (Woolfe, 1992). Thus, the availability of OFSP roots in the participating households reduced food shortage in those households as some of the root production was used as food and therefore a source of Vitamin A. The OFSP contributes to the food security and nutrition of participating families.

Involvement of men in sweet potato value chain activities: Women have been reported as key actors in all activities related to the sweet potato value chain in the Lake Zone of Tanzania. The role of men was to help women in land preparation and transporting sweet potato roots to the market and selling (Benjamin et al., 2010, Badstue & Adam, 2011). However, with use of the IPTA approach, the results obtained from this project indicated that a total of 6,395 people of whom 2,499 were men and 3,896 women participated directly in sweet potato vines production (Figure 10). As expected, the majority (61%) were women but 39% were men, suggesting that the use of the IPTA approach helped to bring men into participation on sweet potato vines production.

During the project period, individual farmers who joined the OFSP multiplication and root production scheme benefited greatly from selling the harvested vines and roots. For example in Ukerewe most of OFSP vines produced were sold within Ukerewe and a small portion sold to Bunda and Musoma districts of the Mara region. Farmers in these districts have engaged in sweet potato production because cassava, the main food crop in these districts, is currently threatened by the cassava brown streak disease (CBSD). OFSP therefore has potentially become the household food security and income generation crop in these districts. Thus, there should be targeted efforts to promote OFSP cultivation in areas ravaged by CBSD and banana Xanthomonas wilt disease. This effort will not only provide food from OFSP roots but also income to vulnerable households by expanding the market for OFSP planting materials.

Challenges

Susceptibility of OFSP to SPVD: Most OFSP varieties currently being promoted are susceptible to sweet potato virus diseases (SPVD). However, negative selection for healthy material for planting, followed by rouging of virus infected plants at the sprouting stage helped to control sweet potato viruses in low SPVD pressure areas (particularly in Bukoba and Sengerema districts).

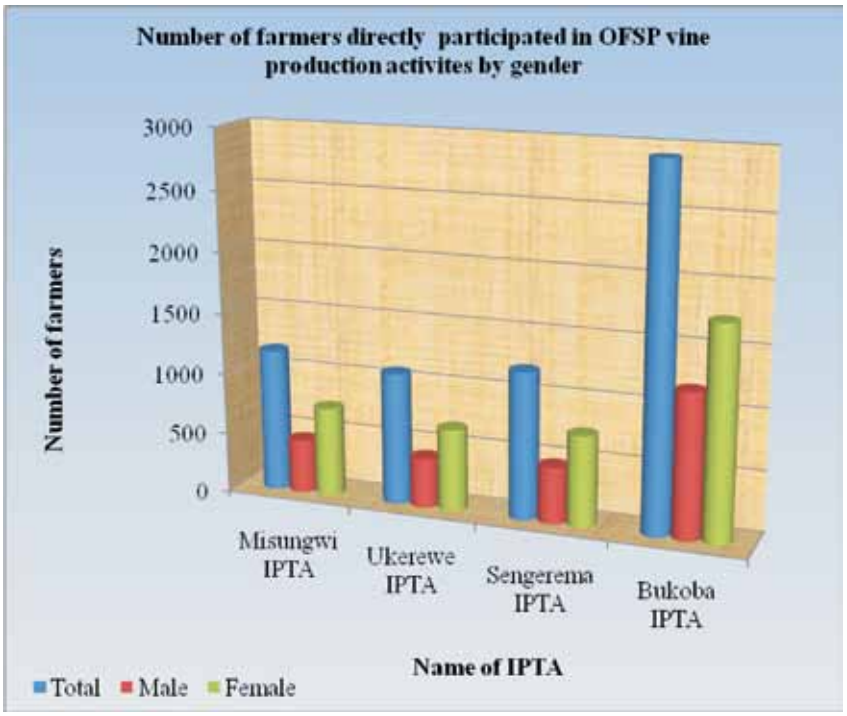

Figure 10: Gender proportion among farmers involved in OFSP vine production

Drought effect: Presence of dry spells in some project areas led to difficulties in production of enough clean planting materials, mainly at the tertiary multiplication sites and at some secondary multiplication sites.

Lack of sufficient market for vines: The market for OFSP vines remains the major challenge, as many farmers were not able to sell the produced vines due to a lack of market. In most cases, vines were purchased by other projects for distribution to their beneficiaries. The Tanzania Catholic Refugees Service (TCRS) in Ngara district, World Vision Tanzania in Rugu and Ibwera ADPs, and the Kolping Society of Tanzania were major buyers of OFSP vines for distribution to their beneficiaries.

Lessons learnt

A key lesson is that given cyclical seasonal demand, and the common property nature of the planting material, a vine multiplication enterprise alone may not be sufficient basis for a viable business. Therefore, particularly at the tertiary multiplication level, strategies which support joint vine and root production and sales are necessary. As stable year-round markets for roots develop, the demand for vines will become more consistent.

The involvement of mass media and other community mobilizing institutions need to be accorded higher priority within the IPTA to improve innovation sharing in the platform. Local media, mostly FM radio stations, participated in the IPTA approach and were the key source for disseminating information to farmers in the Lake zone of Tanzania. In this project, Kasibante FM of Bukoba, Family Alliance for Development and Cooperation (FADECO) radio of Karagwe, Sengerema radio of Sengerema, Radio Free Africa (RFA) of Mwanza were highly instrumental in the dissemination of OFSP technologies in the Lake Zone of Tanzania throughout the project period.

The IPTA approach should be institutionalized: officially incorporated in the national agricultural extension system in Tanzania. The approach is cost effective as it allows cost sharing. It also allows stakeholders to develop collective strategies to address several issues. It is a business-oriented approach which encourages participation because of the expected monetary benefits by those who are more entrepreneurial.

From the IPTA approach adopted by this project, it has been learnt that there should be a balance between productions, utilization, marketing and promotion activities to enable profitable disposal of produce. However, in this project more efforts were put into production and marketing than promotion. The communities surrounding the groups involved in OFSP production in all IPTAs are somehow not aware of the importance of including OFSP in their food systems. This highlights the need for increasing the promotion of utilization of OFSP in the Lake Zone of Tanzania.

Future direction

Advocacy activities should be in place to increase awareness on the importance of OFSP varieties in relation to combating vitamin A deficiency (VAD) in the farming communities in the Lake Zone of Tanzania. Efforts have been made to educate the community on how OFSP can play a great role to combat VAD through different stakeholders under LZARDI, TAHEA, Helen Keller International (HKI) and Reach Agent for Change (RAC) since 2000. Sensitization and promotion of OFSP utilization for improving dietary vitamin A in the farming communities is the future direction which can be extended to other zones through the experience gained in applying IPTA technology in the four project districts of the Lake Zone. Furthermore, market opportunities need to be strengthened, especially for vines and root producers, through the study and analysis of demand.

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Quality protein maize (QPM) seed system in Tanzania under DONATA project

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Introduction

Maize is the most important staple food grown in Tanzania with 80% of the population depending on it for food and cash income providing about 50% of rural incomes (USAID, 2010). Maize is also used as an ingredient for animal feeds. Normal maize grain has low contents of the essential amino acids lysine and tryptophan, which are important for human beings and monogastric animals (Lauderdale, 2000). In order to address the problem of low content of lysine and tryptophan in normal maize, research efforts resulted in Quality Protein Maize (QPM), a type of maize that has double the amounts of these limiting amino acids as compared to normal maize (Vasal, 2000; Prasanna et al., 2001). Tanzania has four (4) QPM varieties namely Lishe K1, Lishe H1 and Lishe H2 (released by the public sector) and TAN H611 (released by the private sector). Dissemination efforts for QPM started in the early 2000s in the Eastern and Northern parts of Tanzania; however adoption has been slow especially in the Eastern part.

In Tanzania, the public Agricultural Seed Agency (ASA) is responsible for the production of foundation and certified seed for maize varieties released by public sector as well as marketing of certified seed of those varieties. The private sector is primarily responsible for production and marketing of certified maize seed, especially hybrids of their released varieties (Ngwediagi et al., 2009).

Although promotion and dissemination of QPM has increased seed demand, adoption of QPM in Tanzania has been limited by failure of farmers to easily access seed. There is limited supply of seed for improved varieties of seed in rural areas and more so for QPM. If farmers happen to get QPM seed for one season and realize its advantage after harvest, they may be encouraged to save seed for next season. Seed is also sourced from fellow farmers and also from local markets. In most cases, seed from these sources is poor quality and of low productivity. In order to solve the problem of seed unavailability, local communities have been engaged in production of quality declared seed (QDS). Unfortunately, QDS cannot be distributed far from where they are produced. In order to produce certified seed that can be distributed in many areas, communities need added expertise and close supervision from the Seed Certification Services.

The problem associated with unavailability of seed was envisaged to affect adoption of QPM varieties in Tanzania. Therefore during the inception of Dissemination of New Agricultural Technologies in Africa (DONATA) project, stakeholders agreed that adoption of QPM would only be realized if quality seed was made available within the project areas. They identified seed multiplication as one of the key components in project implementation so as to accelerate adoption for QPM. The DONATA initiative employed the Innovative Platforms for Technology Adoption (IPTA) approach. Three (IPTAs) came into operation in Tanzania at the start of the project late 2008.

One of these IPTAs called in Kiswahili language "Kikundi cha Wakulima wa Mbegu Muheza (KIWAMMU)", is located in Muheza District, Tanga Region. The platform was established to address the challenge of unavailability of quality QPM seed. The other platforms established in 2008 addressed other issues along the value chain such as how to increase QPM grain production quickly, value addition and improved marketing.

What was done

The IPTA activities started with sensitization events in order to create awareness of QPM technologies and the approach itself to some district administration officials, extension officers and farmers. A platform designed to focus on the production and distribution of QPM seed was established in Muheza district.

Structure and composition of the Muheza IPTA: The Muheza IPTA was launched on 27/2/2009 with members derived from various actors along the QPM seed value chain. Apart from farmers, the IPTA has membership from seed companies (TANSEED International and Aminata Quality Seed and Consultancy Ltd), District Council leadership (District Commissioner, District Executive Director, Division and Ward Executive Secretaries and Agricultural extension officers). The district extension officers offer advisory services to farmers in addition to training them in practices for maize production. Seed companies offer skills in seed production and postharvest handling. TANSEED International has also entered into contract with farmers to buy seed they produce. Tanzania Official Seed Certification Institute (TOSCI) controls seed quality through inspection of seed plots prior to planting and when the crop is ready for harvest.

Governance of the IPTA: Muheza IPTA has a formal management structure. During its launch, stakeholders elected a chairperson, secretary, treasurer and some other committee members to oversee and manage IPTA activities. The management, together with stakeholders, set by-laws for farmers who were to be the seed producers to ensure that they do not contravene the set rules for seed production. Some of the by-laws include on-farm destruction of the crop if the producer is found to have gone against seed production rules - for example, growing a non-QPM maize variety on the farm next to the seed plot. This particular by-law instituted by the platform served to self-regulate and police the IPTA farmer group members producing certified crops under contract with seed companies. This was also helpful to the regulatory agency, TOSCI, who often do not have adequate staff to inspect and implement sanctions such as the destruction of a compromised seed crop.

IPTA activities: After launching, the IPTA management committee continued sensitization of farmers and stakeholders in villages within the district. They also utilized opportunities of meetings organized at district and village levels to capture and sensitize large audiences. Early in 2009, management identified 21 farmers (5 of whom were women) in four villages (Kwelubuye, Potwe, Mwarimba and Mkanyageni) to participate in seed production. By 2012, this number had increased to 83.

Farmers' training sessions were carried out to build their capacity in seed production and handling. Areas of capacity-building included seed production techniques, post- harvest handling of seed and leadership and group management. Under seed production, aspects of isolation distance, proper spacing, fertilizers application etc. were covered. Leadership training included, among others, principles of good leadership, roles of different stakeholders and management. Partners identified to have the required skills and experience needed to conduct the training provided the training. After training, farmers received inputs for seed production including basic seed of QPM and fertilizers. The IPTA put emphasis on the production of certified QPM seed so that other areas outside Muheza will have access to QPM seed produced by the IPTA. Tanzania Official Seed Certification Institute (TOSCI) was involved in all stages of quality control from the inspection of seed production plots to inspection of seed in the field as well as harvested seed. The IPTA managed to plant 20 hectares for Lishe K1 in 2009 and 15 acres for Lishe TAN H611 in 2010. In 2011, some 20 ha of Lishe K1 and 15 ha of TAN H611 were planted. Farmers cleaned and graded their seed under supervision of staff from seed companies and IPTA leaders. In order to increase demand for QPM seed, the IPTA embarked on promotional activities to enhance

the growing and consumption of QPM. This was done through promotional talks given to either nearby farmers or at village meetings, during field days and national agricultural shows called Nanenane and through mass media.

Relationship between farmers and seed companies: The IPTA approach has facilitated and built a mutually beneficial relationship between farmers and seed companies. Seed companies and farmers sign contracts for seed production. In this relationship, the seed companies provide foundation seed to farmers; train them on practices of producing quality seed and post-harvest handling of seed. They also pick the raw seed from farmers, transport it to their storage facilities where they sort, and grade, clean, dress and package it. Finally, they distribute it to agro-dealers.

The IPTA has been instrumental in the value chain by enabling farmers to access input and output markets. Companies deliver inputs to farmers, purchase their seed and distribute it to other stakeholders including agro-dealers. Companies also benefit by accessing more land and labour from farmers at low cost that they would never be able to acquire on their own. Farmers have, on the other hand, gained experience in seed production, have learnt to treat their farming enterprises as businesses and have also increased their earnings.

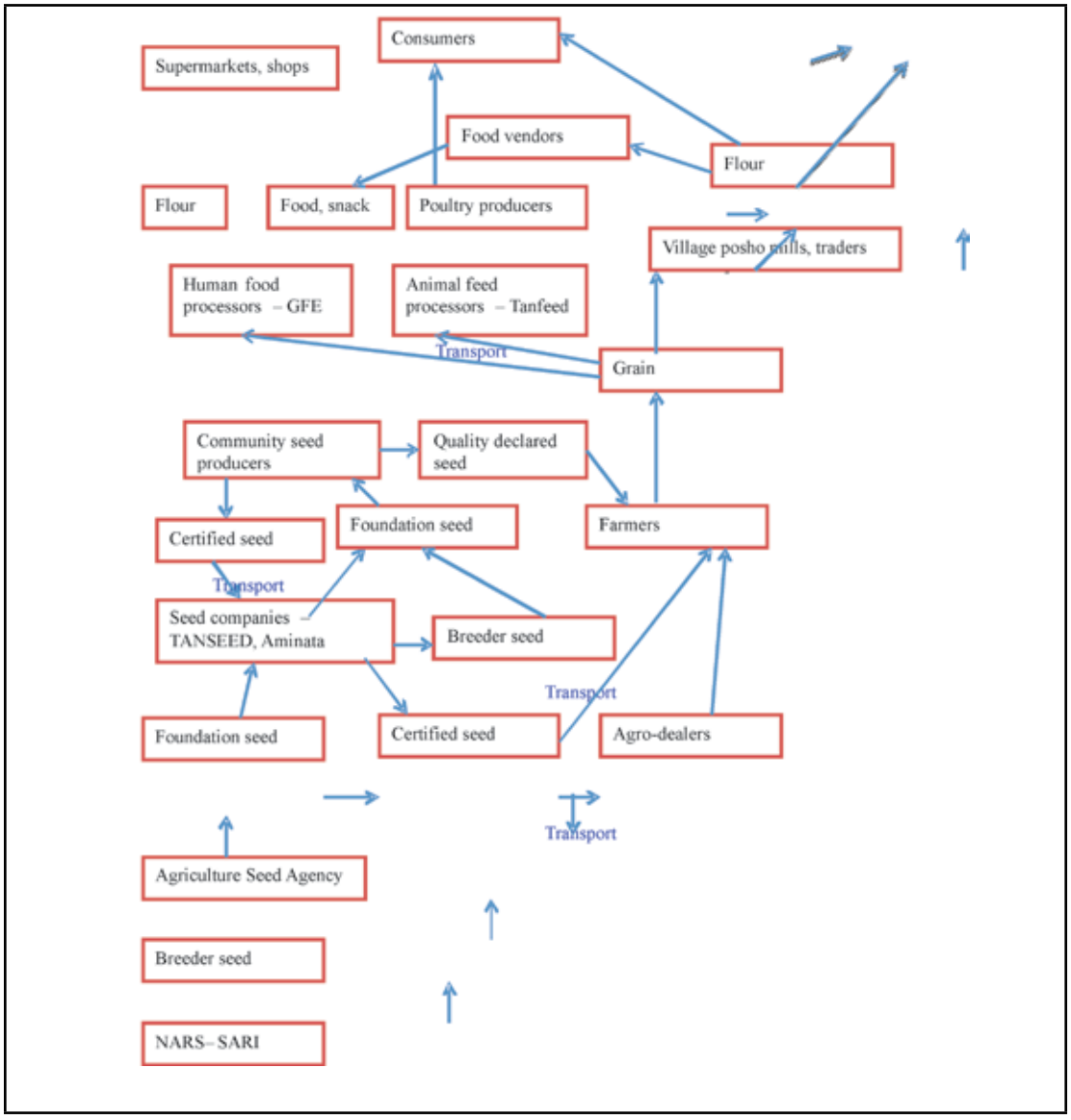

Figure 11: Tanzania Quality Protein Maize value chain

Key achievements

In summary, two platforms dedicated to seed production were established and operationalized under DONATA. Muheza IPTA was the first to be formed at the start of the project in 2008 and by the time DONATA was coming to its end in 2013, the farmers in platform were well trained in seed production and were fully linked to the two seed companies and were producing QPM seed under contract. The second platform, Korogwe IPTA was established in 2011 in similar way as Muheza IPTA. Two QPM varieties, Lishe K1 and TAN H611, the first an Open Pollinated Variety (OPV) and the second a hybrid were promoted in Tanzania using the IPTA approach. Through the IPTA activities, farmers who acted as seed producers received various trainings on production of QPM certified seed and in the use soil fertility options such as intercropping maize and legumes (such as pigeon pea) as ways to improve yields and mitigate effect of drought. Project reports indicate a total of 456 farmers (396 from Muheza and 60 from Korogwe) were engaged in QPM seed production for the period of 2009 to 2013. Approximately 128MT of certified QPM seed was produced by farmers in the Muheza IPTA from a cumulative area of about 217Ha through the life of the project[4]. Approximately 58 MT of the seed has been sold to the two seed companies, from which the farmers earned equivalent US $19,426. The harvest of the 2013 crop (part of the 128MT) had not yet been sold by the time of writing this paper. Because the Muheza IPTA has been operating much longer that the one in Korogwe, most of the discussions on achievements and lessons learned are drawn from it.

Figure 12: QPM seed at Muheza

Farmer capacity in seed production built: The relations built by the IPTA between farmers and other QPM value chain actors have resulted in substantial capacity for farmers to produce seed. Farmers have gained skills and confidence in seed production and handling. Not only did the farmers in the IPTA gain skills in seed production, but also earned substantial income from the sale of QPM certified seed. Data on seed sales are presented below.

[4] In some years, the yields were so low due to effects of drought. For example, in 2012, only 3 MT was harvested from a total of 83 Ha planted with Lishe K1.

Table 5: Clean seed sales under Muheza IPTA

Variety	2009		2010		2011		Total	
	MT	USD	MT	USD	MT	(USD)	MT	USD
Lishe K1	12.4	3,863			24	7,500	36.4	11,363
TAN H611			10.5	3,938	11	4,125	21.5	8,063
Total	12.4	3,863.	10.5	3,938	35	11,425	57.9	19,426

Increased availability of seed: Seed companies played a great role in building the capacity of farmers in seed production, whereby inclusion of farmers in seed production also made it possible for increased land area under seed production that seed companies alone could not secure. This led to increased production of QPM seed, where also farmers and seed companies interacted to enhance seed multiplication and distribution. Apart from formal distribution of QPM seed, there are informal arrangements whereby farmers who produce seed, can sell some seed to their fellow farmers.

Increased demand for QPM by farmers and other stakeholders: Awareness-creation campaigns resulted in an increase in demand for QPM seed. As QPM seed became available and accessible, more farmers joined the platform and started producing grain for household consumption and sale. This necessitated a change in the platform mandate towards diversifying activities to cover other aspects on the QPM value chain rather than focusing on seed production alone. Awareness-creation activities and tasting of QPM products motivated farmers to grow QPM for home consumption and for sale to earn more income. Farmers saved a proportion of harvested seed and used it for grain production while maintaining their seed production role. Therefore, IPTA members benefited from consumption of QPM at household level and gained extra income from sale of the grain.

Increased number of beneficiary farmers: Benefits of the IPTA have extended beyond Muheza district. QPM has become popular far away from Muheza district due to the linkages created between seed companies (TANSEED International and Aminata Quality Seeds and Consultancy Ltd) and farmers. The linkages have been useful in facilitating post-harvest handling such as the processing and marketing of seed. The two companies purchase QPM seed from Muheza district and make it available to farmers and stakeholders far away from Muheza. TANSEED International buys QPM seed from Muheza farmers, processes and packages it before selling to other farmers in Morogoro and Coast Regions. Aminata Quality Seeds and Consultancy Ltd. sells seed to farmers in Tanga and Morogoro Regions.

The seed companies also organize promotional events aimed at creating awareness and sensitizing utilization of QPM, and they also sell QPM seed during these events. Promotional events and increased availability of QPM seed, have led to increase in the number of farmers cultivating QPM grain from 257 in 2009 to 1,062 in 2013.

Challenges

A lot of benefits to farmers in this IPTA were realized as outlined above. However, there were challenges to both the farmers and seed companies.

Violation of contractual obligations by farmers: Some farmers failed to sell the required amount of seed to the companies according to the initial contracts. Due to the need for money to take care of domestic needs, some farmers sold seed as grain before the companies returned to purchase it. Companies were compelled to advance some money to farmers so that they could meet their basic household needs. Even with these advances, some farmers still sold seed out of their contractual obligations, pushing companies into losses.
Failure of companies to pay for seed instantly: Farmers felt that they had to be paid for their seed when the company collected it. On the other hand, the company position was that a farmer gets partial payment, with the remainder paid after the seed has passed all laboratory quality tests.

Failure of agro-dealers to pay for seed delivered by companies: Most agro-dealers took seed from companies on credit but they also took a long time to pay, thus affecting company activities. The seed companies frequently have to vet for honest agro-dealers and request them to make part-payments when seed is delivered. Aminata Quality Seeds and Consultancy Ltd located in Tanga have established seed outlets in Tanga municipality and at Kwedizinga village in Handeni District where even small agrodealers and farmers can purchase QPM seed directly.

Failure to meet quality requirements for certified seed: Often farmers have failed to produce seed that meets the quality requirements for certified seed. Several factors are responsible for this, but the main ones are poor storage facilities and failure to adequately isolate seed production fields from other maize fields. Farmers do not have suitable storage facilities for seed. Subsequently, seed gets contaminated and loses its quality and value. Seed companies therefore have had to incur extra costs in making close follow-up visits to farmers to ensure proper storage conditions are adhered to.

Sometimes it is difficult for farmers to get fields for producing QPM seed that are far enough from other maize fields to meet the mandatory isolation distance. This jeopardizes the quality of seed in terms of genetic purity, sometimes leading to its rejection by TOSCI. This in turn discourages farmers from participating in seed production especially those that are not endowed with large land resources.

Frequent drought and unreliable rainfall: Unreliable rainfall and frequent droughts lead to low QPM productivity especially where there are no irrigation facilities. Amanita Quality Seeds and Consultancy Ltd has consulted district authorities to offer farmers rights for the use of rivers for irrigating their crops. Setting up of irrigation facilities implies another cost that may discourage more farmers from producing seed.

Perceived low prices for QPM seed by farmers: Farmers have reported that they are uncomfortable with seed prices offered by companies. They feel that their seed is worth more than they are paid, having hoped that they would have been able to sell the seed at retail prices. However, seed companies continue to educate farmers that the difference in price is due to operational costs incurred by seed companies before seed reaches the market. These costs are related to transport (especially when seed companies are far from the production point), sorting/cleaning, seed dressing, packaging and storage. However the introduction of Aminata Quality Seeds and Consultancy Ltd within Tanga Region has minimized transport cost since the factory is not very far from the farming community. Farmers' visits to Amanita factory, have even helped them in learning post-harvest seed handling issues for quality maintenance and hence appreciated the role of seed companies in making seed to reach market.

Producing certified seed is still a challenge to many farmers especially those who joined the IPTA later as a group with small acreages: Farmers with a small amount of land have to grow seed as a group hence requiring more supervision so that no one farmer violates the seed regulations. Thus, quality maintenance from fields through to harvesting and post-harvest handling is difficult for many seed producers in the IPTA. The mandatory isolation distance restrictions and the special care needed (especially for hybrid seed production) are still challenging to many farmers. In 2010 and 2011, farmers produced variety TAN H611. However, in 2012 most farmers lost interest in TAN H611 after they realized that it required more time and care to produce. Farmers subsequently demanded a guarantee that they would be paid more than USD $0.37 per kilogram before they could engage in production. By the time the company made a decision to pay a high price (USD $0.50) per kilogram, farmers had already planted other varieties. The other challenge is that companies sometimes fail to supply farmers with enough basic seed, especially when the season has been preceded by drought.

There is also a perception that farmers are the only ones supposed to play a major role in the IPTA and, to a lesser extent, local government actors are considered. The remaining actors are thought to be providers of technical support and advice. This may affect the efficient operation of activities that need expertise and

attention and hence jeopardize seed quality. If farmers alone are involved, coordination efforts will be minimal. Multi-stakeholders' involvement helps in resource mobilization for coordination of other activities that will not be possible by farmers alone. For example, the seed companies incur extra costs availing staff in training, the provision of basic seed and frequent monitoring so that Tanzania Official Seed Certification Institute (TOSCI) regulations are followed to ascertain the approval of most seed fields. These efforts are beyond what seed companies do to other contract famers.

Other challenges: QPM seed production in the Muheza IPTA is also affected by other factors. These include high agro-input prices, crop damage by vermin, pests and diseases.

Lessons learnt

Multiple stakeholder involvement is key for technology dissemination: Many stakeholders imply that various roles are played by those that are best suited to perform them. For example, through the platform and the facilitated interactions, farmers in the Muheza platform were trained by stakeholders with skills in the production of quality certified seed. They also bring into the IPTAs a diversity of knowledge, experiences and expertise that ultimately result in the smooth functioning and success of the IPTA.

Anticipated benefits attract actors: When a benefit is expected, actors will actively participate in IPTA activities. These benefits may or may not necessarily be financial; for example, farmers are gaining knowledge in seed production while seed companies are getting more land from farmers for seed production and hence increased seed quantities that would ensure they continue in the seed business. Therefore, IPTAs should be run in a way that ensures that each actor benefits. Otherwise, participation of actors who feel they are not benefiting in some way will reduce, and such actors may opt out of the IPTA. For example, seed companies are motivated to participate because of the business interest, and especially when the marketed variety has their brand name. This makes it more attractive for them and easier to enter into contracts with farmers and also to offer the necessary technical support. This linkage also benefits farmers because they are assured of a ready market for the harvested seed and hence they will continue to produce seed.

Efforts should be made to involve big companies: The involvement of big companies in IPTA activities helps to create more demand as they can easily fund their participation in field days and national level agricultural shows.

Plans should be made to handle the increased demand for QPM seed: The success of QPM seed production in the Muheza IPTA has created demand for seed to produce grain for direct utilization. This also implies that there will be demand for more land. Farmers should be helped to secure this land in advance.

Outstanding issues and future directions

At the phase out of DONATA-QPM project in March 2013, there will be need for setting up sustainability strategies to ensure continuity of activities. Some of the approaches the IPTA proposes to implement to ensure sustainability include:

Formation of a revolving fund: The IPTA plans to sensitise and mobilize farmers to contribute some money to create a revolving fund to support and sustain seed production enterprises.

- Expansion of production to meet increased demand for QPM seed.
- The IPTA needs to ensure that the farmers understand what the market demands so that they produce the right product.
- Building capacity of IPTA members so that they can be able market clean seed that will attract a high price
- Credit access for both agro-dealers and farmers. Creation of modalities for seed companies to continue working with farmers beyond the project period.

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Experiences on use of formal and informal seed system to facilitate increased access to quality protein maize in northern Uganda

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Introduction

The Seed Industry in Uganda can be characterized into three systems as follows; a formal seed system, traditional farmer saved or farmer-to-farmer informal system and quality declared seed system.

The formal seed supply system: This system is strictly regulated throughout the entire process of research, production, processing and marketing of the seed. The sector is organized on a commercial basis with the participation of seed companies registered and fully regulated and supervised by the Ministry of Agriculture, based on the Seed and Plant Act and the attendant regulations, including International Standards such as the Organization for Economic Cooperation and Development (OECD) and the International Seed Testing Association (ISTA) Standards. A good amount of the seed is produced and marketed in this system with high genetic and purity values and export potential. Unfortunately, the formal sector is able to supply less than 60% of maize seed demand and less than 20% of demand for vegetatively propagated materials. Hybrid seed varieties are planted only once, and the farmers have to revert to the seed companies who dominate this sector for fresh seed every season. The formal seed sector is able to supply about 20% of improved seeds that are of well-defined quality in respect of genetic purity and physiological, physical and phytosanitary quality.

The strict regulatory regime imposed on this sector, the high quality standards thereof and the fact that the private sector meets all the costs for the foundation seed, its multiplication, inspection and certification services, processing and marketing makes the hybrid seeds relatively expensive to the resource-limited farmer and in short supply, thereby calling for complementary systems to increase the supply of seed to the wider farming community.

The traditional farm-saved-seed system: The traditional seed system is known as the farmer-saved-seed-system/ informal system, whereby an individual farmer positively selects from his/her garden some healthy, large-sized (and probably tasty) part of the crop such as a maize cob and keeps the seed for the next season's planting. Seeds of grain in crops such as maize are at times kept above the fireplaces and smoked as a way of protecting them against storage pests. This system is common among small-scale farmers, mainly dealing in food security crops for which the formal sector has very little interest. Some of the preserved seed is given to neighbours or relatives, thereby contributing to the farmer-to-farmer informal system supply system. It is not regulated by the government and limited in scope.

The selection of seed is based on external characteristics such as size and colour and does not consider such parameters as germination, purity and moisture content. The informal seed system, can, at most, supply most of seeds of traditional or orphan crops such as groundnuts, millet, sorghum, sesame, field peas and cow peas, which are very important food security crops for the majority of the population in the country. Although limited in the quantities of quality seed it generates, the informal seed system contributes the bulk of seed supply (about 80%). The informal seed system also conserves the biodiversity of different seed crops from season to season. The farmer-saved seed system should therefore be encouraged to make these contributions and

to conserve the land races (traditional varieties of crops) with the good attributes such as pest and disease resistance, palatability and adaptability that make significant contributions during the research processes.

The quality declared seed system: This is a semi-commercial but informal seed supply system. It is a community-based system commonly referred to as the Quality Declared Seed (QDS) system: selected farmers or farmer groups are given foundation (elite seed) from research stations or formal seed companies and they multiply the seed under the guidance of agricultural staff. The seed does not undergo the full scale of government rigorous certification processes. Only simple standards on crop health and hygiene are adhered to by the seed producers, provided the source of the foundation seed is known and therefore traceable. Only 10% of the seed crop by the farmer group is inspected once, at the critical stage such as flowering.

The seed multiplied may be passed on to other farmers or farmer groups for further multiplication before distribution to the wider farming community, who may use it to grow food crops. In this manner, many farmers are able to access improved seed varieties efficiently and at a cheaper cost than the formal seed sector. The Quality Declared Seed system further serves as a Research-Extension-Farmer linkage, for quick adoption of improved technologies. Under the Quality Declared Seed system, the Agricultural Staff guide the farmers/group of farmers on the best practices in terms of crop management, work ethics and marketing of the seed that is trusted by the local market and valued by the customers who are prepared to meet fairly high prices and return patronage. In this context, although the seed is not certified and therefore "not standard seed" in the technical sense, the product is strongly advocated as being fairly cheap and suitable for planting, and of superior quality to the seed available on the existing informal (local) market. Quality Declared Seed production system is not considered a competitive system to the existing seed trade, but rather a bridge to address the key gap areas and enable reaching small-scale farmers who do not use certified seed for their crop production. Therefore, the quality- declared seed was highly promoted to ensure the fast multiplication of improved seed varieties through a community-based approach in the IPTA.

In the context of seed, maize is a major crop in terms of production, consumption and income generation. The crop yields well and can be cultivated in a wide range of environmental conditions. It also plays a very important role in the nutrition of both humans and livestock as a source of energy and protein. The nutritional importance of maize has become even more important with the introduction and dissemination of quality protein maize (QPM) under various promotional efforts. The main advantage of QPM is the fact that it contains higher levels (>8%) of the essential amino acids lysine and tryptophan, that the body needs and cannot be derived from the normal maize (Knabe et al., 1992; Osei et al., 1999). Thus, QPM is nutritionally superior because it has more available protein and offers cheaper source of protein compared to eggs, fish and meat in areas where maize is the main staple food. It is has been shown to offer 90% of the nutritional value of milk (Olakojo et al., 2007; Upadhyay et al., 2009).

In Uganda, two QPM varieties were released - Longe 5, an open pollinated variety, and Salongo, a hybrid. Their release was followed by several dissemination efforts mainly in central and eastern regions through the QPM working group that comprised several stakeholders that resulted in increased adoption. In areas where these varieties have been taken up, adoption was influenced by their superior agronomic performance, cooking and sensory characteristics (taste and flavour); understanding of QPM's nutritional benefit; higher participation of the farmers in QPM evaluation; and reliable and continuous supply of seeds (Hugo de Groote et al., 2010). Adoption of QPM varieties however, remained poor in areas where farmers were not exposed to the varieties.

Northern Uganda, where QPM was promoted and up-scaled, was just settling from a long civil war that affected the farming system. One or two seed companies operated in that region with limited outlets and most farmers did not have access to improved seed and/or could not afford seed purchase. Few Non-Governmental Organizations were engaged in seed distribution as relief but this effort was faced with several challenges including increased incidence of counterfeit seed, inadequate extension services for crop management and

expensive accompanying inputs such as fertilizers. The National Agricultural Research Organization (NARO) partnered with other stakeholders in the QPM value chain to disseminate QPM technologies in former war affected areas in northern Uganda using a unique approach of innovations platforms for technology adoption (IPTA) under the project Dissemination of New Agricultural Technologies in Africa (DONATA).

As a result of the IPTA activities, demand for QPM seed attracted agro-dealers to stock seed and other agro-inputs. The agro dealers' efforts, however, could not satisfy farmers' seed demand. One way was to train farmers in the IPTA on aspects of seed production for establishment of community-based seed producers who would sell and/or share locally as quality declared seed (QDS). Due to limitations of QDS in seed distribution, in the 3 IPTAs established in districts of Gulu, Lira and Oyam, each had a component of community-based seed production. Herein, we share experiences of the seed system, both formal and informal, operating within the IPTA in a complementary approach.

What was done

Creation of IPTAs: The IPTA activities commenced in 2008 with the launch and sensitization activities in the project area. A planning meeting was held in Lira from which establishment of two IPTAs was agreed; one to be based in Lira and the other in Gulu. It was agreed that the Gulu and Lira IPTAs should concentrate on seed and grain production, respectively. In the two districts, farmer groups were established and assigned roles. For example, in Lira, Ogur United Mothers, Camkwoki Grass Root Initiative for Development and Rural Livelihood Promotion Initiatives were to spearhead technology uptake activities. The District Local Governments provided technical backstopping, advocacy, supervision and monitoring and evaluation. Sasakawa Africa Association (SG2000) and NARO provided technical backstopping. In addition, NARO would provide breeder and foundation seed to jump-start grain production. Meanwhile, media organizations, particularly Mega FM and Radio Waa, played an important role on information dissemination and awareness campaigns. Seed companies such as Pearl Seeds and NASECO participated as actors and provided certified seed, set-up demonstrations and trained farmers. A management committee was formed to govern all the IPTAs.

Training was an important activity conducted within the IPTA to empower the farmers with knowledge of quality seed production and entrepreneurial skills. Farmers received training in practices of maize field production and post-harvest management, marketing and other business skills. Within the IPTA, small farmer groups were used as farmer field schools, where training was carried out following FAO's approach. These schools evolved into commercial farming associations when the farmers learned new marketing skills. As a result of the training, farmers were able to test and select new QPM varieties for local adaptation and market demand. Consequently, farmers saw the need to switch from an old version of Longe 5 to an early and disease resistant version, Longe 5D after realising that it was more suitable for the drought prone environment in northern Uganda. Farmers were also trained in production of quality declared seed (QDS) and engaged in seed selling with their localities. Training in post-harvest handling involved QPM seed selection during harvest, drying and storage. They were also trained on enterprise development and agricultural innovation systems. As a result, farmers were able to map out all the boundary partners and define roles.

Training conducted by research on seed production including isolation, seed selection and processing

To support the project's capacity-building objectives and efforts, each IPTA was given start up small equipment and inputs such as ox-ploughs, knapsack sprayers, fertilizers and insecticides used mainly in the training and establishment of demonstration plots with the hope that farmers would learn from these plots and be motivated to purchase inputs. Training of trainers played important role in conducting trainings and were supported by bicycles for their movement and monitoring activities of demonstrations and seed multiplication fields.

Key achievements

Adequate quantities of QPM breeder and foundation seed were multiplied and distributed within IPTA and neighbouring areas: access to improved seed and perceived high seed prices were the main challenge to farmers who were used to free relief hand outs; however, there was a clear shift from dependency and seed hand outs to self-reliant seed production initiatives. The farmers also realized an opportunity for additional household income through sale of seed. A total of 892 kg of breeder seed from research and 4,530 kg of foundation seed were produced and processed for seed production activities within the IPTAs. Increased availability of breeder seed for Seed Companies provided opportunity for bulking and sales to IPTA and non-IPTA areas following increased awareness and demand for QPM seed. Partnering with companies, NGOs and farmers in the IPTA arrangement increased demand of Longe 5 that currently commands 40% of the seed market and increased area of maize under improved varieties.

Figure 13: Seed selection and sorting out of ear rots infected cobs from Quality declared seed

Farmer capacity in seed production built: following several training activities, farmers in the IPTAs are now skilled in all aspects of production and post-harvest handling maize. In some seasons, the project facilitated each IPTA with the necessary equipment such as fully fitted ox-ploughs, knap sack sprayers and bags of fertilizers and termiticide for demonstration purposes. In addition, ToTs received bicycles to enable them move and monitor demonstrations and seed multiplication fields. Tarpaulins for drying and handling harvested seed were also provided.

Increased and timely availability of QPM seed in the IPTAs

Training and provision of start-up breeder and foundation seed increased availability and timeliness of seed for farmers for planting. On average, each IPTA produced 5T of seed. In addition, the participating seed companies

played an important role in building capacity of farmers in seed production and establishing local agro-dealers, thereby reducing the cost inputs for the farmers. Some of the trained farmers were selected by seed companies as contract farmers for their seed production offering them premium prices and this relationship cultivated a business attitude from the farmers.

Challenges

Failure by the seed companies to buy farmer produce: in some cases farmers failed to produce enough quantities of seed. Seed companies thus never found it worth to invest in transport to collect just a little produce. Farmers were forced to sell seed as grain at a much lower price.

Unpredictable weather pattern: some seasons were characterised by unreliable rainfall or short rains. Crop yield was thus negatively affected in such seasons; thus discouraging producers.

Lack of storage facilities: some farmers lacked proper facilities and were often forced to sell their produce early when the market was still oversupplied. They therefore had to accept a low price.

Isolation distance for maize seed production: maize seed production requires an isolation distance of between 200 and 400 m. This requirement was very difficult for many farmers to meet. Many were thus left out of the seed production enterprises.

Lessons learnt

The experiences in the project demonstrated that the IPTA approach allows innovation. For example, in the Lira IPTA, a spacing of 75 x 30 cm with one plant per hill was found to give the highest yield in comparison to the recommended 75x60cm and two plants per hill.

Given the right environment, training and support, smallholder farmers can play a leading role in identifying markets and successfully exploiting higher-value market options.

Outstanding issues and future directions

The IPTA approach of technology transfer has just been introduced in northern Uganda as a pilot project. Although farmers see great promise in the approach, there is the need to think and put in place measures to sustain it. These measures will include ways to pool resources from among farmers themselves; understand market demands so that farmers respond appropriately; credit access, expansion of production etc.

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Theme 2: Grain and Roots Production

Introduction to key constraints and issues in the grain and root production systems for QPM and OFSP

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Both QPM and OFSP face a yield-gap between the potential of the varieties of each crop grown under research-managed conditions and what is achieved under farmer-managed conditions. Sweet potato, on-farm yields for smallholders are around 6-10 t/ha whereas under research and commercial production systems yields of up to 40 t/ha can be realized (PRAPACE, 2008). Yield increases can be achieved through improved varieties (20-50%), and the use of clean, quality planting materials (30-50%), improved crop management and input use. Large yield improvements can be made through improved agronomic (60%), weevil control (10%-20%) (Oswald et al., 2008) and sweet potato virus disease (SPVD) (management 66-90%) (Gibson and Aritua, 2000). These can bring additional benefits not only in terms of yield, but also marketable value, and consistent supply throughout the year. However, we need to understand what farmers' objectives are in what are often rain-dependent, risky, diverse environments. The characteristics which have contributed to the crop's usefulness, i.e., low input requirements, ability to perform in marginal conditions and short maturation period, have also paradoxically led to farmers not considering it worthwhile to invest in improved practices. Therefore, incentives for intensifying crop management should be considered. The incentive to invest in production depends on what priority and use the farmer places on the crop; is it for home consumption, and/or for marketing? This in turn is influenced by agro-ecology, the crop's place in the farming system, gender considerations and intra-household decision-making. The most common including drought, poor soil fertility, sweet potato weevils, SPVD and a lack of enough clean vines at planting time. Thus sweet potato production technologies need to be available to support crop production under the different constraints, and access to markets should be enhanced to increase farmers' incentives to adopt them.

In QPM production like sweet potato, farmers are also faced with a several constraints. The major challenges include increased cost of agricultural inputs - especially fertilizers; access to quality seeds; pests and diseases; low soil fertility and frequent incidences of drought that ravage many areas affecting crop yields. These combined limited access to markets and poor marketing arrangements increase the risk to farmers of investing in best management practices and thereby contribute to the low productivity of maize in the region. To a great extent, use of improved seed is limited in most subsistence, smallholder agricultural systems. Although the genetic potential of most varieties is greater than 7 t/ha, the average farmer yields in the region are below 2.5 t/ha and post-harvest losses are high: estimated at greater than 40%. Field and storage insect pests are among the factors that reduce potential grain yields and increase post-harvest losses in storage. The challenge for agricultural practitioners, including extension, is to reduce the yield gap and increase farmer confidence to invest in better management practices, and hence increased productivity.

In addition to the aforementioned biological and marketing related constraints, many farmers have limited access to information and knowledge about available improved production practices. Even when they have information about improved crop management practices and varieties, smallholders often lack the skills on how to apply them and may not be able to access the quality seed or planting materials. The constraints associated with access to information and inadequate skill on how to apply the technologies is largely due to ineffective extension systems and dissemination approaches. Similarly, lack of access to seed of the improved varieties, either at the appropriate time or at affordable prices, is associated with ineffective technology delivery methods.

Therefore, it was critical in the interventions for both crops to understand the forces driving farmers' adoption and apply appropriate strategies that would put such forces into effective play. This included identifying and using the most appropriate ways to increase the supply of information and the improved technologies and inputs by different types of farmers building their capacity to put them into use. Underinvestment in the agriculture research and extension system, ineffectiveness of the conventional linear research-extension farmer linkages and challenges associated with poor farmer organization in value chains, have been singled out as among key factors that have contributed to ineffective technology dissemination and poor adoption across Sub-Saharan Africa and the search for alternative approaches (Gudrun Kochendörfer-Lucius and Boris Pleskovic (eds.). 2008.; World Bank 2006).

DONATA adopted the multi-stakeholder approach in the form of innovation platforms to address these challenges and improve adoption and production of QPM grain and OFSP fresh roots for home use and for marketing. Through the multi-stakeholder approach, different actors along the value chain would be brought together to plan, share information and knowledge and use it to come up with innovative ways to address the challenges such as access to quality seed, markets and marketing arrangements. Some of stakeholders in the platform would be from the dissemination and knowledge domain and would provide innovative ways and channels for information dissemination, while others would share and try out methods for linking farmers to markets and for building their capacity to improve production and marketing. The following case studies drawn from Kenya, Uganda, Tanzania and DRC illustrate how the IPTAs addressed these issues depending on their local context.

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Scaling out technologies for improved production of orange-fleshed sweet potato under the DONATA project in Kenya

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Background

Sweet potato (Ipomoea batatas L.) is one of the most important crops in unfavourable environments in Kenya, where poverty is common and severe. Because of its versatility and adaptability, it ranks as the world's seventh most important food crop after wheat, rice, maize, potato, barley, and cassava, as it constitutes a substantial source of carbohydrate and carotene (FAO, 2002). The crop is easily propagated and grows well with limited inputs under a range of rainfall patterns. The food security role of sweet potato is critically important in areas along the Lake Victoria basin due to the failure of cassava caused by the African cassava mosaic disease (ACMD) and cassava brown streak disease (CBSD) epidemics and striga weed infestation. Owing to rapid population increases, increased food prices and input costs for the staple crop maize, and persistent unfavourable climatic conditions facing the country, sweet potato is increasingly becoming more important.

The orange-fleshed sweet potato (OFSP) varieties are a cheap source of β-carotene and are important for the control of vitamin A deficiency (VAD), which is a major nutritional problem in Kenya. Globally, it is estimated that 250,000 to 500,000 preschool children go blind from VAD and about two-thirds of these children die within a few months after getting blind (Rule, 2001). Nonetheless, the yields are only 7 tonnes/ha compared 30-50 tonnes/ha obtained under experimental conditions (Ndolo et al., 2001). The low yields are caused by a range of factors including the growing of low yielding and late maturing varieties, use of inappropriate agronomic practices, limited quality planting material, pests and diseases, inadequate post-harvest utilization and marketing information.

The poor yield of OFSP can be improved by planting high yielding varieties with desirable traits and adopting appropriate agronomic practices. Farmers must have adequate quality planting material at the onset of rain, plant on time and control pests and diseases. Nutrient and weed management must also be taken care of for good yields to be realized. Planting of the right varieties and adopting good agronomic practices will not only lead to improved productivity, but also high volume of storage roots in the market and improved income to the farmer. The health and nutrition status of the households will also improve as more people eat the OFSP storage roots.

Despite efforts by KARI in collaboration with CIP and other partners to improve the profile of sweet potato through the release of improved varieties and development of good agronomic practices, the yields are still low. In addition, the belief the farmers have that sweet potato is a hardy crop that can grow and produce under adverse climatic conditions with minimal input led to farmers not considering it worthwhile to invest in improved practices. Besides, for farmers to invest in sweet potato production there must be incentives to do so. There must be a market for the crop that will return the investment to farmers.

A five-year project referred to as "Dissemination of New Agricultural Technologies in Africa" (DONATA) on OFSP was started in Kenya to enhance the production and utilization of OFSP for improved health and income of the households. The project was implemented through Innovation Platforms for Technology Adoption (IPTAs). The

IPTAs were organised around the value chain and were composed of different players along the OFSP value chain. The aim of the project was to up-scale the utilization of the OFSP for improved nutrition and income.

What was done

Formation of IPTAs

In Kenya, the DONATA project started with the formation of three IPTAs namely Busia IPTA, Bungoma IPTA and Mumias IPTA to take care of up-scaling OFSP technologies in Busia, Bungoma and Kakamega project counties respectively. The IPTAs were made up of different actors along the OFSP value chain. The actors consisted of partners who were directly involved in the OFSP chain activities such as storage root producers, seed multipliers, transporters, processors and traders. Other partners were service providers including NGOs, Ministry of Agriculture Extension staff and researchers. These IPTA partners represent actors in different segments of the OFSP value chain. By the IPTA partners coming together they are able to articulate innovative ways of upgrading the OFSP value chain and able to share some of their resources and experiences with different partners. Traders and processors in the platform provided information on the quantity and type of roots required in the market and processing industry. Seed multipliers ensured that quality and quantity of seed demanded by the root producers was met. The extension staff mobilized and trained communities on quality seed and root production. Researchers were responsible for capacity building in seed and root production as well as provision of suitable OFSP varieties as demanded by the consumers. Each IPTA had a coordinating office which was responsible for chairing IPTA meetings and providing quarterly and annual reports to the focal person. Composition of the IPTAs was dynamic with new partners brought in when necessary. The IPTAs also had informal agreements and silent rules for coordinating and managing the IPTAs. Each IPTA put in place sustainability strategies that will ensure that the activities continue even after the end of the DONATA project.

The main activities conducted by the IPTAs included the introduction of appropriate sweet potato varieties, capacity building in agronomic practices, provision of planting material, soil fertility management, control of pests and diseases and linking of the root producers to markets.

Introduction of improved varieties

The first OFSP varieties introduced to farmers in Western Kenya in 2000 were Zapallo, Salyboro and Kakamega. These varieties did not reach many beneficiaries because of lack of organized seed multiplication and distribution system. There was also poor interaction among the value chain actors, for example, while the seed multipliers talked of lack of demand for seed, the storage root producers did not know where to get the planting material. In addition, these varieties had low storage root dry matter contents while the Kenyan consumers preferred roots with high dry matter and a floury texture when cooked. In 2009 the project introduced a high beta-carotene and high dry matter variety Ejumula from the Uganda sweet potato-breeding programme. The variety was multiplied by the IPTAs through a three-tier seed multiplication system of primary (PMS), secondary (SMS) and tertiary (TMS) multiplication sites. As indicated in the value chain diagram (Figure. 14) for OFSP in Kenya, the initial clean planting material derived from tissue culture was multiplied at the PMS level by the Kenya Agricultural Research Institute (KARI)-Kakamega and two individual seed multipliers in Busia and Bungoma counties. The IPTAs and farmer groups used materials from here for setting up SMS plots. The groups then gave planting material to the group members and other farmers to establish TMS, which were used as a source of seed as well as root production. Individual seed multipliers who were producing seed for cash also did the multiplication of planting material. The Bungoma IPTA also used the Agriculture and 4-K club members in six primary schools to multiply planting material in the school gardens. The Siwongo Processing Company, based in Busia, was also involved in the multiplication of planting material. The planting material was used by the root producers for fresh root production. The fresh roots were consumed at home or sold to the market traders who later sold the roots directly to the consumers, processors or other distributors. Root producers contracted by the Siwongo Processing Company sold their fresh roots to the company. The processors produced OFSP flour

and other processed products which were sold to the other distributors and consumers. The yield of Ejumula declined after one year as a result of severe virus disease infection. In addition, the market preferred roots with pink or red skin colour while Ejumula had creamy skin colour. The project later introduced two new OFSP varieties Vitaa and Kabode also from the Uganda Sweet Potato Breeding Programme by the end of 2010. The varieties were evaluated with 10 farmers in Busia, Bungoma and Kabodo before they were released for wide-scale multiplication.

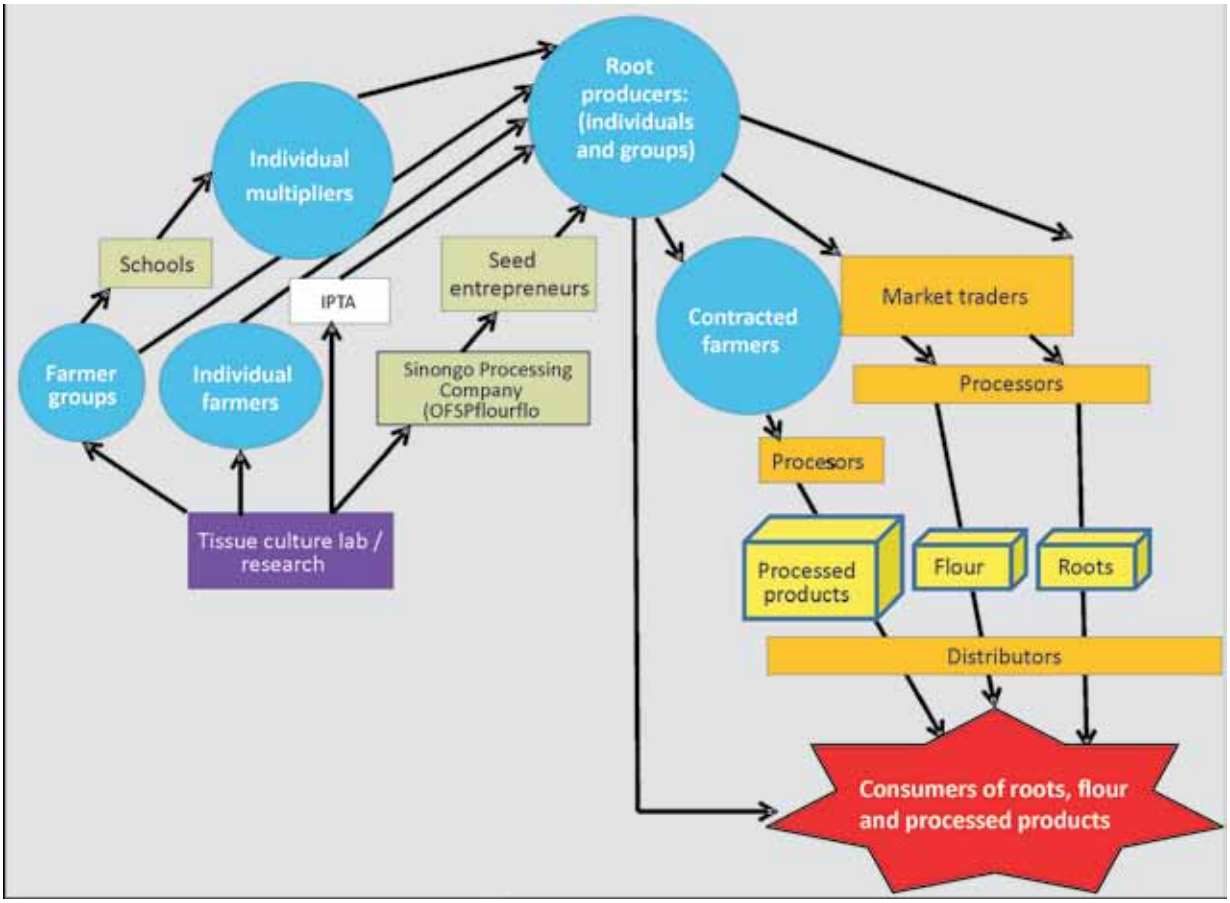

Figure 14: Linkages in the OFSP value chain and innovation platform in western Kenya

Promotion of production packages

One of the constraints to fresh root production was the use of poor agronomic practices. Farmers were planting late in the season because of limited planting material at the beginning of the rains. The IPTAs addressed this problem by promoting the use of wetlands for seed production, establishing nurseries in homesteads using waste water, and planting in areas next to water points.

The IPTAs enhanced capacities of farmers through training of TOTs and farmers on rapid multiplication techniques as a means of accelerating planting material production as well as identification of pests and diseases. Seed multipliers evolved when vines became a commercial enterprise. This ensured that farmers had planting material at the beginning of rains and they were now able to plant in good time and plant bigger area than before. The IPTAs also trained TOTs on good agronomic practices. The trained TOTs later trained farmer groups on good crop husbandry practices. The PMS sites were used as demonstration sites during the training of TOTs while the SMS sites were used in training of farmers. The training focused on time of planting, selection of quality planting material, ridging, spacing, hilling up, pests and disease identification and control, integrated nutrient management and harvesting practices.

The IPTAs also promoted good agronomic practices through field days, on-farm demonstrations, exhibitions, drama, radio talks and road shows. The IPTAs also used friendly promotion materials such as leaflets, posters and calendars to promote good crop husbandry. The production manuals were also developed and distributed to the TOTs and other extension agents in the Ministry of agriculture. The involvement of the extension service in the IPTAs played a big role in ensuring that messages on production of OFSP were consistent unlike before, when different extension agents gave conflicting messages to farmers.

Development of Seed Systems

Sweet potato production in Kenya has for a long time been limited by the lack of timely availability of quality planting material. Use of poor quality planting material has been shown to reduce fresh root yield in Kenya by up to 80% (Ndolo et.al. 2004). Farmers in areas affected by drought are forced to plant two months into the season. Late planting leads to limited area planted and reduced fresh root production. The situation is further aggravated by the lack of a formal seed system and low seed multiplication ratio. Effective seed systems are therefore needed to provide the farmers with planting material in sufficient quantities and at the right time. The IPTAs developed a sustainable planting material multiplication and distribution system. This ensured the availability of planting material to the storage root producers. The project engaged a private Tissue Culture laboratory (GTL) in Nairobi to multiply Kabode and Vita varieties. The plantlets from the laboratory were first hardened by the Kenya Plant Health Inspection Service (KEPHIS) before being distributed to seed multipliers in the three counties. KARI was also mandated by the IPTAs to inspect OFSP multiplication fields before planting materials were harvested and sold to the other seed multipliers or root producers: this was to ensure that the quality of planting material was maintained. The sale of planting material, which was a taboo in the area before, spurred the springing up of individual seed multipliers. The multipliers were willing to invest in the seed enterprise as it had good financial returns.

Achievements

Improved varieties were introduced

The new improved varieties- Kabode and Vitaa- were introduced in the target counties and evaluated by DONATA farmers before being released to farmers for mass root production. The evaluation showed that the new varieties were superior to the local ones in terms of yield and beta-carotene content (Figure. 15). They were also found to be affected less by the virus disease in comparison to Ejumula. Adoption of these varieties and use of quality seed by farmers significantly increased the yield of OFSP per hectare from 7 tonnes/ha before the project to 12 tonnes/ha after the project and potential yield of 20 t/ha under good management.

The IPTAs trained a total of 183 TOTs who later trained 106 farmers groups and 920 individual farmers on good agronomic practices. The number of people trained represented 15% of the farmers growing the OFSP varieties. The farmer groups conducted participatory monitoring of individual farmer's fields to ensure that they followed the right production practices. The IPTAs also organized field days and demonstrations in the famers' fields and used the farmers as trainers during the two activities. The Ministry of Agriculture extension staff were also using the DONATA farmers as trainers during field days and demonstrations organized by them. The seed multipliers were equipped with information on how OFSP crop is grown and were also giving similar messages to those purchasing seed from them.

Producers got access to quality planting material

The availability of quality planting material ensured that the OFSP root producers had planting material at the beginning of rains. Farmers became aware of the importance of using quality planting material. They also became aware of the pests and diseases that affect OFSP and their control measures. The root producers were ready to buy quality-planting material from whatever source. The presence of seed multipliers and the use of wetlands for multiplying vines during the dry season ensured that farmers had planting material at the beginning of rains. Figure 16 is an example of a vine multiplication field in western Kenya.

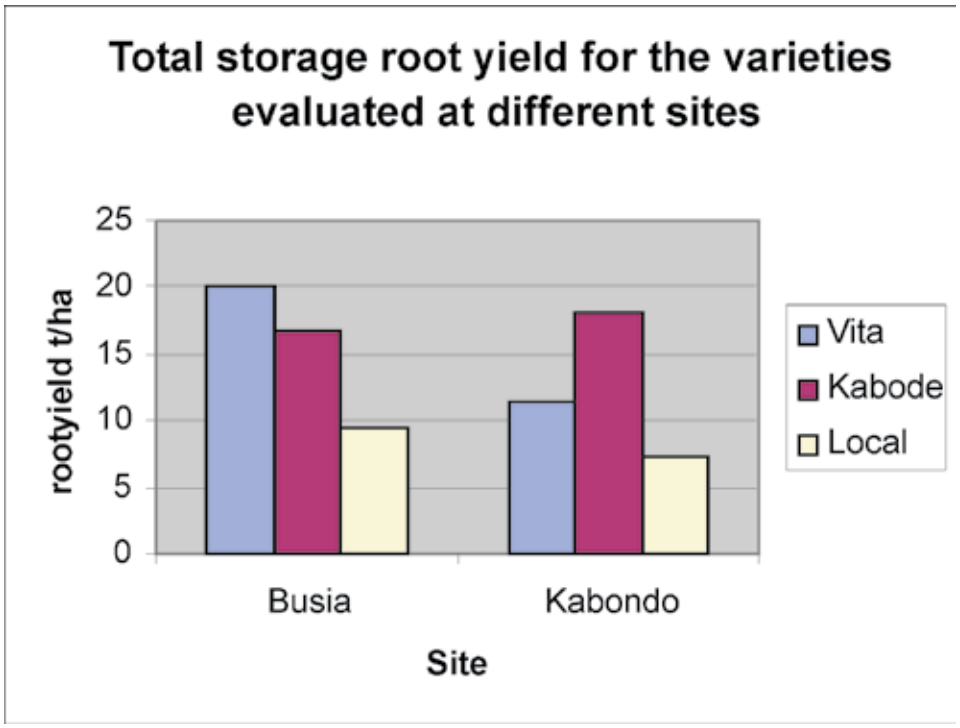

Figure 15: Yield of OFSP varieties Kabode, Vita and local varieties at two sites in western Kenya

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OFSP gained market

In the past, a limited amount of OFSP roots were sold in the markets and the bulk of the roots in the markets were white/yellow-fleshed types. Through awareness creation of the importance of OFSP by the IPTAs, the market for OFSP expanded. The number of consumers looking for fresh OFSP roots increased. The pink skin colour of the Abode and Vita storage roots also facilitated expansion of the market for OFSP. In Kenya, consumers prefer pink or red skinned sweet potato roots to cream coloured ones. The major market for fresh OFSP storage roots during the project period was the Siwongo Processing Company in Busia County. The company required 25000 tonnes of fresh roots per month to produce 5 tonnes of flour required by Azuri Health and 8000 tonnes of roots to produce 2 tonnes of dry OFSP chips for the Kirinyaga Millers. In order for the farmers to meet the demand by the company the IPTAs linked the farmers to the company. The root producers responded to the company's

demand by increasing their root production through increased area under sweet potato and productivity per unit area of land. Productivity was increased through the use of high-yielding varieties and appropriate production practices. The majority of farmers had fewer than 0.1 hectares under OFSP before the beginning of the project but this increased to about 0.4 hectares. Some of the commercial sweet potato farmers planted up to 2 hectares of the crop. The market pool from Azuri Health, Kirinyaga Millers and urban traders from Kitale and Eldoret stimulated farm-level increased planting and production of OFSP roots. The IPTAs recognized this demand and organized root producers to respond to this market demand.

Figure 16: Seed multiplication field

The Bungoma IPTA organized their farmer groups into production clusters. Five clusters were formed in 2012 with the number of farmer groups per cluster ranging from 5 to 32. Each famer group consisted of 20-30 members, bringing the number of farmers who benefited from the arrangement to between 2100 (1500 females and 500 males) and 3200 (2400 females and 800 males). Each cluster was run by a management committee, which was responsible for ensuring that all operations of the clusters were run smoothly. The committees in collaboration with the Bungoma IPTA were responsible for making production plans for the clusters. The plan included the amount of roots to be produced and area to be planted.The farmer groups within the cluster were staggering their planting to ensure that the company had a consistent supply of roots. Each cluster was assigned a specific week to harvest and deliver the roots to the collection points a day before collection.The roots were sorted before transporting them to the collection points for weighing and delivery to the company (Figure 17). The Company and sellers had a "gentleman's agreement" in which the price and quality parameters were agreed upon before purchase. Farmers were paid USD $0.15-0.20 per kg depending on how the roots were delivered to the processing unit. Each village was contracted to deliver two tonnes of fresh roots per week.

In order for the processing company to ensure improved supply of roots it contracted a number of individual root producers. These were given free seed on condition that they sold the roots to the company and returned the equivalent amount of planting material given to them. The returned planting materials were given to new farmers or sold to other root producers.

Figure 17: Farmers sorting and weighing roots at the collection point

Farm Concern International (FCI), which was a member of the Busia IPTA, linked the Bungoma cluster farmers to the sweet potato traders in Kitale and Eldoret. The traders usually informed the farmers through the cluster committees three days before the collection day. After harvest, farmers sorted their roots and graded them. The marketable roots were put in extended bags and taken to the collection centre where they were weighed. A total of 58 metric tonnes of fresh storage roots have been sold to the traders between November 2012 and April 2013.

Challenges

- The staggered planting in the absence of irrigation facilities was not very effective. Fields planted late in the season did not get enough rains and were more affected by the sweet potato weevils than those planted at the onset of rains.
- Storage facilities were not available which made it difficult for farmers to utilize favourable market periods.
- Farmers were exploited by individual traders who were using extended bags.
- Conflict between livestock farmers and OFSP producers arising from competition for the wetlands during the dry season because the animals were also grazing in the same place.
- Sweet potato virus disease continued to be a major threat to the production of OFSP roots.
- The two varieties Kabode and Vita are very susceptible to the Erinose mite.

Lessons learnt

- Gender equity: Sweet potato production was in the hands of women before the project started. As sweet potato became more commercialised, men realized that sweet potato could be a profitable enterprise and are getting more involved in its production than ever before. For example, the first groups to be involved in planting material multiplication were women groups. However, when the groups started selling and getting money from multiplication, men became interested. Now, most of the individual seed multipliers are men, while women are involved in group multiplication plots or work individually at a lower scale. These changes highlight the need for gender-specific actions to ensure that women can benefit from project-supported training and the need for discussion during training and at household level about the allocation of income benefits. It is thus important to reach women with messages on better agricultural production techniques as well as nutritional education. At the same time, men control family resources in the project areas and are the key decision makers regarding allocation of land and crops, so their role must be also considered.

- Timely availability of quality and quantity planting material resulted in increased root production, timely planting and increased availability of roots in the market. Sweet potato was mostly regarded as a woman's crop, but through sensitizations and awareness creation on nutritional and commercial aspects of OFSP by the IPTAs, both gender are now involved in its production and marketing.
- Use of IPTA enhanced collaboration and information sharing among the partners in the OFSP value chain resulting in increased production and marketing of OFSP.
- The market pool provided by the Azuri Health and Kirinyaga Millers through the Siwongo Processing Company stimulated farm level increase in demand for quality planting material and enhanced root production. The IPTAs used this to organize farmers into clusters for bulk selling of the roots.
- Commercialization of OFSP roots and vines has resulted in significant shift of the OFSP sub-sector from being a subsistence to a cash-earning enterprise.
- Financial gain from OFSP roots and vines has made sweet potato root producers plant quality vines, unlike before when farmers used any planting material from their previous crop or neighbours.
- Timely surveillance of pests and diseases has now been recognized as an important activity in OFSP production.
- Information dissemination on OFSP through the IPTA approach was cost effective as some of the IPTA members used their own resources to organize some of the meetings or used their forums to pass information.

Thoughts for the future:

- There should be a sustainable strategy for ensuring the availability and maintenance of quality planting material. This will require continued linkage with GTIL for provision of tissue culture planting material and using the recently developed technique for conserving quality planting material using fleece tunnels (Obusuru et.al. 2011)
- Players should see how best to capitalize on the favourable government policy on biofortification of foods by promoting the consumption of provitamin A-rich OFSP
- There should be economic ways of utilizing OFSP peels e.g. using them as poultry or livestock feed, which will require linking with livestock enterprises.

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Promotion of orange-fleshed sweet potato production and consumption in northern Uganda

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Background

Sweet potato is one of the most important staple crops in Northern and Eastern Uganda. Many farmers, including those with limited land, labour and capital cultivate sweet potato. Unlike cereals and grain crops, farmers harvest sweet potato piecemeal as needed for home consumption and/or income generation. Most sweet potato varieties cultivated in the Lango region, northern Uganda are white-fleshed implying that they have negligible amounts of Vitamin A. Orange-fleshed sweet potatoes contain reasonable quantities of beta-carotene (Kapinga et. al., 2010) a precursor of Vitamin A and thus provide a cheap remedy for vitamin A malnutrition related ailments including poor vision.

Four orange-fleshed sweet potato (OFSP) varieties were introduced into the region to among other reasons provide vitamin A to the population. These were: Kakamega, Ejumula, VITA (Naspot 9 O) and Kabode (Naspot 10 O) (Mwanga et. al., 2007). However, dissemination of these varieties was hampered by lack of clean planting materials mainly due to the prolonged dry period (usually from December to March) that dries out the sweet potato crops completely. Others reasons include poor agronomic practices, high prevalence of pest and diseases (Stathers et. al. 2005) and roaming animals. As a result, farmers delay sweet potato production until June/July. In order to increase production and consumption of OFSP, proven, available and emerging technologies for production were promoted through a DONATA project employing the innovative platform for technology transfer (IPTA) approach. Overall, the project objective was to increase production, utilization of OFSP and processed products resulting into food security and nutrition, as well as increased livelihood and economic growth in Northern Uganda. Specifically, the project aimed at (i) enhancing OFSP production in Northern Uganda, (ii) strengthening capacities for OFSP production to enhance production-to-consumption continuum, and (iii) making available information on OFSP production and consumption in Northern Uganda.

What was done

IPTA initiation: A workshop to initiate the project in Northern Uganda was held in Lira in August 2008. Several stakeholders were invited and included non-governmental organisations (NGOs), government institutions and Community Based Organisation (CBOs). NGOs included Development Training and Research Centre (DETREC), Agency for Sustainable Rural Transformation (AFSRT), Camkwoki Grassroot Initiative for Development (CGIFD), Mid North Private Sector Company Limited (MNPSCL) and the Red Cross. These have varied expertise including crop production, processing and marketing. During the workshop, a project work plan was developed. Organizations that participated in the workshop formed the Lira IPTA. Ngetta Zonal Agricultural Research and Development Institute (NgeZARDI), a government institution, became part of the IPTA in December 2008 when the International Potato Centre (CIP) identified it. The constitution for the IPTA was drafted and fields were opened for planting OFSP. Subsequently, a new Institutional Framework for the Lira IPTA was adopted. District leaders were briefed on the project activities and radio talk shows initiated to disseminate information on OFSP. The Lira IPTA actors identified 650 farmer groups to participate in the promotion of OFSP. Extension agents from IPTA member organisations were selected and trained as trainers on different aspects of sweet potato production. The trained extension agents in turn trained farmers. Monitoring visits by contact persons and CIP technical personnel backed farmer training. Under the Lira IPTA arrangement, membership is granted after their expertise is assessed and found relevant. However, one is free to resign membership of the IPTA at will.

Production and dissemination of OFSP production technologies: The Lira IPTA did not come up with a uniform model for scaling up OFSP technologies among member organisations. Farmer groups under each IPTA organisation that identified OFSP production as one of their enterprises to be carried out were given vines and trained on sweet potato production and management practices. The vines were passed on from one farmer group to another within the organisation. Some vines were sold or passed on to relatives and neighbours. Plans are under way to form an association for OFSP producers to further the scaling up of the OFSP production activities in the region.

Training OFSP technology dissemination: OFSP production technologies were passed on from research to IPTA member organisations. Within IPTA member organizations, ToTs were trained who in turn trained group members in their respective organisations. Researchers provided technical backstopping including cleaning varieties of diseases and supervising seed production activities. Trainings were conducted at farmer level whereby farmers carried out all practicals on their fields during trainings sessions. Each trained farmer applied the knowledge gained both in group and family level activities. At family level, an opportunity was availed for relatives and friends to access OFSP production technologies. This further aided the dissemination of OFSP technologies.

Other stakeholders were mobilised to promote or disseminate OFSP production technologies. These included institutions such as schools and colleges, health centres and people living with HIV and AIDS. Students involved in planting OFSP in their respective schools passed on the technologies to their parents and neighbours. Meetings were also organized to sensitise district leaders, local councils and the general public on the project and the importance of OFSP in particular. Information was also passed to the public through radio talk shows, brochures and news. Field days and shows were also used to pass information to the public.

Achievements

Internal capacity for local organizations built: Lira IPTA is made up of ten organizations some of which played a specific role or set of roles. Nen Anyim Agro Processor's Entrepreneur (NAAPE) was involved in processing. Mid North Private Sector Company Limited (MNPSCL) and Micro Small and Medium Enterprise (MSME) Consult provided business services. Agency for Sustainable Rural Transformation (AFRST), Development Training and Research Centre (DETREC), Uganda Red Cross Society Lira Branch (URCSL), Camkwoki Grassroot Initiative for Development (CGIFD), Aboke Farmer Field School Network (AFANET), and Ngetta Farmer Field School Network (NFFSN) mainly dealt in field crop production. PATO TELECAST, a media practitioner, played a role in disseminating information on OFSP, its benefits and production practices. Local government institutions, religious and cultural institutions were very important in up-scaling the technologies. Ngetta Zonal Agricultural Research and Development Institute (NgeZARDI) coordinated the project and backstopped farmers and fellow IPTA partners. These organisations benefited from the activities of the IPTA as more internal capacity was built through participating in the project. Lira IPTA consisted of DETREC, AFSRT, MSME, CGIFD, NAAPE, URCSL, AFANET, NFFSN, PATO TELECAST and farmers and farmer groups.

DETREC, CGIFD, AFSRT, URCSL, AFANET, NFFSN were responsible for mobilizing farmers into groups, organizing training while PATO TELECAST focused on documentation and disseminating information on IPTA activities. MSME and MNPSCL were responsible for delivering business development services i.e marketing and market strategies to all participating farmers and farmer groups. In total, 6,031 male and 5,566 female farmers were trained.

OFSP yields increased in the region: Four varieties i.e., Kabode (NASPOT 10 O), VITA (NASPOT 9 O), Kakamega and Ejumula were promoted in the project. Preference for each of the 4 varieties varied from group to group or person to person. Children preferred VITAA due to its bright colour, sweetness and its softness (Fig 18). Adults liked Ejumula because it has high dry matter content compared to VITA. However, 10% of the farmers reported that Ejumula was low yielding compared to Kabode and VITA (Personal communication). The mean

yield of each of the four varieties at Ngetta ZARDI were 7.8, 12.8, 17.4 and 17.8 MT/ha, for Ejumula, Kakamega, VITA and Kabode respectively, with a corresponding marketable tuber percentage of 76.1, 76.9, 82.5 and 81.7 respectively. This compares with a yield of 5 MT/ha previously obtained in the region.

Figure 18: The colour of different OFSP varieties (from left VITAA, Kabode and Ejumula), being promoted in Lira Uganda.

Several farmers in the Lango sub-region and beyond have been reached with OFSP technologies: Between 2009 and 2012, 17,147 farmers organised in 686 groups, 25 schools and four health centres participated directly in the production of OFSP in Lango sub-region. In the Lira district, farmers in Adekokwok, Barr, Ngetta, Agali, Ogur, Aromo and Agweng sub-counties were involved in OFPS production. In the Alebtonneg district, sub-counties from which farmers were involved are Abako, Amugu, Omoro, Aloi, Akura, Apala and Awei. Farmers from Aboke, Ayer, Alito, Bala and Akalo sub-counties in the Kole district started cultivating OFSP in 2011. In the Apac district, some vines were introduced in 2009 in Chegere and Agwiciri sub-counties. Farmers in the Otuke district got OFSP from a nearby market in Akura sub-county. Some households who were in camps for internally displaced persons in OFSP project areas took the vines with them when they returned to their original homes. In addition, three staff working at Ngetta ZARDI also took the vines to their family members who were in Otuke.

Some farmers had earlier received OFSP production technology while in the internally displaced peoples' camps in Lira district. However, activities carried out under the IPTA have contributed to the current wide distribution of OFSP technology in the region. The technology has now spread to districts such as Otuke, Dokolo and Amolatar that are beyond the project mandate. Radio talk shows have also enabled farmers in the Acholi sub-region districts (such as Kitgum, Pader, Oyam) to receive information about OFSP technologies. Through field days, farmers took OFSP varieties up to the Kabale district (over 700 km from Lango). Due to the IPTA approach employed in the project, it is estimated that six of the districts in the Lango sub-region were reached.

Text Box 1: Mr. Jacob Otim a farmer from Ayer sub-county, Kole district heard about the OFSP through radio talk show and became interested in being a producer. He visited CGIFD and was referred to Ngetta ZARDI for clean planting materials. He grew and sold the roots to market vendors in Kampala and raised over 10 million UG shillings (US $3,800). According to Jacob, yields from his farm were about 25 MT/ha. Three women from Jacob's village were engaged in marketing OFSP roots at Aboke highway centre. They hired motorcycle riders to transport the roots to the centre. After washing the roots, they sold a basin-full of OFSP at UGX 11,000 (US $ 4.1) having bought it at UGX 8,000 (US $ 3). They indicated that selling OFSP was a rare business that has changed their way of living. In addition to selling roots, Jacob sold 938,451 vines to other farmers, thus diversifying source of income from OFSP. In the last planting season of the project, Jacob sold 500 bags of vines to World Vision alone. Jacob Otim, Jacob Arapa, Betty Ouni, and Okidi Charles are some of farmers who have reported huge financial benefits from dealing in OFSP.

OFSP recognised as a food security crop: IPTA partners often met with the district leaders of Alebtonneg, Lira and Kole and enlightened them on the benefit of the OFSP. Many leaders realized the importance of OFSP as a food security crop and supported its promotion.

On field days conducted at Ngetta ZARDI and agricultural shows held in Lira and Amac sub-counties in 2010 and 2011 respectively, many individual farmers asked for vines for planting. This showed that the public was enlightened on the potential benefits of OFSP and the technology is spreading very fast.

Production and marketing of OFSP is established in Lango sub-region: As a result of the OFSP dissemination activities by the IPTA, marketing centres for the crop were established in Lira town and Corner Aboke in Kole District. Currently, OFSP is commonly found in the main market alongside the traditional white-fleshed sweet potatoes. This is to a great extent due to the massive training that was facilitated by the project mentioned above.

Farming is now regarded a business: Training in farming as a business targeted stakeholders operating at the different levels of the OFSP value chain. 56 (42 male and 14 female) TOTs received training in farming as a business. As a result of this, business along the OFSP value chain has sprung up. These include vines, roots and several OFSP bakery products. Jacob Otim, Jacob Arapa, Betty Ouni, and Okidi Charles (See Figure 19 where they are at field for dry season vine multiplication) are among the farmers who have engaged in commercial ventures using OFSP.

Figure 19: Production of vine planting materials during dry season

Figure 20: Sweet potato roots ready to be taken to market

Radio talk shows have revolutionised extension messages dissemination: Radio talk shows were facilitated by the IPTA arrangement. They have an advantage that radio messages reach many people at once. Whenever a radio talk show was aired, listeners asked questions, but these were mainly on where to find planting material and the cost. Appropriate IPTA partners who are presenting the talk shows answer the listeners' questions. These talk shows were held at least twice in a quarter. Some callers even proposed that the vines should be taken to markets so that farmers who come to markets could easily access them. Information on OFSP was also disseminated through shows. Feedback from these shows also suggested that vines be sold in small quantities as some farmers with interest may not have the money to buy in bags and may have limited land to plant all the vines. As a result, a bundle of 40 to 50 vines was found to be the most appropriate for such farmers. The vine producers were then taking the bundles to shows and markets as well as selling them on farms. Root production therefore increased because even those who were not in the project areas heard about OFSP and came to buy the vines.

Challenges

Extended dry seasons: The long dry seasons make multiplication and preservation of vines very challenging. In addition, the accompanying water and pasture shortage force livestock to roam and destroy the preserved vines. Multiplying vines during the dry season requires irrigation facilities, which are unfortunately out of the reach of farmers.

Varying partner institutional policies: Another challenge is that partners have varying institutional policies that make it difficult for them to work together and make decisions instantly. Some require consulting their superiors before decisions can be made; a process that slows down IPTA activities. For continuity, IPTA should be at institutional level, but represented by one person for continuity, except in the case of the farmers.

Sweet potato is a bulky crop: The bulkiness of sweet potato makes its transportation to the market costly. Therefore, most farmers prefer to sell them in the village markets at lower prices than in towns. For example, a heap of potato roots weighing about 2kg is sold at Ug Shs. 500/= (approximately US$ 0.2) in the village while the same quantity fetches Ug Shs. 2000/= (approximately US$ 0.8) in town.

High staff turnover rate in some member organizations: When a staff member assigned to the OFSP activities in an organization leaves, a new member of staff takes a long time to internalise the projects and methods of implementation. This affects the running of project activities as well as the IPTA activities.

Lack of sufficient funds: Some IPTA members do not have there own (or are not willing to contribute) resources to supplement funds from ASARECA to implement OFSP related activities, especially those who are fairly new in the platform. This therefore has a direct negative impact on project activities, and points to the potential danger of failing to sustain the platform in future.

Non-commitment to the constitution: Some IPTA members have failed to adopt and operationalize the constitution. This hampers efforts to generate or solicit additional funding to sustain IPTA activities and also to meet running costs.

Constraints

- Understanding and adopting the Innovation Platform approach to dissemination of technologies has not been uniform for different stakeholders. Some even feel that the approach limits effective enhancement of productivity. This disparity was expected because IPTA is a new approach that requires a change in mind-set.
- There are only a few technical staff from the District and Ngetta-ZARDI to cope with the increasing numbers of famer groups.

Lessons learnt

- *Approaches such as the use of programmes on FM radio stations, demonstrations in public places, schools and health centres facilitated quick and wide adoption of technologies.* In this project, messages were designed to promote OFSP as both a food crop but also for its unique nutritional qualities. The involvement of stakeholders in production (farmers, DETREC, AFSRT) and those with a nutritional focus from health department provided synergy that resulted in quick adoption of OFSP technologies. As a result, farmers have realised that indeed OFSP provides more vitamin A, is high yielding and drought tolerant, and thus fits very well into the cropping systems in the Lira sub-region and probably the entirety of Northern Uganda. They have also learnt that sweet potato can be available for about 10 months a year, thus continuously supplying a rich and steady source of food and vitamin A.
- *In the IPTA, members come and leave:* IPTA membership is dynamic; it keeps changing as the activities along the value chain change.

Opportunities of Lira IPTA

- There are several opportunities for the objectives of the Lira IPTA to be met and sustained. Availability of large pieces of fertile land in the Lango sub-region is a very big incentive. The activities and approach of disseminating technologies demonstrated by the Lira IPTA have been accepted and are supported by the district's political and civil society organizations such as local councillors, production department staff, and cultural leaders. The community has, in addition, accepted and adopted OSFP based technologies. Furthermore, sweet potato is a local crop that has been grown for a long time and the demand for roots within and without the districts under Lira IPTA is high.

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Improved quality protein maize dissemination and production in medium and low altitude ecologies of Kenya

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Background

Due to persistent malnutrition in many parts of the world efforts have been made to improve nutritional quality of staple food crops (Johns and Eyzaguirre, 2007; Nestel et al, 2006; White and Broadley, 2005, De Groote et. al. 2010) through breeding and biofortification. Maize is a vital staple and source of dietary protein in many areas of the developing world. In many African countries, maize is the basic food for the subsistence farmers. Traditional maize varieties are poor in protein quality due to deficiencies in lysine and tryptophan, two amino acids that are essential in the diets of humans and monogastric animals (FAO, 1992). The deficient amino acids can be supplemented by animal protein such as meat, milk, eggs or fish, pulses or commercially produced synthetic amino acids. Poverty makes it almost impossible for most rural households to afford meat, eggs or milk, except perhaps on a few special occasions (National Research Council, 1988). Some cannot even afford beans or other protein-rich plant foods to supplement maize, and many raise children on foods that are almost entirely derived from maize.

To address the problem of malnutrition and lack of a cheap source of proteins, quality protein maize (QPM) varieties were released in Kenya. These included two hybrid varieties (KH631Q and KH500Q) targeting the moist, medium altitude (MM) and moist, transitional (MT) maize ecologies of Kenya respectively and one open pollinated variety (OPV), WS104Q, for the semi-arid environments, dry medium altitude (DM) and lowland tropics maize zones. Despite the availability of varieties, their adoption and uptake still remains low. A study conducted in East Africa to assess adoption of quality protein maize in areas where promotion had been undertake found that adoption was high in Uganda (70%), Tanzania 30% and none in Kenya. In Kenya, the problem was further compounded by inadequate seed. One study recommended the use of a value chain approach to catalyse adoption of protein enhanced maize varieties (Wanyama et al., 2012). The Dissemination of New Agricultural Technologies in Africa (DONATA) project was therefore designed to address the problem of low adoption of new QPM varieties and innovations and low household incomes along the quality protein maize value chain. The project used Innovation Platforms for Technology Adoption (IPTAs) as the main mechanism for dissemination of the QPM technology.

What was done

To increase adoption and production of quality protein maize in Kenya, the innovation platforms (IPTAs) adopted a multi-stakeholder approach to address the constraints along the quality protein maize value chain. The first stage was to address issues related to seed production, followed by issues related to dissemination of QPM technologies and promotion.

Seed production: As there were inadequate quantities of seed for distribution to maize producers, the stakeholders in the innovation platforms for technology adoption (IPTA) requested KARI to provide seed of the two QPM varieties, KH500Q and KH631Q, which had been released by the institute (KARI). This was made easier because KARI was part of the IPTA which undertook to produce the seed in the short term to alleviate inadequacy while at the same time auditing the companies that were involved in seed production.

To ensure seed availability for future hybrid production, inbred lines from International Maize and Wheat Improvement Centre (CIMMYT), referred to as CIMMYT Maize Line (CML) 181, CML 182, CML 144 and CML 159 were obtained from CIMMYT and planted at Kiboko to increase seed. All the inbred lines were hand-pollinated to avoid contamination. However, crosses were made between CML 144 and CML 159 to produce seeds for the female parent. Two hybrid development nurseries were established; at Kiboko and at a contracted farm. A farmer was contracted to help produce the hybrid seed in Makindu due to scarcity of land at KARI Kiboko sub-station.

Dissemination and promotional framework: On the basis of their structure and institutional arrangements, IPTAs used different variants and combinations of promotion/dissemination strategies. In general IPTAs used demonstrations, agricultural shows, field days, media, market surveys, capacity building and exchange learning visits. Table 6 presents the stakeholders in each IPTA, technologies and promotional strategies they employed.

Achievements

Hybrid seed was made available: At the beginning, there was a shortage of hybrid seed. However, through KARI-CIMMYT collaboration, inbred lines were produced from which 2.5 tonnes and 1.3 tonnes of KH631Q and KH 500Q respectively were produced at the Kiboko Sub-Centre and at a contracted farmer's field in Makindu. KARI also took steps through their legal office to audit seed companies licensed to produce QPM seed KH631Q and KH500Q. Through these efforts, the amount and quality of seed produced increased with the seed companies producing seed of both varieties which are now available at the companies' head offices in Nairobi and seed stockists in Embu, Nyeri, Kirinyaga and Murang'a. During the long and short rainy seasons of 2012, the companies had seed in excess of 50 tonnes in their stores.

Dissemination strategies: IPTAs were empowered to determine their dissemination strategies that suit their situations and work context. The dissemination strategy adopted by each IPTA was a function of location, focus, stakeholder composition, production stage and technology/innovation. Location, focus and production stages determined the technology/innovation to be disseminated.

The Kirinyaga IPTA was composed of several farmer groups from different locations, research, (KARI Embu and Katumani), government ministries, NGOs and the private sector. Table 6 below presents stakeholders, technology and dissemination strategies for the different QPM IPTAs in Kenya. They held monthly meetings to plan their activities and give feedback to stakeholders. From the onset, stakeholders agreed that a multi-dissemination strategy be adopted. The multi-dissemination strategy is a strategy whereby more than two strategies were used in combination, and no one strategy was preferred. For example, during field days several dissemination methods would be used including demonstrations, farmer-to-farmer interactions, the use of brochures and poems to recite the good qualities of QPM technologies and innovations. The main strategy, however, was the use of satellite plots. Different location/divisions combined to make an IPTA and at each location there were farmers' groups: each group had its management committee and at the IPTA level all these committees were represented in the IPTA management committee. It is during the IPTA management committee meetings that it was agreed that each farmer group should set aside a group plot identified as a satellite plot for demonstration and field days during every season. The aim for this was to transfer QPM technologies and innovations horizontally to other farmers. The strategy worked well and many farmers in the IPTAs where the strategy was used are now aware of QPM technologies and innovations. The satellite plots were used for field days and demonstrations.

In addition, The Catholic Diocese of Murang'a agreed to include on their Diocesan agriculture radio programme information on QPM technologies and innovations.

The Embu and Karurumo IPTAs had several similarities. The composition of the two IPTAs, technologies for dissemination and strategies were similar too. The two IPTAs focused on production, management practices and value addition. The composition of these IPTAs included farmers, NGOs, Ministry of Agriculture (MoA), Ministry of Health (MoH), private companies, agro-dealers, KARI Embu and KARI Katumani. Although during their initial meetings it was agreed that a multi-dissemination strategy would be adopted, the main focus was put on demonstrations, marketing and capacity building.

The IPTAs agreed to focus on developing the QPM enterprises; and do it through formation of producer marketing groups. One producer- marketing group composed of some IPTA members was tasked to do market-intelligent surveys and identify markets. The group identified the markets, and a shop to sell QPM products was opened at the Kiritiri market.

Table 6: Stakeholders, technology and dissemination strategy for the different QPM IPTAs in Kenya.

IPTA	Stakeholders	Technology/Innovation	Dissemination strategy
Kirinyaga	KARI, Catholic Diocese Murang'a (CDM), MoA, MoH, Farmers, Stockists, Freshco	KH500Q, KH631Q, Good Agricultural Practices (GAP), value addition, market strategies	Demonstrations, agricultural shows, field days, media, market surveys, capacity building and exchange learning
Embu	Catholic Diocese of Embu (DOE), MoA, MoH, Farmers, Stockists, Freshco, Western seed Company	KH500Q, KH631Q, GAP, seed technologies, market strategies	Demonstrations, agricultural shows, field days, market surveys and capacity building, Farmer field school
Maragua	Catholic Diocese of Kirinyaga, MoA, MoH, Farmers, Stockists, Freshco, Schools	KH500Q, KH631Q, GAP, postharvest technologies, market strategies	Demonstrations, agricultural shows, field days, media, market surveys, capacity building and exchange learning
Karurumo	KARI, Catholic Diocese of Embu, MoA, MoH, Farmers, Stockists, Freshco	KH500Q, KH631Q, GAP, market strategies	Demonstrations, agricultural shows, field days, media, market surveys and capacity building
Kilifi	KARI, MoA, MoH, Farmers, Stockists, Freshco, Western Seed Company	KH500Q, KH631Q, GAP, Postharvest technology	Demonstrations, agricultural shows, field days, market surveys, capacity building and exchange learning, Farmer field school
Kathon-zweni	KARI, MoA, MoH, Farmers, Stockists, Freshco	KH500Q, KH631Q, GAP	Demonstrations, agricultural shows, field days, market surveys, capacity building and exchange learning

The Kilifi IPTA focused on production, value addition and utilization. The composition of this IPTA included research centres (KARI Mtwapa, KARI Katumani), farmers, NGOs, the private seed sector, the Ministry of Agriculture, the Ministry of Health and the provincial administration. At the IPTA, farmers were represented by their respective committee members who later formed an umbrella management committee whose function was to run the affairs of the IPTA as a whole.

All farmers in the IPTA were represented. Apart from managing the affairs of the IPTA other roles included identifying markets for QPM products and events where they could showcase their products.
Awareness of QPM has been increased in Kenya: The marketing study conducted later clearly showed higher awareness of QPM in the surrounding urban centres. This is to some extent attributed to sustained dissemination messages by the IPTA aided by the radio programme.

The IPTA was transformed into a community-based organisation (CBO): As the IPTA evolved, members thought that they could increase opportunities by registering the IPTA with the government as a community based

organization (CBO). Indeed, registration into CBO paid off because it enabled the IPTA to successfully negotiate with the Ministry of local government for a piece of land to establish a processing unit (posho mill) and shop. Transformation to a CBO was also envisaged to make it possible to develop proposals and source funding to sustain IPTA activities in future.

Increased OPM acreage and yield, and capacity building: Other achievements by the IPTA included increased OPM acreage and yield, and capacity building. The IPTA acquired metal silos, posho mills and cooking ovens. In response to inadequate seed availability, 45 IPTA stakeholders were trained in seed production and processing. In general, uptake of QPM technologies resulted in increased planted acreage and yield of QPM and increased the number of households involved in QPM production.

QPM based diet improved the growth rate of chickens: Demonstrations of the effect of QPM maize feed on chicken growth was done only once. Results from this one trial showed that birds fed on a base of QPM grew significantly faster compared to those fed on a non-QPM diet. This is an important message that has the potential for enhancing adoption of QPM production and related innovations.

The IPTA approach is now appreciated by many organisations: The IPTA approach to technology dissemination has generated interest amongst other institutions such as KARI and several NGOs. KARI has now embraced the use of platforms for technology adoption in some of its projects while some NGOs have been enquiring about the approach, its implementation and outcomes, with a view to adopting the approach.

Figure 21: A field of a young QPM hybrid seed crop and harvested and packed H500Q

Challenges

Lack of suitable land for seed production: The biggest challenge in seed production was obtaining land where the right isolation distances for production of inbred lines and foundation seed could be enforced. This situation made the IPTA look for alternative ways and innovations. The IPTA opted to grow seed off-season and also to contract a farmer with irrigation facilities and on whose farm the right isolation distance for seed production could be achieved. The issue of isolation distance (due to small land holdings) also made it very difficult for the seed company to contract farmers to produce seed. In addition, elephants damaged farmers' seed crops in Makindu and Kiboko.

Dissemination challenges: Technology dissemination activities were made difficult due to a number of factors that include:

(i) Although the IPTA approach is embedded on a multi-stakeholder approach to issues and problems, in some instances interaction with other stakeholders created conflicts and threats. At the Kilifi IPTA, some farmer groups threatened the IPTA coordinator because they were not happy that they were not included as part of the IPTA. While this was an external threat, there were also some internal conflicts within the farmer groups. During discussions there could be disagreements that took a long time to solve. A good example was at one IPTA where the chairman had disagreements with the members because they accused him of always taking visitors to his farm and holding demonstrations on the same farm. These disagreements often called for meetings to attempt to resolve them through the various tiers of the IPTA management structures. These meetings consumed valuable time that could have been used for better and more productive activities.

(ii) Through promotion of the QPM innovation and technologies, demand increased resulting in inadequate seed availability. This problem, however, was sorted with time and now there is enough seed of two varieties: KH500Q and KH631Q.

(iii) When the project commenced in 2009, there were three QPM maize varieties for promotion, KH500Q for medium altitude, KH631Q for high altitude and WS1104Q for low medium and dry altitudes. The production of WS194Q was discontinued mid-way and this resulted in activities of the Kilfi IPTA being stopped.

(iv) Even though QPM has an enhanced nutrient quality, it has no premium because consumers are not able to tell any difference between QPM and other maize in the market. This greatly discourages production of QPM.

Lessons

A number of lessons can be drawn from disseminating and producing quality protein maize using the IPTA approach.

The need to understand the IPTA framework from the onset: At the onset of the implementation of the project there was limited understanding of the IPTA theoretical framework as a tool for disseminating agricultural technologies. The understanding of the framework was clearly at variance between institutions involved (donors, regional organizations and the NARS). The implementation and understanding of the IPTA concept across implementing countries was also at variance. Training on IPTA as a dissemination tool should have been done at the onset to have a common understanding across all the stakeholders. Lack of understanding of the IPTA approach as a dissemination tool meant the country coordinators did not establish appropriate sensitization for the establishment of the IPTAs. As a result, the IPTAs were established at different levels due to the limitations of understanding.

Cohesiveness in a group is important for performance: Another lesson that can be drawn from this project is that group cohesiveness is an important attribute, especially when working with diverse groups of stakeholders and different farmer groups. Dissemination of QPM technologies was not adequate in IPTAs where there was poor working relationship between stakeholders. Therefore, IPTAs need to devise innovative ways for detecting and diffusing potential conflicts within groups.

The choice of farmer group to join the IPTA: It may not always be possible to have all farmer groups in a geographical area in an IPTA. For QPM in Kenya, this was the case; some of these farmer groups felt left out of IPTA activities and were not happy. In one case, an IPTA coordinator received threatening messages from a disgruntled farmer group.

Inadequate stakeholder analysis at inception of IPTA activities: During the implementation of the IPTA activities it was realised that some important stakeholders had been left out while some were brought on board early

when there was nothing for them to do. This, therefore, calls for a thorough value-chain analysis at the initial stages to determine the right stakeholders at each segment of the commodity value-chain.

Outstanding issues and future direction

Although the dissemination of QPM innovations and technologies was implemented relatively successfully, there are some outstanding issues. These relate to items in the QPM value chain. The issues include development of more QPM varieties for the dryland medium altitudes and the coastal lowlands; identification of novel ways (innovations) for group dynamics; institutionalization of the IPTA approach with tangible results and outcome and development of the guiding principles of the IPTA approach and theory.

Limited QPM varieties: Currently there are only two varieties of QPM available for dissemination in Kenya. The farmer's choice of variety is, therefore, limited: hence the need for greater availability. There is also the need to develop varieties suitable for lowland areas and other maize agro-ecological zones so that farmers in these areas can also benefit from QPM technology. The attributes that farmers look for in the dry land mid altitudes are drought tolerance, high yields, disease resistance, pest resistance and soil nutrient tolerance e.g. low nitrogen tolerance.

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The production of quality protein maize (QPM) grain in the Democratic Republic of Congo

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Background

In Democratic Republic of Congo (DRC), maize is the main cereal and one of the staple foods. Unfortunately, its nutritional quality is poor (FAO, 1992) due to limited amounts of essential amino acids like lysine, tryptophan and threonine; lysine being the most limited followed by tryptophan. In contrast, quality protein maize (QPM) has nearly twice the amount of lysine and tryptophan. The superior quality of QPM over normal maize can alleviate protein malnutrition if grown and massively fed to people. QPM was introduced in DRC in 2006 mainly to alleviate malnutrition due to protein deficiency. A total of thirteen lines of QPM were introduced. However, only those lines best adapted to specific agro-ecologies could be recommended for production in those areas. Therefore, participatory evaluation of varieties was undertaken with selections of the potential varieties made based on requirements and criteria of the different stakeholders and performance in specific environments. This process resulted in the identification and release of 3 QPM varieties out of the 13 that had been introduced and evaluated. The 3 were named MUDISHI 1, MUDISHI 2, and MUDISHI 3. However, for these varieties to be produced and exploited, farmers have to access their seed in sufficient quantity and at the time when they need to grow the crop. This paper presents the Dissemination of New Agricultural Technologies in Africa (DONATA) led efforts to promote produce QPM grain in DRC. The approach used to do this was the innovation platform for technology adoption (IPTA). Achievements made and lessons learnt from these efforts are also presented.

What was done

Challenge identification: Being a new type of maize, researchers convened to identify likely challenges that could impede adoption and production of the QPM in DRC. The following were identified as likely challenges: (i) the most appropriate method to convince people of the agronomic superiority of the QPM varieties, (ii) the uncertainty of whether QPM would grow well in poor soils, (iii) the likely higher price of QPM grain relative to normal maize, (iv) resistance of QPM varieties to weevils compared to the normal maize varieties, (v) reliability of QPM seed source. At this stage, based on their experiences, researchers were the ones to think about any reason that could impede QPM promotion and tried to see how the IPTA could help QPM adoption but not rejection.

Participatory variety selection: This was initiated by researchers, as mentioned above. They included only farmers at this stage: if they accept the technology, they will grow it and other IPTA actors will use it. When farmers realized that among QPM varieties, there were some varieties that were performing better than normal maize, they selected it and started sensitizing other people that better-performing materials were in the INERA pipeline. This made the adoption easier as people are aware that farmers have a reputation for rejecting new technologies: as they had accepted this one, it must have meant that it was really good. Seed and grain producers then took the technology for producing seed and grain of the selected materials.

A participatory variety-selection exercise involving farmers was carried out, where selection of QPM varieties was done based on criteria set by farmers. This was deemed the best approach because farmers make decisions based on their own observations and reasoning. They noted that some QPM varieties performed better than the local varieties in terms of yield and resistance to downy mildew. For example, in their own fields, the yield for MUDISHI 1 was 5-6 tonnes/ha in forest soils and 3 t/ha in savannah soils. These yields are much higher than those from local varieties. Mr Nzeu is one of the farmers in Kalunga village who adopted MUDISHI 3. On very fertile soil, he reported harvesting ears with up to 24 rows. With this variety, the yield of 12-14 ears is equivalent to the yield of 34-36 ears of the landrace maize he used to plant before. Farmers also noted that MUDISHI 3 is an early-maturing variety, allowing it to escape the drought common in the second growing season. It is also resistant to downy mildew and can tolerate late planting. They also noted that these varieties were better adapted to valley conditions in comparison to the local landraces. In the DRC, farmers plant maize 3 times in a year i.e., in season A, season B and season C. Season C maize yields are the highest because during this season maize is planted in valleys. Therefore, any maize variety that is not adapted to valley conditions has a low chance of to being adopted in the DRC. In this case, the QPM varieties performed well in valleys.

Performance of QPM under different planting dates was also tested in valleys (season C). Farmers are used to planting during three seasons. They needed to ensure the selected varieties would perform in valleys. They then tested different planting dates in valley conditions to assess the performance. These dates were April, May, June, July and August. Farmers observed that the July planting consistently resulted in the best yields. Planting QPM on other dates exposed the crop to downy mildew. As a result of these evaluations, QPM was adopted and a lot of it is now grown and consumed. It is now held in high regard, so that in Luputa, a farmer who does not use QPM during celebrations (wedding, religious events, etc.) is considered backward.

The performance of a new crop variety in infertile soils determines whether it gets adopted widely or not. A variety that yields well in relatively poor soils has high chances of being adopted. In this project, evaluation of the QPM varieties was conducted in both fertile and poor soil. In comparison, farmers observed that QPM varieties yielded better than local varieties when grown in poor soils. They also observed that QPM performed better than local varieties in rotation with *Mucuna* in exhausted soils. Farmers then became confident that QPM could perform in a variety of soil conditions. The IPTA approach facilitated a partnership between the University of Kinshasa, Institut National pour l'Etude et la Recherche Agronomiques (INERA) and an NGO CARITAS. Through this partnership, studies were carried out to assess the influence of *Tithonia diversifolia and Entada abyssinica* green manures on QPM grain production. This partnership facilitated increased awareness of QPM in project areas.

The participatory evaluation also allowed farmers to bring out the negative aspects of QPM varieties being studied such as the susceptibility to weevils. They noted that if this was not addressed, it could impede QPM adoption.

Setting up of a seed production system:

Quality seed production and supply is critical for the production of any crop. Therefore, even if QPM were adopted, a reliable seed production system should be in place. INERA (researchers) provided breeder and foundation seed for this project. However, it could not meet the demand of foundation seed by itself. Other reliable foundation and certified seed producers had to be brought on board. Consequently, an organization of seed producers, *Association des Producteurs de Semences du Kasai Oriental* (APSKO) was formed. Members of this association were trained in seed production by the Public Seed Inspection Service called Service National des Semences (SENASEM). SENASEM inspects and certifies seed before it is allowed to be sold to grain producers. Only seed producers belonging to APSKO are allowed to produce QPM seed. Grain producers are all encouraged to source seed from APSKO and are told to demand to see the SENASEM certificate before buying seed.

Setting up of a QPM grain production system:

A diversity of organizations came forward to produce QPM grain. These included NGOs, farmers' groups, individuals and religious groups. The IPTAs together with INERA devised a system that would facilitate production of QPM grain by these organizations. Grain producing organizations would receive QPM certified seed from either INERA or other recognized private seed producers. They would also receive seed from the DRC Central and Provincial Governments, Ministry of Agriculture, Food and Agriculture Organization (FAO), and some other projects. Seed producers could also provide grain in the form of ears that failed to meet the standards set for seed. Grain production would then be carried out in either QPM villages/sites during normal seasons or in off-seasons. Seed producers would also provide grain from ears that failed to meet the standards set for seed as grain.

In QPM villages or sites, fields were then established taking into consideration isolation standards; at least 400m from the nearest normal maize varieties. The QPM production sites were Mpiana, Basangana, Tshianzevu, INERA, Mpasu, Nsona (Gandajika IPTA), Tshiala (Mbujimayi IPTA), Wikongo (Mweneditu IPTA), Hamba and Katobo (Lwilu IPTA). Producers worked with agro-dealers to access fertilizers; while others practised maize-Mucuna rotations to maintain soil fertility.

Standards set for transporters and millers: Some QPM grain producers own mills and process grain immediately after harvest or sell it without processing. Those without own mills transport grain to the millers. The IPTA set standards for transporting, milling and handling QPM grain. All QPM grain millers are supposed to transport grain in a way that ensures that mixing with normal maize is avoided. Millers must also ensure that QPM grain and flour are not mixed with normal maize produce. This was important to ensure QPM properties for QPM consumers. If there could be a mixture of QPM and normal maize, the expected results from QPM could not be seen and consumers could become discouraged. They may no longer trust them and this could affect QPM grain production, as consumers would no longer buy an untrustworthy product.

Sellers and selling points established: Millers are urged to transport QPM only to designated sellers. The designated sellers of QPM products are INERA and Project DITUNGA (PRODI) shops (in Gandajika IPTA), DDAIDV (in Mweneditu IPTA), Paroisse Notre Dame de la Grace and Centre de Nutrition Saint Sauveur (in Lwilu IPTA) and CARITAS (in Mbujimayi IPTA). Radio played a very important role of informing buyers when QPM was available for sale at designated points (Figure 22 & 23 showing women sorting QPM grain and admiring QPM harvest).

Schools used as rapid avenues for QPM technology dissemination: Dissemination activities for QPM/products were carried out in schools. The involvement of teachers and pupils facilitated rapid uptake of QPM. Pupils received QPM seed and helped distribute it to communities and their families. Teachers continued to train groups of children in schools on the benefits of QPM. Some even set up field demonstrations through which they taught children field management practices of QPM. Teachers even created songs to draw people's attention to QPM. Schools which were IPTA members were also important consumers: QPM biscuits and bread were sold. Over time, one nursery school decided to have its own QPM field to feed their own pupils and now no longer relies on the QPM products supplier.

Central Government actions in promoting QPM: The Central Government was brought on board to promote QPM technology. Central government has been involved in distributing free QPM seed. In 2013 B season, Central Government distributed enough seed to plant 80 hectares. It also provided tractors to help farmers plough fields early. During pre-season periods, Central government agencies organized sensitization campaigns on the benefits of growing and consuming QPM. The Central Government has representatives at different levels (provincial, district, sub district and grassroots level). The policy makers at grassroots and sub district level were IPTA members. They have themselves experienced QPM nutritional properties. When the Central Government needed to assist farmers in terms of maize seed, collaborators at grassroots and sub district levels preferred to make QPM varieties available to farmers instead of normal maize.

Figure 22: Women sorting QPM grain in DRC

Figure 23: Women and children admiring QPM harvest in DRC

Achievements

QPM has been widely adopted in DRC: From the start of the project (2008) up to December 2012, a total of 36,612 kg of QPM seed was distributed to farmers; these were planted to more than 2,034 ha. This figure doesn't take into consideration a lot of seed that was directly exchanged between farmers. Approximately 4,500,000 kg of QPM grain was produced in this period. Farmers growing MUDISHI 1 get up to 6 tonnes / ha in forest soils, 3 tonnes /ha in savannah soil, 5 tonnes/ ha when they use *Mauna* in rotation. QPM started in one province (Kasai Oriental Province) and has now reached 9 provinces out of 10. Apart from farmer-to-farmer technology exchange, media (radios, especially United Nations Radio that has a national scope or coverage, televisions, newspapers, leaflets, and posters) have played an important role in disseminating information on QPM. Sensitization campaigns through training sessions, field days, and radio interviews have also played an important role. Also, when people are aware that the Central government itself has allocated 500 ha for QPM production, they feel the technology is good enough to be undertaken.

Challenges

QPM seed still in short supply: Most farmers who could multiply seed cannot meet the requirements in terms of isolation distance. Thus the number of seed producers in the IPTA is still low. As a result, many farmers who would like to grow QPM cannot access the seed when they need it. The IPTAs have made arrangements to make seed available at any time but farmers must be prepared to buy it in order for the seed production to be sustainable. Because the country has more than 10 IPTAs located across agro-ecological zones with different seasons, it is possible for the platforms to coordinate seed production to ensure there is more seed available at any time. Also, by having stakeholders from the media, such as TV and radio stations in the IPTAs, these channels have started to be used to inform farmers when and where seeds are available, and the cost. Informing small holders that they should not expect free seed is one the added functions of the IPTA. This is done through interactive TV and radio programmes. For example, during an interview at *Radio Télévision Nationale du Congo* (RTNC), a journalist wanted to know if the cost of seed would be affordable to farmers, the majority of whom are poor. At US $1/Kg. it is expected that most farmers would be to afford the seed.

QPM grain is still in short supply: the demand for QPM is far higher than can be produced with the current resources. Much as this is a challenge, it provides an opportunity for expanding efforts to produce more QPM. This implies that the economic and nutritional benefits of QPM will be spread further to a wider DRC population. This provides stakeholders with an opportunity to design innovations for producing more QPM and thus have more people benefiting.

Not every farmer who wishes to join the lucrative business of producing QPM seed is able: Not every willing farmer can produce QPM seed, mostly due to the failure of farmers to have fields where a mandatory isolation distance of 400m can be achieved. This presents a challenge of explaining to ordinary farmers why this distance is mandatory and why not every farmer can be a seed producer. This limits the availability of QPM products that could be processed by processers participating in the IPTA.

Lack of drought tolerant QPM varieties: The released varieties i.e., MUDISHI 1, 2, and 3 are not tolerant to drought. Should the region experience an unnecessarily long drought, many farmers could easily lose interest in growing QPM. Therefore the long-term goal of breeders should target incorporating drought-resistance in these varieties. To address this issue, a promising drought-tolerant QPM variety was introduced from Tanzania and is now under evaluation.

The IPTA networks should facilitate regional collaboration to address this challenge.

Lessons learnt

(i) *The IPTA approach leads actors into self-monitoring:* Individual members ensure that their actions do not lead to the failure of the entirety of IPTA activities. The feeling of individual responsibility for the success or failure of group activities is good because it fosters hard work, ultimately resulting into group success. For example, a processor dealing with QPM bread making knows customers like QPM bread as it makes them full for longer, which is not felt when normal maize is used. He cannot make normal maize bread because if customers realize it does not give the expected effects (as with QPM), they will give up buying his bread and customers will no longer trust his products. He will then contribute to limiting the spread of the technology instead of contributing to its use.

(ii) *The IPTA creates a self–evaluating system:* Each actor in the value chain has the responsibility to ensure that everyone else works according to set guidelines to meet expected quality standards for the crop or products. Overall, this results into high quality seed/products.

(iii) Central Government can support the dissemination of a helpful technology if they are informed and have evidence of it.

(iv) Schools are another way of boosting a technology by making pupils and teachers aware and applying a technology.

Outstanding issues and future directions

- *QPM ears, grains and flour cannot be distinguished from those of normal maize:* Farmers and consumers fear that unscrupulous traders could easily sell them any maize claiming that it is QPM. Some innovative way of branding QPM needs to be sought.
- *Many farmers want to grow QPM seed:* The requirement for field isolation for QPM seed production needs to be addressed as many potential seed farmers feel “left out”.
- *The amount of QPM seed to produce the grain is still limited:* Plans needs to be made to upscale seed production capacity in DRC so that grain producers can increase acreage of QPM.
- *INERA has enough land with the required isolation distance for seed to be produced;* it should avail land to any seed producer who needs it and thereby increase the number of QPM seed producers.

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Promotion of quality protein maize in northern Uganda: Experiences in the Dissemination of New Agricultural Technologies in Africa (DONATA) using Innovation Platforms for Technology Adoption (IPTA)

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Background

The government of Uganda has prioritized maize as important strategic crop in its Development Strategy Investment Plan in the Ministry of Agriculture, Animal Industry and Fisheries to address food security and household income. Statistics from the Uganda National Household Survey 2005/06 showed that maize was cultivated on an estimated area of 1.54 million hectares by about 86% of the 4.2 million agricultural households (UBOS, 2012). However, most of the maize is still produced under smallholder conditions characterized by low yields averaging 2.5t/ha. The major challenges in the maize sub-sector include limited access to improved agricultural technologies, increased cost of agricultural inputs - especially fertilizers, decreased soil fertility due to low use of fertilizer and increased pressure on land and frequent incidences of drought that ravages many parts of the country and affecting crop yields and hence, income for many smallholder households. These challenges combined cause low productivity and increased food prices, especially as demand for maize continues to increase nationally and regionally for both food and feed. Thus, increased agricultural productivity remains a formidable challenge. To a great extent, use of improved technologies is limited in most subsistence, smallholder agricultural systems.

We implemented African Development Bank supported project on dissemination of quality protein maize as a new agricultural technology in Northern Uganda for five years starting in 2008 using innovation platforms for technology adoption (IPTA). Previously, tremendous progress had been made in promotion of QPM in central and eastern Uganda through a multi-stakeholder approach of QPM working groups and a village variety saturation approach that led to increased adoption of >60% and improved household incomes in the target areas. To date, two QPM varieties (a hybrid - Ssalongo and an open-pollinated variety- Longe 5) have been released and are being commercialized by the private seed companies. The popularity of the QPM arises from the dual advantage of food and nutritional benefit it offers compared to the conventional maize, which lacks essential amino acids needed for growth and proper functioning of the body (Mertz et al., 1964; Nestel et al., 2006). In addition, QPM provides other indirect benefits such as reduced health costs, low burden of malnutrition in both children and expecting or lactating mothers, freeing more time for the family and savings for other needs such as school fees and social amenities.

The situation in northern Uganda at the time the project started was characterized by low production of food crops as most families were settled in internally displaced camps due to insurgency and depended on food relief from humanitarian agencies. Promotion of QPM was a timely intervention that provided opportunity for access to improved agricultural technologies for families returning to farm on their lands. This intervention coincided with the reduction and/or withdrawal of food relief thereby exposing the households to crop production and management training that became handy as they settled and farmed.

What was done

During the designing of IPTA, emphasis was placed seed and grain production in separate IPTAs to conduct in-depth training, increase speciality and foster mutual learning, inter-IPTA collaboration and linkages. Access to improved seed is limited as most seed companies do not have distribution networks in Northern Uganda and there was opportunity for a market outlet to the World Food Programme that was based in the area but purchasing grains from other regions in the country for relief purposes in the region. Key stakeholders with complementary roles within the maize value chain were identified and included NGOs (e.g. SG2000, WFP), CBOs/seed producers, extension agents, seed companies, local governments, farmer groups and associations and media to create awareness. The criteria for identification and inclusion in the IPTAs included diversity of stakeholder types, e.g. agro dealer networks, but willingness to participate was the most important consideration. In the end, two IPTAs were formed initially, one for grain production in Lira district (Lira IPTA- comprising Rural Livelihood Programme Initiative (RLPI) and Camkwoki Grass Root Initiative for Development) operating in five Sub counties of Adekokwok, Barr, Amac, Ngetta and Agali. A total of 3,152 members constituted the Lira IPTA from the three major associations made up of farmer groups. The Gulu IPTA, based in Patiko sub-county, comprised 14 farmer groups each made up of 20 farmers on average covering 3 parishes of Kal, Pawel and Pugwenyi. The third IPTA was formed later in 2011 in Oyam district made up of 350 farmers from 11 farmer groups.

The IPTAs were structured into registered organizations in each district with elected representatives that formed the leadership for decision-making and with bank accounts to raise and save funds from their activities. The main activities conducted by the IPTAs included the introduction of QPM varieties; capacity building in agronomic practices; provision of breeder and foundation seed; soil fertility improvements; control of pests and diseases and bulk collection and marketing of grain meeting quality standards.

Achievements

Increased access to seed of improved varieties

Seed is an important input in the production value chain and the IPTA approach provided an opportunity for farmers in these areas to access improved seed. The improved varieties of Longe 5 and Ssalongo were introduced in the target districts with accompanying recommended production practices. The demonstrations and field days showed that the new varieties were superior to the local land races in terms of yield. Increased adoption of these varieties by farmers significantly increased the yield of maize per hectare and food security due to bumper harvests. The IPTA also provided a unique approach for the farmers to interact with value chain actors directly, increasing their knowledge in a shorter time. Most often, few farmers benefit from extension services due to a limited number of staff and do not have access to improved varieties due to perceived high seed cost.

Once the farmers realized the value of improved seed, there was increased demand for seed that led to the attraction of an agro-dealer firm located within the vicinity of the IPTA. Additionally, community based seed producers started to produce adequate volumes to meet the local and neighbouring demand from farmers. Seed was sold as quality declared locally and provided income for the farmers who took it up as an enterprise. In general, the IPTA approach increased the amount of improved seed in these areas where seed companies only operated to a limited extent. The IPTAs introduced another unique approach of seed loans that were bulked from farmers given seed previously and about 10% of the total production was recovered. To ensure quality, a production and marketing committee verified the isolation distances and production practices. Recovered seed was then loaned out to more new farmers, thereby ensuring increased access and improved quality seed augmented with other sources of seed from seed companies and government programmes. Within the project period, a total of 1.2 MT of breeder seed and 8.4 MT of foundation seed was bulked and provided to the IPTA groups and an estimated 1,000 MT of quality declared seed was produced and sold locally.

Increased grain production

Based on knowledge of better production practices for maize from various key stakeholders, there was increased productivity from the IPTA areas. Although the national average maize yields are 2.5 t/ha, the farmers were recording 4-5t/ha on average in the IPTA areas with evidence of improved grain quality from better post-harvesting management practices. Due to the volumes produced from collective bulking and storage, the members of Lira IPTA were linked to the purchase for progress programme of the World Food Programme through the Sasakawa Global 2000. All those stakeholders provided their expertise in their niche specialism, such as agronomy practices organized in farmer field schools, and post-harvesting handling. These trainings targeted training of trainers (TOTs), community based facilitators (CBFs) and farmers.

Training and capacity building

A number of trainings were conducted along the QPM value chain on aspects of seed production, crop management, post-harvest management, value addition and soft skills. With the IPTA training on adding value to the grain to fetch premium prices, training was conducted by several stakeholders along the grain value chain, for example for food processors, grain millers, and seed companies. Training covers different products, which can be made out of grains, e.g. flour, cakes, chapatti and bread. In the end, a total of 880 farmers were trained mostly as TOTs who will train more farmers. It is estimated that more than 10,000 farmers were trained from the combined training of the TOTs in the IPTAs.

Post-harvesting training: In the IPTA we identified the possible losses in the grain value chain and post-harvesting losses stood out the most. To address this, several training sessions were conducted by some of the boundary partners in IPTA, for example WFP who had a programme of Purchase for Progress (P4P) and they helped the IPTA to train in areas to overcome the losses.

Figure 24: Different methods of drying used in post-harvesting handling

Demonstration Training: With the IPTA all the trainings were done in the farmer field schools where we established demonstrations, some led by researchers, the others by ToTs and those for farmers. This enabled farmers to have a first-hand experience of the different performance of the same variety under different management conditions.

Experience Learning: Within the IPTA several occasions were used to organize exchange visits between RLPI and Camkwoki farmer groups during the value addition training.

Better method of QPM farming due to knowledge gained leading to better land utilization and enterprise selection. Farmers have gained skills and knowledge in the production of QPM through training and experimentation. The group strategy has promoted participatory learning drawn from individual farmer experiences and backed by the provision of professional extension services. This has increased agricultural knowledge among the farmer groups that has built their capacity and will enable them to sustainably manage the available resources in their locality.

Challenges

The IPTAs are now firmly established, although they face many challenges, they are seeking to develop strategies for growth. Among the key challenge is increased incidence of drought that affects crop establishment and productivities. This increases farmer risks and reduces investment in best management practices.

Although seed availability has dramatically increased in IPTA areas, quantities are still not enough to meet the increasing demand from farmers in the IPTA areas. In addition, breeder seed is always in short supply to fulfil both the IPTA demand and other seed company needs. This is a concern for the sustainability of seed production in IPTAs.

Fluctuation of grain market prices. The basic reason of seasonal price fluctuation is demand/supply pressure, non-holding/storage/purchasing power of farmers and market imperfections. At the end of each crop season, there is a supply pressure on agricultural producers. In most of the IPTA the majority of farmers have ended up selling their produce at low prices due to a lack of storage facilities and this negatively impacts on their motivation.

Although two of the three IPTAs are functioning well, there is still lack of coherence in one of the IPTAs as the big associations behave as separate entities within the IPTA organization. This impacts on service delivery to the primary beneficiaries: the farmers.

Efficient operation and functioning of IPTAs requires constant monitoring internally by the leaders and externally by one of the key stakeholders to get feedback and collectively address them in a transparent manner. However, this effort requires a significant budget that was not adequate from the IPTA budgets and accounts. It makes it difficult to capture emerging issues and immediately address them leading to low morale of the members.

Lessons learnt

The IPTA approach has been instrumental in exposing farmers to improved maize varieties and good field management practices. In Uganda, the participating farmers started farming activities with the IPTA that involved training and technologies which were quickly and well adopted. In addition, participation of the Mega FM (regional radio station) helped in out-scaling information to farmers beyond those participating in the IPTA exemplified by the calls received and amount of seed given to those farmers was another important approach to reach more farmers.

The IPTAs' experiences demonstrate that participatory market orientation enabled these smallholders to play a leading role in identifying a market and successfully linking themselves to a higher-value market option. This required strong support from the service providers, but it showed that farmers could learn rapidly not just how to supply, but also to innovate and respond to new challenges as they emerged.

Outstanding issues and future directions

Limited storage facility: Increased demand for grain for both food and feed provides opportunity for increased production, however, there were still issues related to post-harvest handling and storage because most do not have access to low cost improved storage. In Lira, SG2000 constructed a one-stop centre complete with processing equipment, but this kind of facility was lacking in other IPTAs. Grain bulking also needed to be at the right moisture content but all the farmers lacked moisture meters

Need for QPM seed production enterprise not fully realized: All IPTAs had taken up seed production as a key enterprise with potential for increased seed business. However, this was not feasible due to the failure to have fields where the required isolation distance for maize seed production could be enforced. This constraint may remain unless off-season production supported by irrigation facilities is implemented.

Limited QPM varieties: The most popular variety in the promotional activities was Longe 5, which is an open pollinated variety. There is still the need to develop new stress-tolerant hybrids that yield better and provide opportunity for increased diffusion of hybrids and increased productivity.

Levels of amino acids in the QPM: For QPM varieties to provide nutritional benefits, the levels of the essential amino acids need to be frequently verified. However, there is a challenge of the absence of a functional laboratory to verify levels locally. It is important to have a way to verify the levels or availability of amino acids in the grain, since there is no colour distinction between QPM and normal maize. At the level of research, analyses were conducted in CIMMYT, Mexico but this poses a challenge for seed production locally by farmers with the possibility for contamination from non-QPM maize.

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Theme 3: Product Transformation, Marketing and Income

Introduction to how the IPTA approach was used to promote value addition and marketing of QPM and OFSP for improved incomes

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Access to markets and effective marketing linkages and arrangements are well recognized as key variables for enhancing adoption and scaling up of improved agricultural technologies. In ECA sub-region as in other parts of the continent, poor linkages and limited access to remunerative markets are major factors that limit smallholders' adoption of improved technologies (Gudrun K and Pleskovic B (2008). This challenge is much more pronounced in staple crops such as maize and sweet potato. QPM and OFSP, like their conventional counterparts, are mainly sold both as seed maize, grain or fresh maize on the cob and as fresh roots (PRAPACE, 2005), respectively; and are mainly consumed in those forms. Sweet potato is also both bulky and perishable, forcing the bulk of it to be sold at the farm gate or local markets, earning farmers very little. The seasonality of production, insufficient quantities produced, inconsistent supplies and variable root quality, have all contributed to the limited integration of sweet potato into larger markets.

Serious diseases in other staples (such as cassava) are forcing farmers to turn to alternative food crops, such as sweet potato. Short-maturing crops such as sweet potato also take advantage of limited rainfall and unpredictable climate patterns. There is also an increasing demand for alternative foods in the face of price hikes for wheat-based products (Ouma JO et al. 2011). In addition, the nutritional benefits of OFSP is creating demand among both rural households where many mothers and children are at risk of vitamin A deficiency diseases; and among the urban middle-class who are seeking healthy food options. Similarly, the nutritional benefits of QPM provide an alternative source of protein especially for poor households who cannot afford meat, fish, milk and eggs. QPM grain also offers alternative source of protein to replace artificial lysine and expensive fishmeal in the production of poultry feeds. All these demand transformation of QPM grain and OFSP roots to create diverse options for utilization, to increase the value and expand market opportunities for smallholder farmers engaged in these value chains in ECA sub-region.

A key challenge in bringing DONATA and the IPTA concepts into operation was around how to promote the uptake of diverse ways for utilizing QPM and OFSP through value addition to produce other non-traditional products, for both human consumption and the animal industry. For example, the IPTA framework could be adopted to ensure that smallholders have access to the technologies and skills to produce various QPM or OFSP based value added products for home use or for sale in local markets. Also, how the approach could be applied to interest existing medium-scale producers of animal feed to use QPM grain and bakeries to produce OFSP-based bakery products. Furthermore, the formation and operation of the innovation platforms had to address how to enhance farmer access to markets including developing or adapting innovative marketing arrangements and facilitating interactions between actors across the value chain in ways that could build trust so that both smallholders and buyers would benefit from the transactions. In addition, the IPTAs had to identify the most

appropriate ways in which to facilitate the establishment of small and medium scale QPM or OFSP-based enterprises that could exploit the value addition technologies.

This thematic area has six countries' case study papers that provide experiences on three key parameters, which can significantly influence scaling out adoption and impact of QPM and OFSP technologies. These key parameters are: product transformation (sometimes broadly referred to as value addition), marketing and smallholder income generation. The countries' case studies show how the IPTA approach has been used to promote the uptake of value addition technologies at household level and by small to medium scale processors and how it has broadened the range of products based on QPM and OFSP. They also provide examples of how marketing functions, such as the identification of market potential, organizing smallholders for produce aggregation or assembly and market promotion were facilitated through IPTA processes. They also show marketing arrangements; including forging linkages with the private sector (processors, seed companies, supermarkets) and other buyers have been done to enhance market access and profitable marketing. What comes out across the six countries' case studies is an illustration, though in different degrees, of the unique attributes of the innovation platform mechanism in terms of bringing value chain (VC) actors together, facilitating their interactions such that they could plan, build trust and break down traditional barriers to develop efficient and mutually beneficial transactions along the VC.

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Sweet potato marketing initiatives under innovation platforms in eastern and central Africa

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Introduction

Marketing of agricultural commodities in East and Central Africa (ECA) is largely informal, ad hoc in nature and disorganized (KIT, 2010). Farmers strive to sell their commodities through various channels and many times with little benefit. On the other hand, traders and other chain actors are equally frustrated, as they have to deal with high transaction costs. Such costs are a result of poor infrastructure, high bulking costs, and quality adulteration, among others. Yet markets offer an opportunity for commercializing agriculture and hence improving the livelihood of smallholder farmers and other chain actors. This is especially so in the ECA region where most people depend on agriculture.

Sweet potato markets in the ECA region are not any different. The bulky and perishable nature of the crop further hinders its entry into lucrative markets. As noted by Bashaasha and Mwanga (1995), sweet potato marketing is constrained by bulkiness, high perishability, high transport costs, minimal storage facilities, limited market information services and absence of processing. The authors further note that the most common method of selling is where women in rural markets sell small amounts, though urban trading is becoming significant. As such, it is mainly regarded as a woman's crop and therefore mostly held in low regard; further exacerbating its trade. However, the crop offers a lot of opportunities to farmers especially those living in marginal areas given that it is drought resistant, nutritious (especially the orange-fleshed varieties which contain beta carotene) and matures earlier than most other root and tuber crops. According to Ewell and Mutuura (1994), sweet potato is an efficient provider of cash income over unit of land and time. Even with low external input, the profitability of the crop is high with great potential to double when improved technologies are applied (Bashaasha & Mwanga, 1995). In addition, the ECA region is the highest producer of sweet potato in Africa, accounting for over 60% of the continent's production (FAOSTAT, 2010). Considering the aforementioned benefits, it is important that efforts to improve its marketing are stepped up in the region.

The Dissemination of New Technologies in Africa (DONATA) was a five-year project by the Forum for Agricultural Research in Africa (FARA), implemented in four regions in Africa. In the ECA region, the DONATA project was overseen by the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA) and focused on Quality Protein Maize (QPM) and Orange-fleshed Sweet potato (OFSP). The OFSP component was managed by the International Potato Centre and was implemented in Ethiopia, Kenya, Rwanda, Tanzania and Uganda. The project began in 2008 and ended in 2012. The DONATA project employed a multi-stakeholder approach, in the hope that this would promote dialogue and iterative learning hence accelerating innovations along the OFSP value chain. As such, Innovation Platforms for Technology Adoption (IPTAs) were formed in the project operational areas. By the end of the project, 21 IPTAs were functional in the five countries. The IPTAs comprise of National Agricultural Research Institutes (NARIs), Universities, Extension service providers, NGOs, chain actors, the media, farmers and other private sector actors, among others. In most cases, the NARIs provided the coordinating function except in the Gulu IPTA where coordination was done by Gulu University.

At the beginning, the IPTAs focused on establishing seed systems to counter the challenge of availing quality seed in a timely manner to farmers. Once considerable progress had been made in this area, focus shifted

to supporting root production, processing and later, marketing of OFSP products. However, the IPTAs faced a number of challenges in supporting farmers and other chain actors to market their OFSP products. This in part stemmed from a lack of technical expertise in marketing within the IPTA membership, and also from a host of supply and demand related issues. This prompted CIP to commission a study in 2011/12 to identify the underlying marketing related issues, with an aim of supporting the IPTAs to devise strategies to address them. The phased study was conducted in Tanzania, Kenya, Rwanda and Uganda.

The overall objective of the study was to characterize the various market chains of OFSP products across IPTAs in the project countries so as to come up with strategies to improve their performance. This in turn would improve the benefits accruing thereof to smallholder farmers and other chain actors. The specific objectives were:

- To comprehend the functional aspects of the various market chains
- Identify potential market opportunities
- Recommend strategies for developing the OFSP value chains

This paper provides an insight into the regional marketing initiatives that were undertaken by the IPTAs. It underscores emerging good practices, challenges faced, coping and sustainability strategies employed. The paper further highlights CIP's experiences in providing technical support to the NARIs and IPTAs and the resulting effects.

Methodology

The study employed participatory action research where several approaches were used. These included face-to-face interviews with key informants, workshops with traders, farmers and IPTA members and focus-group discussions with farmers. Other methods used included literature review from secondary sources (e.g. IPTA records, presentations and reports) as well as through observation during site visits to markets and key market chain actors' premises. A simple checklist was developed and used to gather information from the market chain actors, while a questionnaire was used to collect data from IPTA members on the underlying themes:

1. *Main products and market outlets:* what are key products marketed, in terms of quantity, quality and volumes? Who are the main actors in the market chain? What are the consumer's needs?
2. *Chain Organization:* What kind of relationship exists between the various market chain actors? What are the major challenges? How has this impacted on the market chain? What can be done to improve the relationship?
3. *Support functions:* Which organizations/entities provide support to the sweet potato chain/business? What kind of support is provided?
4. *Areas for improvement:* How could the existing marketing arrangements be improved? What opportunities exist in the market? What can be done to harness these opportunities? What could be done to improve consumer satisfaction?

A total of 185 respondents were interfaced comprising of 3 District officials, 51 IPTA members, 8 processors, 19 vine producers, 84 root producers, and 18 traders (Table 7).

Results

Functional aspects of the market chains of OFSP products

The major OFSP products traded with support of IPTAs in all project areas were vines, roots and assorted processed products. These were traded through various forms of supply chains, which varied in nature and functional aspects. Unlike other countries, Kenya had fairly well developed OFSP chains, especially in the Busia

IPTA. This was attributed to earlier work done on OFSP market development, and also to the fact that one of the members – Farm Concern International (FCI)- had marketing expertise. The supply chains in Ethiopia were just emerging, given that OFSP was introduced most recently as compared to all other countries. Below we present the functional aspects of the OFSP product chains at the time of the study.

Table 7: Number of respondents interfaced with in the study

	Number of respondents per country			
Type of respondent	Uganda	Kenya	Tanzania	Rwanda
District Officials	-	-	3	-
Root producers	5	8	51	20
Vine producers	5	5	5	4
Processors	-	2	6	2
Traders	-	-	16	2
IPTA members	14	15	10	12
Total	24	30	91	40

The vine chains

Vines are an important component of the OFSP subsector trade, as they affect the availability and subsequent quality of the other OFSP products. Vines are vulnerable to seasonal variations, and must be conserved in pristine conditions for usability. Most of the IPTAs established a three-tiered seed system in a quest to improve availability of quality vines to farmers. Clean vines were multiplied at Primary Multiplication Sites (PMS) mainly at research stations. These vines were supplied to IPTA members to set up Secondary Multiplication Sites (SMS). In some IPTAs, the SMS was managed by the IPTA (e.g. in the Busia IPTA, Kenya), while in others they were managed by farmer groups (e.g. in Ukerewe IPTA, Tanzania). Vines from SMS were then used to set up Tertiary Multiplication Sites (TMS, managed by farmers, which also served a dual purpose of vine and root production). As of December 2011, the IPTAs has a total acreage under PMS of 9.1 ha, SMS 41 ha, and 43 under TMS. It was difficult to capture the area under TMS, and most IPTAs did not have information on this parameter except Lira and Rwanda. The details are provided in Table 8[5] below:

However, there were other chains that were observed. The most common one was where farmers (or tertiary multipliers) exchanged vines freely with fellow farmers. This was because the practice of procuring vines was not common in all areas. This chain was mostly prevalent in IPTAs that had not actively promoted SMS, like the Lira.

The second most common channel observed was where an SMS would sell vines to farmers that were not group members. This chain was observed in all the countries, but varied in scale of operation from group to group, and also across IPTAs and countries.

The third chain observed was where large seed producers sourced seed directly from research centres and established large multiplication plots. The vines produced were sold to institutional buyers, who distributed the vines to beneficiaries either through project mode or relief programmes. This chain attracted the greatest volume of sales, and was more sophisticated in terms of technical practices, product handling, quality assurance, and value.

Notably, a new type of chain was seen to be emerging in Kenya and Rwanda. Large producers were supporting the emergence of entrepreneurs through provision of starter seed and technical advice, and later, linkages to markets.

[5] Source: DONATA 4th quarter IPTA/Country 2012 reports

Table 8: Area (ha) under vine multiplication by various IPTAs in the OFSP target countries (October-December 2011)

Country	Mult. Level	Oct-Dec 2011	Varieties Under Multiplication	Geographical Focus
Kenya	PMS	1.00	Ejumula, Kabode, Vita, SPK031	Western Kenya: Busia, Bungoma, districts Kakamega and Mumias
	SMS	3.60		
	TMS	n.a.		
Uganda	PMS	1.83	Ejumula, Kakamega, Vita and Kabode	Northern Uganda
	SMS	1.75		Lira only
	TMS	2.50		
Tanzania	PMS	2.50	Ejumula, Carrot-C and Jewel	Lake Zone: Sengerema, Ukerwere, Bukoba Rural, Missungwi, Missenyi districts
	SMS	11.80	Carrot C has replaced Carrot-Dar	
	TMS	Na		
Rwanda	PMS	0.80	Caceopedo and 97-062, Kakamega and Ejumula	Bugesera, Kamonyi, Nyamagabe, Rwamagana and Rusizi districts
	SMS	21.65		
	TMS	40.50		
Ethiopia	PMS	3.00	Tulla and Kulfo	SNNPR: Boricha, Hawella Tula and Boloso sore Woredas
	SMS	2.15		
	TMS	n.a.		Areka
Total	PMS	9.10		
	SMS	41.00		
	TMS*	43.00		

*reflects figures for Rwanda and Lira (Uganda).

The role of the IPTA in the vine chain was uniform across countries – IPTAs secured clean virus-free seed from the research station PMS and supplied it at SMS, but also at times directly to TMS. IPTAs also helped in assessing demand and supply, providing such information to relevant actors, and in linking seed producers to relevant partners.

The roots chain

The OFSP fresh roots chains were the least developed in almost all the IPTAs. This was mainly attributed to low demand for the roots due to their low dry-matter content. The study team did not find substantial volumes of roots being sold in the markets, whereas white-fleshed varieties were found in all the markets visited.

The most common chain was a producer consuming the roots. Producer also sold roots directly to buyers, either at the farm gate or at roadside markets. The volume sold was low, and sales were made in heaps or basins. Mixing OFSP with white-fleshed varieties was a regular occurrence.

A farmer group in Msozi, Ukerewe district in Tanzania and another in Busia, Western Kenya had managed to sell OFSP roots at a higher price than white fleshed ones. In the beginning, the Msozi group sold the roots directly to consumers in the market, but later identified traders who collected the roots from their farms. The Busia farmers accessed wetlands and produced OFSP during the dry season. They too had identified traders who picked up the roots and sold them in the town market. One farmer in Lira, Uganda reported sales of 300 bags of OFSP to a peri-urban market, but this was a one-off occurrence. In Kenya, the Bungoma IPTA had established clusters of root growers on a regional basis in a bid to improve root production and marketing. By December 2012, 380 farmers had each established at least 0.2ha of OFSP roots for sale.

The processed products chain

Most of the processors encountered during the study were also root producers. The most common chain, therefore, was where the producers/processors transformed their roots into various types of snacks, and sold them at public events like agricultural shows.

The second chain observed was where small and medium scale processors procured roots from producers, and transformed them into snacks and flour. The processed products were sold to retailers, who sold to final consumers. This chain was commonest in Tanzania, where each IPTA had at least 7 processors. A few of these processors were producing snacks more regularly and reported sales of 15-20,000/ Tanzania shillings per week, selling to local markets and schools in addition to the larger agricultural shows and exhibitions.

In Kenya and Rwanda, larger processors were engaged in all nodes of the chain (seed, roots and processing). In addition, they bought roots from root producers, on a kilogram basis. The processor in Kenya sold flour to a distributor, who supplied various supermarkets in Nairobi. The processor in Rwanda sold bread, cakes, and doughnuts to retail outlets within the district.

Challenges faced and market opportunities identified

Working with the IPTA members, critical challenges constraining the OFSP products value chains were highlighted, in relation to the market opportunities that were identified during the study. It was observed that challenges affecting the various product chains were interconnected and that these could affect the ability of the IPTAs to take advantage of the market opportunities identified.

The vines chain

The market opportunities identified included: (i) sale of vines to organizations promoting nutrition and food security. This opportunity existed in most countries and accounted for an estimated 70% of the total market demand. (ii) sale of vines to subsistence producers located in drier areas. (iii) sale of vine varieties conducive for processing to root producers who supplied processors. This was evident in Tanzania, Rwanda and Kenya where specific varieties had been classified to suit different processed products. In Rwanda for example, root producers supplying processors of mandazi and doughnuts would opt for *Gihingamukungu* due to ease in making puree, while processors of biscuits preferred *Carcaepedo*. This market segment was smaller and more specialized than others. In terms of profitability, vines were considered an investor-worthy venture as exemplified in Table 9.

Table 9: Cost benefit analysis of producing 1 acre of vines using the Rapid Multiplication Technique in Busia, western Kenya

Expenses	Phase/major activity	Cost (Kenya Shs)
	Establishment	55,000/
	Ratoon 1	32,000/
	Ratoon 2	26,000/
GRAND TOTAL		
Income	First harvest	72,000/
	Ratoon 1	144,000/
	Ratoon 2	108,000/
GRAND TOTAL		324,000
NET INCOME		210,500

(Source: presentation made at SPHI Regional Sweet potato Support Platform Consultative Meeting held in Nairobi, June 2012).

Various institutions were identified that could support the vine chain. Research stations within the IPTA's geographical scope provided support in form of (i) availing clean primary/starter planting material (ii) technical

support e.g. training (iii) linkages to buyers and (iv) inspection and quality assurance. Fortunately, the Research Stations were the coordinating institution of the IPTA, easing access to these services by vine multipliers on the IPTAs. Business Development Service providers included credit institutions for credit and investment planning, Skills Development Institutions for capacity development, linkages to other service providers and technical advice. In some cases, the BDS providers were members of the IPTA e.g. Sengerema, Lira, Busia and Bungoma, while in other cases they had to be outsourced. In this case, the IPTA focal persons played an important role in sourcing these services. The Local Government was identified as an important service provider that provided technical advice and monetary support, as well as ensuring an enabling environment. There was limited access to credit services in most IPTAs, and similarly market development services were hard to come by. Table 10 shows the various service providers that were accessible to the OFSP market chain actors

Table 10: Business development support institutions and functions available to OFSP market chain actors

Support function	Provider	Ease of access	Beneficiaries
Input provision	Research stations (vines)	Fair	Vine & root producers,
	Agrovet shops	Fair	Vine & root producers
	Equipment manufacturers	Limited	Processors
Technical assistance – skills development, advice, etc.	Researchers	Fair	Producers & processors
	Local Government	Fair	Producers & processors
	IPTA	Good	All actors
	BDS companies	Limited	Producers, processors, traders
	NGOs	Good	Producers & processors
Access to credit	SACCOS	Fair	All actors
	Microfinance institutions	Fair	All actors
	Banks	Limited	All actors
Market Intelligence	Traders	Limited	All actors
Trade linkages	BDS companies	Limited	All actors
	NGOs	Fair	All actors
	IPTA	Fair	All actors
Inspection and quality assurance	Research stations	Fair	Vine producers
	Bureau of Standards	Limited	Processors
Product development	Researchers	Fair	Processors
Awareness creation	Media	Fair	All actors
	NGOs	Fair	Producers & processors
	Schools	Fair	Producers
	IPTA	Good	All

Commercial vine producers targeted institutional buyers, but had the challenge of obtaining *advance information on demand* (when, how much, what variety). The institutional buyers either supported livelihood improvement efforts, or emergency relief efforts. The former was encountered in all countries, while the latter was mostly seen in Ethiopia. Few producers actively sought to engage with institutional buyers to elicit their needs, and waited for the buyers to approach them. Nor did they seek for weather and climatic related projections, which could help forecast droughts, floods or other conditions that could result in the need for emergency action. If they had such information in advance, it would inform their investment and expansion plans. This had a bearing on the availability of the preferred vine varieties- especially in times of high demand.

Low *willingness* to pay by the root producers was observed as a central challenge in commercializing the chain. This was especially noted in IPTAs that are located in Agro-Ecological Zones (AEZ) with two rainy seasons (e.g. in Bukoba, Tanzania), where farmers were able to save vines from one season to the next. In areas with longer dry seasons, farmers were more willing to buy vines. In Tanzania, a farmers' group in Mwasonge, Missungwi IPTA had sold over 600 bags (out of the 1,000 needed) to traders from Songea, in central Tanzania, which is drier. This conformed to results from a willingness-to-pay study done in Mozambique in which farmers in drought prone areas were more willing to pay for vines with preferred characteristics, and at an appropriate price (Labarta 2008 in Andrade et al., 2009). This implied that vine multipliers had to understand the consumer demand in terms of *quantities, timing and preferred traits*.

The other challenge experienced was quality assurance, especially for large sales. Previously, vine producers in Kenya obtained quality certificates from KARI. However, some buyers had questioned the validity of the certificate on the premise that it was a conflict of interest, since KARI had been the original source of seed. In Ethiopia, a team comprising technical experts from CIP and research had to verify the quality of materials before purchases for emergency relief could be made. In summary, lack of a quality standards hampered trade and also increased transaction costs.

A high production cost especially in long dry periods was another challenge faced in this chain. Large producers had to look for land close to water sources, and at times invest in irrigation in order to maintain the vine plots. Increased prevalence of disease and pests was also noted during specific growing seasons (e.g. erinose mite in Kenya), prompting the producers to identify innovative ways of dealing with the problem (Makhoha, 2012).

The roots chain

The opportunities identified included (i) availing OFSP roots for sale in local markets during the dry season to take advantage of low supply of the white fleshed varieties e.g. in Kenya, Uganda and Tanzania (ii) sale of roots to large processors – existing and emerging (iii) sale of roots to non-farming communities e.g. fisherfolk in Islands surrounding Ukerewe District in Lake Victoria, Tanzania (iii) supply of roots to schools as part of the school feeding programme in Tanzania, and to boarding schools in Rwanda, Kenya and Uganda.

The greatest challenge faced in this chain was low acceptability of OFSP roots mainly because of the low dry matter content. Both farmers and traders claimed that fresh OFSP roots were not preferred, and could not compete favourably with the white and yellow fleshed counterparts, especially by adults. This could have prompted mixing varieties in retail sales as noted in one market in Bukoba. Hence, farmers with limited access to markets grew OFSP on smaller plots for their own consumption. Even then, they experienced challenges in accessing quality vines at the start of the growing season especially in cases where they had lost their own due to drought and diseases.

The other challenges included the bulky nature of the roots that resulted in high transport costs especially for farmers located far away from markets. This was further exacerbated by limited number of collective bulking and marketing initiatives. Farmers reported that the most common form of transport to the local market was carrying the crop on the head, or use of bicycles. The low shelf life of roots affected storability and the window within which marketing of fresh roots could be done. Customers interacted with in Sengerema and Bukoba markets indicated preference for roots that appeared fresh, prompting them to opt for other crops like cassava if the sweet potato on offer were deemed old. They also exhibited low awareness of OFSP and its attributes, hence preference for traditional varieties.

Traders in Mwanza revealed that OFSP could not compete with traditional varieties mainly because it was believed to be a genetically modified organism (GMO). They believed that this was the cause of its inferior taste, amongst other properties. The traders further indicated that customers preferred traditional varieties of most commodities (cabbages, bananas) as compared to research-generated varieties as they were more health

conscious and were worried about the effects of GMOs. Another challenge cited was low and inconsistent supply of roots by the producers. This led to higher transaction costs as one had to move long distances to get decent volumes.

Processed products chain

Processed products were gaining significance in Kenya, Rwanda and Tanzania. According to Siwongo Processing Company, the demand of OFSP flour had grown from 2 to 5 metric tonnes per month by retail outlets in Nairobi at the time of the study. Furthermore, two large processing companies had placed an order for 2 metric tonnes of OFSP chips per month. In Rwanda, the demand for processed snacks in Rwamagana District and surrounding areas was indicated to be growing. In Tanzania, latent demand for flour was registered in hospitals and schools.

The major opportunities identified therefore included: (i) increased demand for flour by retailers and consumers (iii) increased demand for OFSP based snacks (ii) increased demand for chips by flour manufacturers

The major challenge faced by large processors was the inadequate supply of roots for processing. Siwongo Company could not meet the growing demand for flour and chips. Similarly, Duhange Cooperative in Rwanda faced shortages in during drier months and had to struggle to maintain presence in the market for baked products.

The other challenge included the low quality of roots. In Busia, even with sensitization by the processor and other IPTA members on the quality required, farmers still included small diseased roots in the consignments offered for sale. The processor also incurred high transport and assembly costs. Though delivery plans were made where farmers had to aggregate their produce at one point, many times these were not adhered to resulting in the processor having to incur higher costs in a bid to reach all the farmers.

Processors also experienced cash flow problems caused by delayed payments by the retailers (supermarkets). This led to a halt in activities especially in cases where the processor had to procure roots from new sellers/ farmer groups. Sourcing capital for investment in upgrading processing machinery so as to match the increasing demand was another challenge. Though the IPTA had provided machinery to the processors, the rise in demand quickly outstripped the capacity of the existing machinery. The processor in Rwanda also had to secure a quality assurance mark from the Rwanda Bureau of Standard before he could access urban markets, which required a considerable amount of money.

Small-scale processors experienced a number of challenges including standardization of products and maintaining market presence. Most of the small-scale processors hence resorted to targeting one-off large events (e.g. the Nane-Nane Agricultural Show in Tanzania and World Food Day in Uganda). Branding and packaging costs were also a challenge, especially since they could not compete favourably with imported snacks and flour.

Strategies employed to support market development:

In a quest to counter the challenges and develop markets for the OFSP products highlighted above, IPTAs used a number of strategies. While there were similar aspects in the strategies across the region, some were area specific. The commonalities could be attributed to CIP's technical assistance to the IPTAs using various approaches. The strategies are discussed below:

Rapid market assessment (RMA)

RMA is a tool that is used to ascertain market prospects, demand and supply of a new or existing product. In this case, RMAs were done with CIP support in Tanzania and Ethiopia to establish if OFSP was known and sold in the market; traders' perception of the demand and also to chart strategies to create and sustain demand for the crop. In Tanzania, the RMA led to initial contact with traders who worked closely with LZARDI to establish a new market channel for OFSP in Mwanza. In Ukerewe, the IPTA was able to identify market opportunities

in surrounding islands, and together with CIP and LZARDI designed ways to further explore and harness this opportunity. In Ethiopia, the RMA served to provide preliminary information for developing study tools and approach for the sweet potato market study. In both cases, the IPTA members appreciated the tool and can now use it confidently on their own as and when the need arises.

Production and Marketing Plans

Production and marketing plans were developed and used by Lira and Bungoma IPTAs to support their efforts in aligning demand to supply of both roots and vines for identified and prospective markets. After 6 months, the IPTAs reviewed actual performance compared to what was planned, as well as the usefulness of the tool. The Bungoma IPTA further supported the root production clusters to plan and phase production to meet the various market demands with the help of the production and marketing plans. In Rwanda, Duhange Cooperative operates a harvest schedule aimed at ensuring consistent supply of roots to the processing factory.

Linkage to Business Development Services

Following the identification of new market opportunities, farmer groups realized the need for additional support in a bid to harness these opportunities. In Ukerewe and Sengerema, farmer groups were assisted by their respective IPTAs to access credit to procure treadle pumps. The pumps were used to irrigate SMS, which improved vine availability for root production and for sale. Traders and root producers in Sengerema also accessed sizeable loans to expand their businesses. The processor in Rwanda applied for a bank loan and obtained funds to expand his business.

Awareness creation and promotion

Breaking into new markets and expansion of existing ones has been achieved through concerted awareness and creation initiatives by the IPTAs. The media has been a strong ally in this, especially in IPTAs where the media was actively represented. In Rwanda, for example, the chairman of Duhange Cooperative featured on Farm Radio International, while in Uganda one large vine producer was hosted on local radio shows. Both entrepreneurs indicated a subsequent increase in demand for their products after the shows. In Mumias, the IPTA registered increased awareness and interest in OFSP through the use of community radios to air specially recorded messages on the importance, establishment and utilization of the crop. Field days, agricultural shows and other public events were also used as avenues for awareness creation. Vine producers in Kenya obtained a trade contact through the sweet potato knowledge portal. Both producers and processors were able to make linkages with buyers that are being consolidated over time with repeat sales.

Formation of production clusters

In a bid to address the rising demand for roots by the processor in Busia, the IPTAs employed a number of strategies. The DONATA focal point encouraged inter-IPTA linkages where the processor was linked to producer groups in Bungoma IPTA. To counter the challenge of high transaction costs associated with pick-up and delivery, the Bungoma IPTA supported the formation of production clusters. These were comprised of 5-7 farmer groups in proximal location. Each week, one cluster bulked the roots at a central agreed point, from which the processor would collect them. The participating farmers would deliver the roots a day in advance at the centre where sorting and bulking would be done. The processor paid on receipt of the roots, on a kilogram basis. The production clusters eventually evolved into commercial villages.

Working closely with traders

Following the RMA in Mwanza and Sengerema markets, a new supply channel was developed as a result of close collaboration with the traders. The collaboration was initiated at a training/sensitization session in which both researchers (LZARDI and CIP) and 14 traders strategized on ways through which OFSP could be re-introduced

and availed consistently in the markets. Traders agreed to introduce OFSP vines to partner commercial farmers who supplied them with the white-fleshed varieties. Information, Education & Communication (IEC) materials on agronomy, utilization and importance were developed in Swahilli and given to traders to support introduction of OFSP to the commercial farmers. Initially, 10 commercial farmers were sensitized and they established 7 acres for vines and roots in October 2012. In the subsequent month, 1 farmer in Musoma supplied vines to 5 other farmers who established 6 acres. Though a number of challenges were experienced, good progress was made and the first harvests from Musoma amounting to 60 bags were successfully sold to Buhemba gold mine and to traders in Musoma and Buhongwa markets. Although initially the aim was to re-introduce OFSP in large Mwanza markets, this was not possible due to the high demand that existed closer to the production areas. Nonetheless, the high demand and positive reception by consumers was very exciting for the farmers and traders. Subsequently, 4 trader groups in Sengerema accessed loans of one million Tanzanian shillings[6] each from a Public-Private Sector Initiative with the support of the IPTA, and have since expanded their business operations.

It is important to note that IPTAs also initiated strategies to explore and expand markets on their own. Some of these strategies were successful e.g. the promotion of OFSP products through provision of free samples. Others included supporting the formalization of business entities. Busia IPTA, for example, supported formalization of the Siwongo Processing Company, while IPTA East in Rwanda supported the formation of Iwacyu Company, which evolved from Duhange Cooperative. These companies were able to access bank loans to upgrade their business operations, and are now the major drivers of the OFSP chains in their localities. Some strategies were not fully explored (e.g. utilizing market/value chain analysis studies, market surveys, among others), but would be useful in future activities of the IPTAs.

Market development

A number of innovations emerged in the various IPTAs as a result of implementing various market development strategies. These innovations could be classified as product, process and systems innovations. Product innovation can be described as development of new products, improvement of existing products, or sale of existing products to new markets. In a bid to address consumer needs, the IPTAs realized the need to transform OFSP into acceptable products. This was seen in Ethiopia where composite flour for making enjeera was produced. While OFSP roots were not easily acceptable, the enjeera was readily acceptable. Process innovation refers to efficient, effective production and processing. Various IPTAs supported improved processing through training and provision of equipment and machinery. Access to stainless steel equipment and mini bakery enhanced the production processes of Duhange Cooperative in Rwanda. Systems innovation on the other hand refers to relevant links and effective support to address demand, supply and value chain upgrading. This was envisaged through inter-IPTA linkages in Kenya, contract farming in Rwanda and Local Government support in Tanzania. Generally, appreciable market development was registered in all the three product chains, as expounded below.

Vines chains

As mentioned earlier, the market for vines grew in all countries. Institutional buyers dominated the market, and may continue to do so in the medium term. Vine producers adopted strategies to increase awareness and sales. In Uganda, one large vine producer provided extension advice to smallholder buyers through demonstration gardens. The vine producer also set up a selling point for his vines, which also doubled as a sales-point for farmers' roots. Through IPTA support, he was able to create awareness for his vines. As a result, local vine sales increased from 0.5 to 1.5 bags per week. His total earnings in the last quarter of 2012 were three million Uganda shillings[7], of which micro sales contributed 20% (Jacob Otim, personal communication). In Kenya, the large vine producer supported the establishment of six entrepreneurs in the Busia district by providing them with

[6] 1US$= 1550 Tanzania Shillings

[7] 1US$ = 2600 Uganda shillings

starter seed, extension advice as well linkages to markets. These entrepreneurs alongside other vine producers in Bungoma IPTA were linked to the One Acre Project and earned $37,000 from sales made in November 2012[8]. In Rwanda, increasing demand for roots by processors indirectly created a market for vines as root producers strived to increase the area under acreage in response to increasing root demand. In the Gulu IPTA, a women's group established a vines sales point under a big tree, which gradually expanded over time. In the first season of 2012, the group sold 120 bags of vines and was able to sell OFSP vines at a higher price than white-fleshed sweet potato vines. In Tanzania, consolidated sales from all the IPTAs in 2012 were 45,035,000/ Tanzania shillings from 9007 bundles.

Roots market development:

As noted in the previous section, development of this market was driven by the demand for processed products. In response to this, two IPTAs in Rwanda supported contract development between Cooperatives/farmers' groups and processors. Urwibutso Enterprises, a big processor, signed contracts with two farmers' groups in IPTA North for the supply of 500kg of roots weekly per group. Duhange Cooperative developed a harvest plan in which members supplied roots for processing periodically. A farmers' group in Kayonza also got a contract to supply Iwacyu Company with 500kg of roots weekly. These farmers had earlier received vines from Duhange Cooperative and were grateful for the market linkage. The proprietor of Iwacyu provided samples of OFSP roots to traders in Kimirongo market in Rwanda, which were accepted. As a result, the company now supplies 600–800kg to traders in Kigali. Iwacyu also supplies OFSP to boarding schools in Rwamagana District. In Lira, Uganda, sales points were established at strategic locations where traders registered sales of 1.5–2 bags per day. The large vine producer also sold roots worth two million Uganda shillings (US$ 700) in the last quarter of 2012. In Kenya, linkages were established between commercial villages and traders in Bungoma market. The farmers were able to deliver 10 tonnes of roots in December 2012. This is in addition to the weekly deliveries to the Siwongo Company. Farmers in Sengerema, Ukerewe and Missungwi IPTAs sold 1,235 bags and earned 46,930,000 Tanzania shillings (US$ 30,277) in 2012.

Processed products market development:

The main commercial processed products emerging in the region included pure OFSP flour in Kenya, bread, cakes, doughnuts in Rwanda and Tanzania, snacks in Uganda and Ethiopia. In Kenya, the Siwongo Processing Company expanded its supply base to producer groups in Bungoma and Mumias IPTAs. The processor further supported more farmers in Busia to grow OFSP by providing starter seed and also guaranteeing a market for the roots. To further strengthen the enterprise, the processor legalized the processing company. The company obtained certification from the Kenya Bureau of Standards and plans to introduce OFSP differentiated products, among others. In Rwanda, Duhange Cooperative registered a 50% increase in sales of processed products like bread, cakes, doughnuts and gateaux between 2010 and 2012, as shown in Table 11 below.

Table 11: Volume of processed products sold by Duhange Cooperatives (2010-May 2012)

Product	2010	2011	January – May 2012
Mandazi	180.00	270,000	150,000
Biscuits	1,800	43,200	22,500
Cake	180,000	396,000	180,000
Bread	72,000	324,000	165,000

(Source: presentation made at SPHI Regional Sweet potato Support Platform Consultative Meeting, June 2012).

Just as in Kenya, the chairman of Duhange Cooperatives formed Iwacyu Company to support expansion of the confectionary business. The company obtained a bank loan to expand business and also commenced on the process of obtaining certification with Rwanda Bureau of Standards.

[8] Source: DONATA quarter 4 2012 technical report

In Tanzania, the IPTAs together with a grant from the local government supported the construction of a processing plant at Usagara. The plant is centrally located and has a capacity of 5-6 metric tonnes of flour per day. Management was entrusted to a group of women processors and production is on going. Schools, hospitals and shops in Mwanza, following a rapid market survey targeted at demand creation, have registered a high demand for the products. The plant is envisaged to spur root and vine production from surrounding IPTAs.

In Uganda and Ethiopia, processing was still at cottage-industry level. In Uganda Nen Anyim Processors in Lira were trained and supported with processing equipment. The demand for the snacks increased gradually, and average sales of 200,000 Uganda shillings (US$77) a week were reported. The processors also trained other small-scale processors and farmers in the Lango region for a fee. In Ethiopia, in addition to snacks, OFSP and tef flour were mixed to make enjeera, albeit at a small scale.

Discussion

In this section, we share our reflections on the results that emerged from the study. We also share experiences on providing technical assistance across the countries, lessons learnt and suggestions for similar interventions in the future.

From the results, IPTAs were able to identify market opportunities, challenges impeding market access, and later devised strategies to counter them. In so doing, innovations were generated that spurred the achievements so made in the marketing arena. The discussion will thus focus on three broad themes in line with the objectives: (i) The ability of IPTAs to identify market opportunities and strategies to harness them (ii) Mechanisms employed by the IPTAs in operationalizing strategies (iii) Sustainability of IPTA marketing interventions.

Identification of market opportunities and appropriate strategies to harness them:
By the general composition of IPTAs, a number of them had limited capacity to identify bankable market opportunities, and appropriate strategies to address them. A number of IPTAs focused mostly on production and supply challenges, with minimal focus on the demand, which lessened the possibilities of engaging in lucrative markets. In addition, most of the IPTA members were of the view that marketing was in a different realm or sphere, which could only be tackled by marketing specialists. IPTA members realized that they had to engage actors in the chain, organizations/individuals supporting the chain, as well as policy makers in order to harness market opportunities. With adequate facilitation, they were surprised to find out that all this was possible. CIP, NARIs and other IPTA members with marketing expertise played the facilitation role initially. In so doing, these organizations acted as 'innovation brokers'. According to Klerkx et al. (2010), innovation brokering is about performing several linkage building and facilitation activities in innovation systems, creating an enabling context for effective policy formulation and implementation, development and innovation. Klerkx and Gildmacher (2012) further underscore three roles of innovation brokers: (i) analysing the context and articulating the demand; (ii) composing networks (iii) facilitating interaction. In addition to the three roles, Nederlof et al. (2011) include other roles such as technical backstopping, mediation, advocacy, documenting learning and capacity building. Indeed, the innovation brokers also imparted practical skills in market assessment, dialoguing with other actors and forecasting demand to the IPTA members. The practical sessions (e.g. RMA) with IPTA members made them realize that improving market access required practical initiatives, dedicated players, and the need to engage with all actors in the value chain in a transparent manner. The IPTA members also realized that the chain actors were the real 'experts' in the marketing arena. As argued by Bernet at al (2005), market chain actors, especially upstream actors who are in close contact with the consumers, have practical ideas on potential strategies to improve marketing, hence the need to take heed of their ideas. Opening traditional boundaries and levelling the ground was beneficial and resulted in improved trader-farmer-researcher relationships. In essence, the IPTA's ability to articulate needs and business opportunities was improved.

Mechanisms employed by the IPTAs in operationalizing strategies

As seen from the results, the IPTAs employed several strategies to harness the market opportunities that were identified. In most cases, there was a need to employ multiple strategies. Some of the strategies required up-to-date market intelligence e.g. forecasting demand and supply, while others called for engagement with BDS providers e.g. sourcing for investment credit, yet others required lobbying for the goodwill of policy makers. In some instances, the IPTA engaged directly as a unit to roll out the strategy, while in others, it provided support to selected chain actors.

There were also cases where the IPTAs decided not to utilize strategies identified e.g. forecasting and synchronizing demand and supply. Acting as a unit increased transparency and ownership of the results, e.g. formation of commercial villages to improve root supply in Bungoma. Provision of support to selected actors/members was also seen to be beneficial, especially when it resulted in market creation for other actors. Provision of machinery to processors in Rwanda, Uganda and Tanzania resulted in increased demand for roots and inevitably for vines as well.

However, it is important to note that the IPTA interventions were not mutually beneficial to all members. While most members registered benefits, a few members did not. IPTA members from Kenya generally were satisfied with the marketing interventions, while a few in Ethiopia indicated not to have reaped many benefits. This could be attributed to the IPTA configurations where the IPTA membership in Kenya was broad-based as opposed to that in Ethiopia. As such, there was limited interaction between the public and private sector, which limited the number of marketing interventions. This is in concurrence with Klerkx et al. (2012) who noted that agricultural innovation is not an inherently good and value-free process, but normatively laden and driven by different world views and visions. As such, different development directions exist, each with its own losers and winners.

We would like to focus on the winners, who in many cases were seen as champions of the process. According to Nederlof et al. (2011), champions are highly motivated stakeholders within the innovation platform. They enthuse peers from their groups, promote contacts between platform members and their respective constituencies, and are often exemplary. An outstanding champion is Siwongo Company, which promoted backwards and forward linkages with the processing functions. The Sengerema IPTA coordinator is another champion, having managed to link producers and trader to credit facilities. The champions were generally noted to have complemented the brokerage function.

Sustainability of IPTA marketing interventions

According to the World Bank (2007), self-sustaining innovation results from a dynamic system that is neither public nor private sector led, but characterized by a high degree of public and private interaction and collaboration in planning and implementation. Such a system is agile, responding quickly to emerging challenges and opportunities and delivering economic growth in a socially inclusive and environmentally sustainable way. A number of the marketing interventions spearheaded by the IPTA are bound to be sustainable e.g. establishment of sales points for roots and vines, contracts between processors and root producers, among others. This is because the IPTAs embraced public-private sector interactions and collaboration in their approach. Some interventions may need continued support after the DONATA project e.g. optimal use of the Usagara processing factory, expansion of the flour and snacks market among others. Interventions in the processed products chains in Kenya, Tanzania and Rwanda are expected to drive seed and root production. As demand for the processed products increases, demand for roots will also increase and hence that for vines. Privatization of businesses was a good strategy that will increase sustainability options. In addition, most IPTAs are well structured to cope with changes in the market, but will need to astutely search for partnerships and income- generating opportunities if they are to remain afloat. The Busia IPTA, that has already identified potential partners to help address new challenges associated with market growth, exemplifies this.

Conclusions and recommendations

Most of the IPTAs made commendable progress in supporting OFSP marketing initiatives and strengthening emerging chains. The IPTAs have also devised good strategies to upgrade the chains, although some were not taken to completion (market studies and surveys). In so doing, their capacity in identifying, articulating and harnessing market opportunities was greatly improved, resulting in innovations such as new products, processes and systems.

Innovation platforms are indeed a novel but innovative way of improving farmers' approach to markets. Through interactions and iterative learning, public and private sector partners can plan and implement strategies to upgrade value chains. The ability of the platform to engage in such initiatives, however, depends greatly on its leadership, membership, harmonization of roles and responsibilities and focused vision. The role of innovation brokers is key in such platforms, and is best played by an external person or institution, as they are bound to be neutral and hence able to steer the platforms towards their vision and goal. Performance of platforms can be greatly aided by champions, who as we saw in the DONATA IPTAs, emerged from within.

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Marketing of orange-fleshed sweet potato in Kenya under the DONATA project

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Introduction

Sweet potato (*Ipomoea batatas L.*) is an important traditional crop that is grown customarily by small-scale farmers mainly for household consumption. It is traditionally regarded as a "poor man's" crop as it is typically grown and consumed by resource-poor households. Relative to other crops, it gives satisfactory yields under adverse climatic and soil conditions, as well as under low or non-use of external inputs (Carey *et al*., 1999; Ndolo *et. al*., 2001). As a food security crop, it can be harvested piecemeal as needed, thus offering a flexible source of food and income to rural households. In addition, it has a short maturity period of three to five months. As an early maturing crop it provides food and incomes during the 'hunger season' between the months of July to September when the staple maize crop is still immature. The orange-fleshed sweet potato (OFSP) varieties are the cheapest source of beta-carotene: this is important for the control of vitamin A deficiency (VAD), which is a major nutritional problem in Kenya. Globally, it is estimated that 250,000 to 500,000 preschool children go blind from VAD annually with about two-thirds of these dying within a few months after going blind (Ruel, 2001). Eating 120 g, of a high β-carotene sweet potato variety is sufficient to provide the Recommended Daily Allowance (RDA) for a pre-school child (Kapinga, 2002).

Over 85% of sweet potato produced in Kenya is consumed at home and the rest sold in fresh form in the local and urban markets (FAOSTAT, 2009). Most of the roots found in the markets are the white/yellow-fleshed types. A survey conducted by Farm Concern International in Nairobi markets indicated that only 6% of roots sold in those markets were OFSP (FCI, 2012).

What was done

Most sweet potato grown and consumed in Kenya are white/yellow fleshed. Replacing these in the diet of rural and urban consumers with beta-carotene-rich OFSP varieties has the potential to reduce vitamin A deficiency and increase income levels. To help achieve this potential, the DONATA project entitled "Transfer and Dissemination of Proven and Emerging Agricultural Technologies in Orange-fleshed Sweet potato" undertook a series of activities to: (1) increase the production, availability, and consumption among households; (2) raise income among those who sell roots, processed products and vines of OFSP; and (3) enhance marketing opportunities as well as linking farmers to markets. The project was implemented in Busia, Bungoma and Kakamega counties of Western Kenya. It worked through a value chain approach referred to as Innovation Platforms for Technology Adoption (IPTA).

Formation of IPTAs: Three IPTAs (Busia IPTA, Bungoma IPTA and Mumias IPTA) were formed to carry out activities in the three counties. The IPTAs were made up of a range of actors in the OFSP value chain including Research, the Ministry of Agriculture, NGOs, community based organizations (CBOs), private sector, traders, and processors. The partners worked together to identify and document appropriate technology uptake pathways

for the scaling out and scaling up of OFSP technologies. The IPTA partners in the Busia and Bungoma IPTAs were identified during the in-country launching of the project in November 2008 while those of Mumias IPTA (covering Kakamega County) were identified in 2011. The stakeholder analyses of the IPTA organizations were done based on their mandates and functions in the region; geographical coverage; value added to the organization through participation in the IPTA; value added and contribution to IPTA through participation by the organization; specific roles and responsibilities in the IPTA (Table 12). In each platform, a partner was nominated by the members to coordinate the IPTA. The coordinating organization was responsible for the day-to-day implementation of the IPTA activities, compiling both technical and financial reports as well as chairing of the IPTA meetings. The IPTAs had informal MOUs, which stipulated the terms and conditions of their engagements, reporting protocols and solving misunderstanding among partners. Three major market chains were identified by the IPTAs at the beginning of the project. The chains were fresh root chain, planting material chain and processed products chain.

Creating demand and markets for OFSP

In the first years of the project, the IPTAs focused on establishing seed systems and promoting OFSP root production. Over time, and with increased root production, there was need to build a market for the fresh roots. The platforms developed and adopted a facilitative marketing strategy, working with existing sweet potato value chains and raising awareness with market actors along the OFSP chains. Awareness creation targeted mainly root producers, traders and consumers. At the root producer level, efforts were made to build their confidence that both market and market demand for OFSP roots existed. At trader level, the IPTAs raised awareness of the nutritive advantage of the OFSP and identified where it could be sourced. For the consumers, the emphasis was on the nutritional benefits of the OFSP. Pathways used in awareness creation included participation in agricultural shows, field days, exhibitions, and demonstrations. The IPTAs also used promotional materials such as leaflets, calendars, fliers, t-shirts, and posters. Innovative approaches such as drama, traditional birth attendants, faith organizations, health facilities and vulnerable groups were also used. The Bungoma IPTA constructed six bus sheds along the Webuye - Malaba road. The sheds were painted in orange colour with writing depicting the importance of OFSP. The Mumias IPTA gave a one-time 30-minute radio talk on the local FM radio station, which reached about 500,000 listeners (DONATA Q4-2011 report). The Mumias IPTA also produced radio tapes promoting the benefits of OFSP.

FCI, which was responsible for marketing issues in the IPTAs sensitized sweet potato traders in Nairobi markets about the importance of OFSP and whether the traders could also venture into the OFSP trade. Although some of the traders were willing to trade with OFSP, the volume and ease of accessing the roots were still a problem. For example, a group of sweet potato traders in Ukulima market in Nairobi became interested in trading in OFSP roots and were linked to OFSP producers in Busia County by FCI. The farmers agreed to gather enough roots for a 7-tonne lorry. The traders hired a lorry from Nairobi but when they reached Busia the farmers had only 5 bags (600 kg) of roots, which discouraged them.

Training on marketing of OFSP: The IPTA partners analysed the OFSP value chain and identified the training needs required for efficient functioning of different segments of the OFSP value chain. Based on the identified training needs, the IPTAs trained 24 ToTs (14 females and 10 males) on different aspects of OFSP marketing. Topics covered included farming as a business; gross margin analysis; grading; sorting; linking with traders and ways to promote and sell produce, including bulk selling of roots. To address traders' concerns about their perceived lack of demand for OFSP, trader training was undertaken at rural markets in the project areas and at urban markets outside the project areas. A total of 56 traders (37 females and 19 males) were also trained on the profitability of trading in OFSP, the nutritional benefits of the products and the importance of telling customers about it. Trained traders were provided with small, folding painted boards advertising the nutritional benefits of OFSP, as well as orange T-shirts, wraps (for women), aprons, and caps. They were also taken to production areas and introduced to producers who had OFSP roots for sale.

Table 12: IPTA partners and their roles in promoting Orange-fleshed sweet potato technologies

Name of IPTA	Partner	Roles in platform
Bungoma IPTA	Kenya Agricultural research Institute (KARI)	• Overseeing project implementation • Compilation of technical and financial compilation of reports • Capacity building of IPTAs and ToTs.
	Ministry of Agriculture	• Training of farmer groups • Identification of farmer groups • Promotion of OFSP
	Community Research in Environment and Development Initiatives (CREADIS)	• Coordinates Bungoma IPTA • Mobilization of the farming communities • Supervision on seed and root production • Promotion of OFSP technologies • Training of ToTs and farmer groups
	Majeso Human Development (MAHUDE)	• Responsible for establishment of SMS and TMS
	Farmer Field School (FFS) representative	• Training of FFS network
	Processor	• Capacity building in processing
	Trader	• Linking root producers to fresh root market • Promoting OFSP in local markets
	KARI	• Capacity building
Busia IPTA	Rural Energy and Food Security Organization (REFSO)	• Community mobilization • Seed multiplication • Capacity building • Coordination of Busia IPTA
	Farm Concern International (FCI):	• Linking seed producers, root producers and processors to market • Provision of market information
	Anglican Church of Kenya, Western Region Christian Community Services (ACKWRCCS)	• Group Mobilization • Linking OFSP to faith organizations
	Appropriate Rural Development Agricultural Programme (ARDAP)	• Responsible for seed multiplication in Nambale Division • Responsible for post-harvest processing in Busia IPTA
	Siwongo OFSP Flour Processing Company	• Small scale processing of OFSP • Linking processors to urban markets
	KARI	• Capacity building of IPTA
	Ministry of Agriculture (MOA)	• Linking OFSP to extension service programmes
Mumias IPTA	Anglican Church of Kenya, Western Region Christian Community Services (ACKWRCCS)	• Coordinating Mumias IPTA • Group mobilization
	Rural Community Empowerment Centre (RUCEC)	• Coordinating planting material multiplication in Kakamega County
	Nabwabini Environmental Health care intervention project (NEHCIP)	• Linking OFSP to Health facilities
	Kholera Kick-Hunger CBO	• Representing CBOs in Mumias IPTA • Coordinate root production
	Munami brothers youth group (a CBO)	• Promote youth initiatives in the value chain
	Kenya Agricultural commodity Exchange (KACE	• Providing information on markets

Acquisition of equipment: The project acquired pieces of processing equipment, which were used during post-harvest trainings and demonstrations. The equipment included washers, manual and motorized chippers, manual slicers and hand slicers. The project also assisted in the construction of Siwongo Processing Unit. The promotion activities and trainings provided by the IPTAs assisted in creating demand and market for the vines, fresh roots and processed products.

Introduction of OFSP varieties: The first OFSP variety Ejumula, which was introduced in the project area, had low market demand because of its creamy root skin colour. Most sweet potato buyers tended to prefer varieties with red or pink skin colour. The project later introduced two varieties, Kabode and Vitaa, which had pink skin colour with better yields and resistance to the virus diseases than Ejumula. The two varieties were first evaluated alongside the farmers' best sweet potato varieties before being considered for inclusion into the seed multiplication scheme.

Linking root producers to the Siwongo processing Company

The major market for the fresh OFSP roots in western Kenya was the Siwongo Processing Unit located in the Busia County. The unit has now been upgraded to a Company status. The Company had been in the sweet potato business since 1998, after the mosaic virus disease swept through cassava, which hitherto was their staple food. The Director of the company approached REFSO, which linked it to the Kenya Agricultural Research Institute (KARI)-Kakamega. The Institute provided five sweet potato varieties for evaluation by the Siwongo farmers. The farmers identified one orange-fleshed variety, SPK 004, as their preferred variety. Over time, the farmers produced more than they needed to eat so they started to think about the markets. Initially, the company failed to find a good market for the roots, and sought the services of FCI, which linked them to the fresh root markets in Nairobi. Siwongo sold fresh roots to Corner Shop in Yaya Centre and Fresh and Juicy. The two enterprises would only buy small quantities of high-grade sweet potato roots. Farmers still had a lot of excess roots, so they sought an alternative market. They were later linked to the Kirinyaga Millers, which was interested in dry OFSP chips. The first consignment of chips did not meet the millers' standards. Unfortunately, by the time the farmers met the required standards, the buyer had switched to another source.

When the DONATA project started, the FCI, which was a member of the Busia IPTA, linked the Siwongo Processing Company to Azuri Health, which is an OFSP flour distributor in Nairobi. The Company could initially supply Azuri Health with half a tonne per month of OFSP against 5 metric tonnes per month required by the distributor. This shortage was caused by inadequate supply of fresh OFSP roots for processing into flour. The Kirinyaga Millers also wanted 2 MT per month of dry OFSP chips. In order to meet this deficit, the three IPTAs came together and developed a number of strategies to increase availability of fresh roots. The first strategy was through a contractual arrangement between the company and the root producers. The processor contracted a number of farmers who produced and sold fresh roots to the company. The contracted farmers were given free planting material on condition that they sell the roots to the unit and return equivalent amount of seed given to them to the processor. The company also rented several pieces of land from which it produced additional roots. The three IPTAs mobilized their farmers to increase the area under root production and productivity per hectare by planting high yielding OFSP varieties Kabode and Vita and using recommended agronomic practices including the use of quality planting material. The IPTAs also provided training to root producers on appropriate production technologies, which resulted in high root production. The most significant strategy was the formation of OFSP production clusters by the Bungoma IPTA that facilitated bulk selling of OFSP roots using the marketing model described below.

Marketing model

OFSP farmers produced roots and when they were ready for harvest, they informed Siwongo processing company directly or through their IPTA partners. A purchase and collection programme was made and farmers delivered the roots to the processing unit or the processor collected the roots. The buyer and sellers had a "gentleman's

agreement" in which the price and quality parameters were agreed upon before purchase. In the Bungoma IPTA, farmers were grouped into commercial villages, each with a specific day for harvesting and delivering roots to the collection point a day before collection. The roots were transported to the collection points on foot, bicycles or motorbikes, weighed and paid for at the rate of US$ 0.15-0.20 depending on how the roots were delivered to the processing unit. Each village was contracted to deliver two tonnes of fresh roots per week. The Bungoma IPTA prepared a production plan for each commercial village with the aim of ensuring consistent supply of roots to the processor.

Marketing of OFSP vines

The sale of sweet potato vines has in the past been a taboo among communities in western Kenya. With the intense promotion of the OFSP technologies and the fact that the improved OFSP varieties were better yielders and more nutritious than the farmers' varieties, the demand for planting material increased. Farmers are now willing to pay for the vines. This encouraged individual seed multipliers to invest in seed multiplication. The IPTAs were later linked to the Kenya Horticultural Competitive Project (KHCP) and the One Acre Project Fund (OAPF), which became main buyers of vines from the seed multipliers. The seed multipliers were also linked to OFSP root producers in areas outside the project area such as Nyanza, Rift Valley and Eastern provinces. The seed multipliers were linked to root producers through the media, bulletins, painting bus sheds orange and writing about the benefits of OFSP. The quality of vines being planted has also improved as the major vine buyers demand a certificate from KARI or KEPHIS to satisfy that the varieties being purchased are true to type and are free of pests and diseases.

The initial quality planting material was obtained by IPTAs from the KARI-Kakamega Primary Multiplication Sites (PMS) as part of DONATA project support. Cuttings from PMS were used by IPTAS to establish Secondary Multiplication Sites (SMS), managed by the farmer groups. Group members accessed seeds from these sites at no cost to establish root production gardens, which also doubled as Tertiary Multiplication Sites (TMS). The seed multipliers are mostly in the TMS stage of seed multiplication.

Marketing of processed products

The Government of Kenya has been putting a lot of emphasis in post-harvest issues and in particular processing and market access for products (GOK 2010). There are several reasons for this. Improvements in traditional processing, particularly small-scale household or village level operations can create opportunities for enterprise development and income generation in rural areas. Improved post- harvest handling and processing activities can increase the value of products in rural production systems through the transformation of low priced raw materials into higher priced and more nutritious intermediate or finished products. Furthermore, processing can diversify utilization methods and create new products and new markets.

Processing and enterprise development were key activities of the DONATA project. The first activity of the project was to take an inventory of the existing processing activities in the three counties prior to the project. The IPTAs then identified potential products for commercialization. The OFSP flour and dry chips were the most important products. The others were bakery products such as 'chapattis', doughnuts, 'mandazis', 'krakies' and juice. Efforts were made to promote the consumption of these products among communities. The IPTAs trained 37 TOTs (22 females and 15 males) and 85 farmers (55 females and 30 males) on processing and product diversification.

The most important markets for processed products are the Azuri Health and Kirinyaga Millers. Azuri Health buys OFSP flour from the Siwongo Processing Company, packages it to sell to Nakumatt and Tuskys' supermarkets in Nairobi. The demand for flour has since grown to over 5,000kg a month. The Kirinyanga Millers, on the other hand, requires 2 MT of chips monthly. Because of limited availability of fresh roots, the processor cannot meet the demand for flour and chips by the two markets. The three IPTAs are now working together to supply the processor with adequate raw materials.

Achievements

Market Linkages made for fresh OFSP roots and processed products: OFSP root producers in western Kenya have been linked to the Soong Processing Company. Contractual arrangements were facilitated and made between the processor and root producers. This created trust between the two parties and root producers were then able to plan their production based on the market requirements. Towards the end of the project in 2012 the company was purchasing 300 metric tonnes of fresh roots from farmers per annum valued at US $60,000. The root producers were also selling fresh roots to traders in urban areas such as Eldoret, Kitale and Nairobi. Promotion activities conducted by IPTAs on the benefits of OFSP reached 6000 households thus creating demand and market within the local communities. This has resulted in increased market for OFSP in the local markets. The Siwongo Processing Company was linked to Azuri Health and Kirinyaga Millers in Nairobi where it supplies OFSP flour and dried chips, respectively.

Commercial villages created for root marketing: Root producers created market villages or clusters for efficient bulk selling of roots to the processor and urban fresh root traders. This has made it economical for the processor and traders to purchase fresh roots from one selling point. The specific clusters are assigned days during which they deliver roots to the collection centre.

Farmers are investing in commercialization of vines: The sale of planting material is now a reality among farmers in western Kenya. Individual seed multipliers are now willing to invest in vine multiplication as a business. At the end of 2012 there were 145 (55 females and 90 males) vine multipliers engaged in commercial production. It is estimated that they had produced about 86 million cuttings during the life of the project. The vine multipliers were earning more money from the vines than roots or maize. For example, one farmer in Bungoma County sold vines worth US $9,000 in one season. The vines were produced on an area where the farmer would have obtained US $600 if she planted maize with good management. The other seed multiplier in Busia received US $4,000 from the sale of vines, which he used to put up a semi-permanent house, bought three cows and paid school fees for his three children in secondary school. Presence of vine multipliers has enhanced the availability of quality planting material at the beginning of rains. Use of quality planting material has resulted in higher root yield and hence higher volume of roots for the market and more income for farmers.

Processed products of OFSP being commercialized: Five farmer groups in Bungoma County, namely: Luuya CBM, Khaka Women's Group, Star Women's Group, Tambulukha Self-Help Group and Mpopolo Farmers' Group were involved in selling OFSP products in local markets and to pupils in schools during break and lunch hours. The processors were also contracted to make cakes for special occasions such as weddings or on birthdays. The Tanga Corner farmers' group in Busia County transformed from a farmers' group to a commercial village through the assistance of the IPTA. The commercial village specialized in the processing of OFSP products, which were sold in their shop at the Tanga Corner marketing centre to individual consumers and retail traders. The Siwongo Processing Company is selling OFSP flour (figure 25) and dry chips to Azuri Health and Kirinyaga Millers, respectively. Both the Tanga Corner group and Siwongo Processing Company were linked to the Programme for Agriculture and Livelihood in Western Communities (PALWECO) in the Ministry of Planning and Vision 2030 which has supported Siwongo Processing Company to purchase additional electrical chippers, flour mill processing and packaging of flour and water storage.

Social and environmental impact: The market information provided by the project and linking value chain actors to local and urban markets improved the incomes of the small-scale farmers through the sales of planting material, fresh roots and processed products. The project also created employment opportunities, though to a small scale, for the unemployed women and youths. For example, the Siwongo processing company provided employment to women and youths to perform tasks such as washing and peeling of fresh OFSP roots before being processed into flour. The vine and root producers also employed additional labour to assist in planting, weeding and transportation of OFSP products. The end-users of the project were mainly the resource-poor

rural individuals, particularly households with low incomes, the unemployed youth and women, women lacking income-generating initiatives; farmer/rural processor groups; market participants and consumers. Other people who benefitted from the project were intermediary organizations such as NGOs, CBOs, county governments (through payment of local authority taxes), district local councils as well as the vulnerable groups particularly the households that have been affected by HIV/AIDS. For example, the Mumias IPTA supported the Tumaini Support Group (consisting of 45 women affected by HIV/AIDS) with seven bags of planting material, which the group used in establishing one vine multiplication field owned by the group. Cuttings from the group farm were given to each member of the group for production of vines and fresh roots. The members used the OFSP leaves as a source of nutritious vegetable, which was important for their poor health status. The vines and roots and the proceeds were used in meeting their basic needs such as paying of school fees, provision of shelter and other foodstuffs for the family. Sweet potato is also friendly to the environment, as chemical input is either not there or very minimal and the plant protects soil from erosion as it closes its canopy in a short time with a well -developed root system.

Figure 25: Orange-fleshed sweet potato flour, which is sold in some supermarkets in Nairobi

Figure 26: Sweet potato fries, a snack liked by school children

Challenges

- The drying facility at the Siwongo Processing Company is inefficient making it impossible to dry all the roots grated in time. Some roots therefore become mouldy.
- OFSP farmers in Kakamega and Busia Counties have not formed commercial villages: making it uneconomical for the processor to collect roots from individual farmers.
- Marketing of OFSP is rapidly shifting from women to men as the crop becomes commercialized. It is feared that this may result in the benefits not being shared equitably among family members, a situation that may result in domestic unrest.
- There are concerns that the partnership between Siwongo Processing Company, currently the major market for fresh roots and the farmers may break should the company stop operating in the area. This could also arise if Siwongo's private partners i.e., Kirinyaga Millers and Azuri Health shift to other enterprises, resulting in loss of market.
- Since project funding of OFSP activities in these counties is soon coming to an end, there is a concern that the current interaction among the chain actors may not continue due to lack of sustainability measures.
- Lack of storage facilities for the fresh roots is still a major challenge in the OFSP sub-sector.
- Underground storability by the new OFSP varieties tends to be poor, therefore not suitable for piecemeal harvesting practised by farmers in western Kenya. This has slowed down the uptake of the varieties by farmers outside the project area.

Lessons learnt

- Through interaction with IPTA partners the Siwongo Processing Company has found new marketing opportunities and is planning to diversify its products to target these markets. The company also wants to use available raw material such as jackfruit to make a sweet potato/jack fruit blend. Other products targeted include cake mix, porridge mix and ugali mix.
- Through the promotion activities and commercialization of OFSP, the sweet potato status has shifted from a poor man's crop to a crop that is demanded by all categories of the population.
- Before the project the only part of the OFSP which was traded were fresh roots and processed products but through the intervention of the IPTAs the vines are now sold as seed.
- The quality, packaging and labelling of the OFSP products have improved through the intervention of the IPTAs. But these products cannot reach the urban markets due to lack of certification. This makes certification by KEBS for processed products a critical issue for emerging and/or expanding markets.
- Acceptability of new products can be increased with targeted training in utilisation and product development to provide consumers with diverse products, as has so far been demonstrated with OFSP value addition.
- OFSP was mainly used for home consumption. Its commercialization significantly increased where access to markets was greater.
- Farmers were willing to invest more labour in improved practices because they were sure that they could get a good price for the product.
- Participation of men in the project was greater when marketing opportunities emerged. This means that there is need for gender-specific consideration to ensure balance between men and women in accessing the benefits from their participation in the project.
- Involvement of Azuri Health and Kirinyaga Millers partners has triggered the production of roots, vines and processed products as well as the income of the farmers.
- Commercialization of OFSP has improved gender relations in families. In the project areas, both men and women are growing sweet potato.

Thoughts for the future

- Groups interested in value addition should have access to affordable machinery.
- There is need for developing a module for training IPTA members in marketing to be used in the future even when the DONATA project ends.
- For sustainability, OFSP production should be commercialized. This can be done through contract farming as is done with sugarcane. Commercialized production of OFSP will make the crop competitive.
- Players should see how best to capitalize on the favourable government policy on biofortification of foods.

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Processing and transforming sweet potato into different products: a case for Lira District, Northern Uganda

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Background

Dissemination of proven and emerging technologies for orange-fleshed sweet potato (OFSP) a project under DONATA was aimed at promoting adaptation of technologies in production, processing, marketing and consumption. Given the predominantly rain-fed nature of crop production in Uganda, there are a lot of sweet potato tubers on the market in the months of September to November. In Lango sub-region, consumers create a market for the crop, thus boosting farm level production and income to farmers in addition to solving the problem of roots rotting in gardens. Transformation of OFSP would also promote maximum utilization of land through processing of the roots fast enough and leaving gardens ready for other agricultural activities. It is also a way through which food security can be enhanced and uptake methods for Vitamins A diversified. Value addition to OFSP can begin with washing, sorting and grading. This can be taken further by creating new higher value products with different eating qualities and enhanced shelf-life. The products being made by farmers in the Lango region are doughnuts, bagia, wedding cakes, mandazi and pancakes (Owori et. al., 2007). With increased production the possible areas for agro-enterprise development are making and packing flour and dry chips. These can be packed and sold in supermarkets. Here we report OFSP processing activities aimed at transforming the crop into different products by the Lira IPTA.

What was done

Lira IPTA is a group of organizations with different expertise that came together in August 2008 to promote dissemination and adoption of OFSP technologies in Lango sub-region. The IPTA was formed to tap the different expertise that existed in the different organizations e.g. Mid North Private Sector Company Limited (MNPSCL), Ngetta ZARDI, Development Training and Research Centre (DETREC), Nen Anyim Agro-Processors Entrepreneurs (NAAPE) and others to promote technologies for the OFSP value chain.

Training of trainers: OFSP transformation activities were initiated by conducting a training course for 30 trainers on processing the roots into different products. The five-day training involved making doughnuts, mandazi, bagiya and chapatti. Trainers were selected from IPTA member organizations, which consisted of: DETREC, Agency for Sustainable Rural Transformation (AFSRT), Camkwoki Grassroot Initiatives for Development (CGIFD), Uganda Red Cross Society (URCS)-Lira, Aboke Farmer Field School Network (AFANET) and NAAPE. These then went out to train other farmers, farmer groups and individuals in the different technologies of transforming OFSP roots into other products.

Setting up a processing point: Processing activities were scaled up by setting up a processing point composed of two units each with a slicer, chipper and grater. The role of overseeing the transformation processes of OFSP was assigned to NAAPE. It was also assigned the role of training farmers in "processing as a business" to sustain the processing unit but also raise an income. Micro Small and Medium Enterprise (MSME) Consult was responsible for providing business development services to farmers and farmer groups that belong to Lira IPTA partners.

Demonstration of processing of OFSP bakery products in markets and public places: Demonstrating how to process OFSP into bakery products (mandazi, bagiya, buddies and chapatti) in public places and on market days was another approach used by Lira IPTA to scale out OFSP processing technologies. These demonstrations drew

attention of market-goers. These demonstrations proved very useful because people who bought the products always came back for more. The demand for these products kept increasing on each subsequent market day.

Achievements

OFSP processing training unit set up: Setting up a processing training unit for OFSP was a strategy for up-scaling OFSP production and consumption along the value chain. The Lira IPTA bought manual and power driven equipment (Fig 28) for chipping and slicing OFSP so that they could dry faster. Well-dried chips are easily milled into flour for use in various recipes for making products such as mandazi, chapatti, doughnuts, bagiya etc. This equipment is centrally hosted in NAAPE and is used for training and processing. In addition to processing, farmers use the facility to slice fresh roots into chips and dry them for later use in the dry season or sell in the local markets to food vendors. Some grind their dry chips into flour for making OFSP products.

Figure 27: Betty Ouni (in apron) training other women in product transformation

Figure 28: Hon. Sam Engola, M.P. Erute South Constituency handing over OFSP processing machines to the NAAPE director.

Through the IPTA arrangement, more processing capacity was availed to many farmers and locations. For example, Ngetta Farmer Field School Network (NFFSN) acquired a grinding and a grating machine. The farmers used the machines to process both cassava and OFSP flour. On a clear sunny day, sliced potato takes 2-3 hours to dry while on a cloudy day it takes about 3-4 hours. With these facilities therefore, farmers have the potential to produce a lot of high quality flour that can be further transformed into various products.

Manpower for training has been created: A total of 36 (18 male and 18 female) trainers in processing have been effective in disseminating OFSP technologies. These trainers have created a multiplier effects in the community. For example, reports from 10 trainers (6 male and 4 female) indicate that they have trained up to 500 individuals (100 male and 400 female), who have in turn been training others; and the training chain has continued. This has created a strong base for sustainability in the future.

Farmers have diversified their sources of income. There are several reports of farmers who have significantly increased their household incomes through selling OFSP processed products. For example, Jacob Aripa of Aboke FFS Network who was trained by Lira IPTA as a trainer in processing earns a profit of Ug Sh 9,000 (US $3.4) per 1 kg of OFSP from selling OFSP bagyia. Due to his success, he was sponsored by World Vision (WV) to participate and exhibit OFSP products on the Peace & Recovery Day in Gulu, September 2012. Jacob Otim, a prominent OFSP farmer in Ayer, Kole District has also made gains from OFSP. For example, between October 2012 and January 2013) he has earned Ug Sh. 5,000,000 (about US $1,900) from sale of both OFSP roots and vines.

Similarly, another processor, Christine Opio makes and supplies shops in Barr trading centre with doughnuts, and bagyia, who in turn supply these products to shops in nearby trading centres. Christine's success has attracted her husband who has joined her in running the enterprise. Betty Ouni, a member of NAAPE has reported gaining a lot from selling OFSP products. She is now able to send her children to school and is putting up a permanent building. These are just a few of the many active processors reporting success after participating in business training conducted by MSME Consult. Lira IPTA also provided machines (chippers, slicers and washers) that enabled the farmers to process clean chips.

Figure 29: Children waiting for OFSP mandazi being prepared.

Figure 30: Mandazi made from orange-fleshed sweet potato

Processing skills developed in many farmers. A follow up three months after the training of TOTs revealed that 10 of these had trained up to 500 farmers in Lira, Kole and Alebtong districts in processing OFSP into various products. They have also reported that they have plans to train many schoolchildren in making OFSP products that they can sell and raise money to support them in school. Up to 20 farmers, all female, in Aboke, Barr and Amac are already processing OFSP into different products after receiving training in April 2012. It has been noted that training in processing OFSP based products is so popular that more farmers turn up for it in comparison to those that attend business development skills (BDS) training.

Increased vitamin A uptake by the most vulnerable groups: Local processors have indicated that the young, school children and mothers are the largest consumers of OFSP products. Although there is no empirical evidence, it can be concluded that there is a great opportunity for increased Vitamin A uptake by the most vulnerable groups i.e., children and mothers.

Awareness of OFSP products and nutritional advantages has spread: Through increased awareness campaigns, demand for OFSP bakery products has increased in the region. Many people are now able to differentiate between OFSP and non-OFSP products. This has been possible due to field days held in many areas in the Lango region in addition to several radio programmes dedicated to promotion of OFSP technologies. Pato TELECAST has put articles in Rupiny and The New Vision newspapers and has also translated the OFSP processing manual from English into Lango to make it readable to the local population. Posters, calendars, stickers, charts on OFSP products distributed to the community, schools, hospitals and health centres have also contributed greatly to raising awareness.

Challenges

One major challenge encountered during the project implementation is the limited supply of OFSP flour and dry chips in the market, hence making the supply of OFSP products to the market irregular. This is because fresh roots are still predominantly eaten fresh after boiling.

Lessons learnt

- The bulkiness of sweet potato has made it difficult and expensive to transport the crop to markets in town where producers would earn more. This on the other hand, has encouraged farmers to process the roots into valuable, less bulky products that are easy to transport to the market and still bring in a good profit.
- IPTA as a platform is dynamic and some partners leave and new ones may come on board. For example Mid North left and was replaced by MSME. PATO TELECAST came in for dissemination and as a result more farmers adopted the OFSP technologies.

Recommendations for sustainable exploitation of OFSP

- There is the need for OFSP farmers and enterprising community members to increase production of fresh OFSP roots so that more can be dried and milled. This therefore calls for sustained promotional activities and training in all aspects of production and processing. The opportunity to tap into processed products lies in the fact that 90% of bakery products in the market are not made from OFSP, yet their demand is very high.
- Training in packaging is also the key to sustaining OFSP enterprises. OFSP products sold in packs will be more attractive and hence more competitive. Researcher, extension staff and producers need more business skills' training so that farmers learn to make yearly production and marketing plans and can support these with profit and loss accounting.

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Marketing strategies for orange-fleshed sweet potato products in the Lake Zone of Tanzania

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Background

Sweet potato (*Ipomoea batatas*) is the third most important root and tuber crop in most parts of Tanzania after cassava and round potato (Ndunguru et al., 1998). It plays an important role as a food security crop as it complements other food crops and serves as a famine reservoir when other crops like cereals and legumes fail due to drought. In areas surrounding both lakes Victoria and Tanganyika, sweet potato was reported to rank second to maize among the major crops in the cassava-based cropping systems particularly in Kagera, Mwanza, Mara, Shinyanga, Kigoma and Tabora regions (Anonymous, 1990). The crop has a short growing period, hence can escape drought (Kapinga et al., 1999) and therefore can provide a sustainable food supply when other staples fail. However, sweet potato is primarily grown for home consumption with only a few areas producing it commercially.

Being bulky, perishable and seasonal, the crop doesn't enjoy lucrative markets. It is considered a woman's crop and mostly held in low regard, which further limits its potential for trade. However, the crop offers a lot of opportunities to farmers especially those living in marginal areas given that it is drought resistant, nutritious (especially the orange-fleshed varieties which contain beta carotene) and matures earlier than other root and tuber crops.

The Dissemination of New Agricultural Technologies in Africa (DONATA) initiative was implemented in the Lake Zone of Tanzania to enhance marketing of OFSP vines and roots in order to stimulate production and generally increase benefits to farmers. The Innovation Platform for Technology Adoption approach (IPTA) was adopted where players in the OFSP value chain came together to discuss ways of getting the produce and its products on the market. This paper presents the strategies that were adopted for marketing OFSP products in the Lake Zone of Tanzania using the IPTA approach.

What was done

Identification of OFSP value chain actors and Innovation Platform Technologies Approach (IPTAs) establishment: The main actors were identified as seed producers, root producers, processors and traders. Seed and/or root producers were organized into groups of 20-25 members who elected their own leaders. Seed producers (secondary multipliers) were responsible for producing OFSP clean planting material and selling to other multipliers (tertiary multipliers) and root producers. The tertiary multipliers mainly produced roots, although some supplied planting materials to neighbouring farmers freely or for a price. Root producers were responsible for producing and supplying clean roots to local markets and in towns for use as fresh roots or to processors. Processors transformed fresh roots into different products. Traders cut across the different categories: they traded in roots, vines or processed products (Figure 31 shows the actors in the OFSP value chain around the lake zone of Tanzania).

Training: The training of stakeholders in production and marketing of OFSP (and OFSP derived products) was carried out by LZARDI Ukiriguru and Maruku scientists in collaboration with SIDO SLEMI-Misungwi and Business Development Service of Sengerema. The groups trained included producers, processors and traders. Vine and root producers were trained on crop management, agronomy, planting material conservation, seed multiplication and root production. Extension staff were trained as TOTs. Processors and traders were trained on processing technologies for OFSP and in aspects of marketing processed products. They were also trained on the nutritional benefits of OFSP. Training on OFSP processing technologies was also provided at group level. During training, extension materials on OFSP production, processing, utilization and marketing were provided to the participants. Other actors in the platforms such as researchers, NGOs and extension service providers received the training and thus were the facilitators in each IPTA depending on the district or IPTA location.

Creating linkages between producers and buyers: Links between OFSP producers and potential buyers were established to facilitate trading of OFSP and its products. The project started with two IPTAs including seed system and processing and marketing for 2009 to 2010. The study made by Mafuru et al., 2009 on value chain analysis at the beginning of the SASHA project indicated the gap in the value chain was incomplete because root producers and the market for the products was not clear. We also encouraged the IPTAs to conduct a stakeholder/ institutional analysis. In the 2011 annual work plan meeting, a review was made to have a clear value chain where more actors were identified to have the chain from seed production, root production, processing and marketing. The annual planning meeting also catalogued OFSP seed and root producers, processors and OFSP product buyers. Through the International Potato Centre backstopping in collaboration with research and BDS, the training was conducted for the root traders. After training root traders, wholesalers were able to distribute clean OFSP planting material to root producers who usually produce non-orange sweet potato. From there more links were formed under informal agreements among seed and root producers, root producers and root traders, root producers and processors as well as processors and super markets (McEwan, 2013).

OFSP planting materials availed to other farmers: At harvest, OFSP producers sold planting materials to other farmers/institutions for establishing tertiary seed nurseries or for producing roots. Institutions that received planting material were those that operated in the project area providing different services to the community. They include PATAGE-Bukoba, TAHEA-Mwanza, KOLPING Society of Tanzania, World Vision, Lweru-ADP Bukoba, and HUBUMA-Ukerewe. These mainly supplied OFSP planting material to vulnerable households especially in areas threatened by cassava brown streak and cassava mosaic diseases.

Achievements

Market linkage among OFSP actors established: The IPTAs identified groups involved with OFSP marketing and linked them to producers. Various market linkages were developed and used to facilitate marketing of the roots and other OFSP-based products. Figure 31 portrays these linkages across the IPTAs established in the Lake Zone Tanzania.

Through the IPTA meetings and other facilitated interactions, the value chain (VC) actors were able to meet, discuss and in some cases marketing contracts were made between producers and buyers. Among the key outcomes of these IPTA facilitated VC actor interactions include improved prices and income earnings for smallholders. For example, the price for the bundle of vines was Tshs 5,000 (equivalent to US $3.2 per bundle) and the bag of roots was sold at price of Tshs 35,000 at the farm gate (equivalent to US $26) while for retailers it was earning about US $40 per bag. Forty-eight root producers (30 female and 18 male) were linked to fourteen (14) (3 female and 11 male) OFSP root traders. A number of informal agreements were made among stakeholders and these included four market linkages: (i) For OFSP roots between Upendo processing group with individual farmers, farmers' groups like Mwasonge root producers, Bunda root producers and Sengerema Hospital doctors' group (ii) between Upendo processing group with supermarkets (SITTA and LAVENNA) with a value of US $45,135 for raw OFSP roots and US $22,871 for OFSP flour; (iii) dry chips were sold to the local

market with a value of US $3000; (iv) informal agreements between IPTA members for vine sales to traders, NGOs, root producers (Shinyanga, Dodoma, Morogoro, Bunda) and OFSP traders with OFSP retailers with a value of US $117,093.

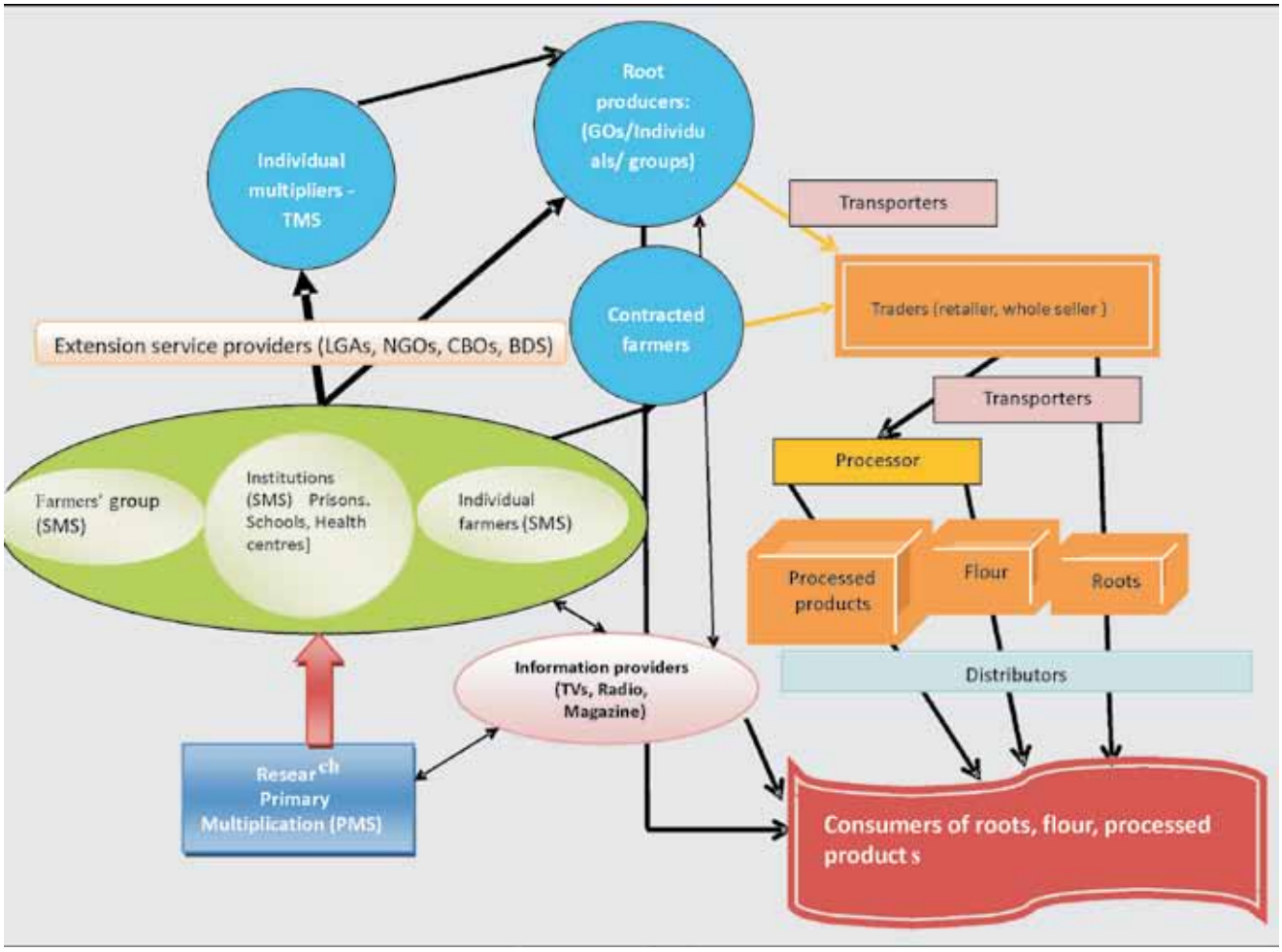

Figure 31: IPTA & the linkages created in the OFSP Value Chain in Lake zone, Tanzania

Increased household income and food security: Households that were involved in the production of OFSP improved their food security and income. A farmer, Mr Bupipi from Tunyenye village, Sengerema IPTA reported that from 2.25 acres of OFSP, he harvested 17 bags of fresh roots. Fifteen of these were sold to traders from Mwanza city at a farm gates price of US $28/bag, obtaining a total of US $420. He further reported that the same traders sold the produce at a retail price of US $40/bag and realised a total US $600.

It can be seen that the total root sales were US $339,687. Misungwi and Bukoba IPTAs recorded the highest sales because many groups were near the lake's shore, thus could produce roots for the whole year and supply the market (figure 32).

OFSP introduced and popularized: OFSP varieties had not been popular in many areas where the project was implemented. Through the DONATA project, OFSP roots were introduced into different markets and Business Development Centres in the Lake Zone of Tanzania. In Buhongwa and Buzuruga, Mwanza district, agricultural products including OFSP are sold in an open-air market that operates weekly. OFSP products are also sold in Kashai market, Bukoba district. In Sengerema, a Business Development Centre was established where OFSP products were promoted.

Establishment of an OFSP processing factory: Traditionally, sweet potato is consumed in boiled or roasted forms. Through the DONATA project, OFSP value addition technologies were introduced. When the DONATA project started there were only two IPTAs. The first IPTA addressed seed issues and the second IPTA addressed marketing and processing of OFSP. Farmers were producing seed but there was no clear market for seed and roots. The gap was identified, and then more IPTAs with full value chain platforms were formed to fill the gap. Awareness creation and market linkages to root producers were implemented and as of now, seeds are sold in the Lake Zone and outside the Zone including Dodoma, Singida, Morogoro etc. Marketing for roots and processed products was not obvious; therefore in order to facilitate the marketing of OFSP in the lake zone of Tanzania, the project established a processing factory at Usagara in the Misungwi district. This was a culmination of a stakeholders' meeting that identified the marketing of OFSP roots and products as a limitation to full exploitation of the crop's potential. Processing increased the shelf-life of sweet potato roots, turned them into profitable sellable forms like chips and flours from which products like bans, chichili, cake, bread, juice etc. are made. The DONATA stakeholders, particularly Misungwi district council, contributed some funds to construct a processing factory at Usagara in Misungwi district to absorb the roots produced by farmers. Market linkages were also established with the supermarkets in Mwanza city for flour and other processed products including chips. This improved OFSP roots' shelf life and enhanced its value. It is expected that the factory, whose capacity is far above the current supply of roots will stimulate and increase production of OFSP.

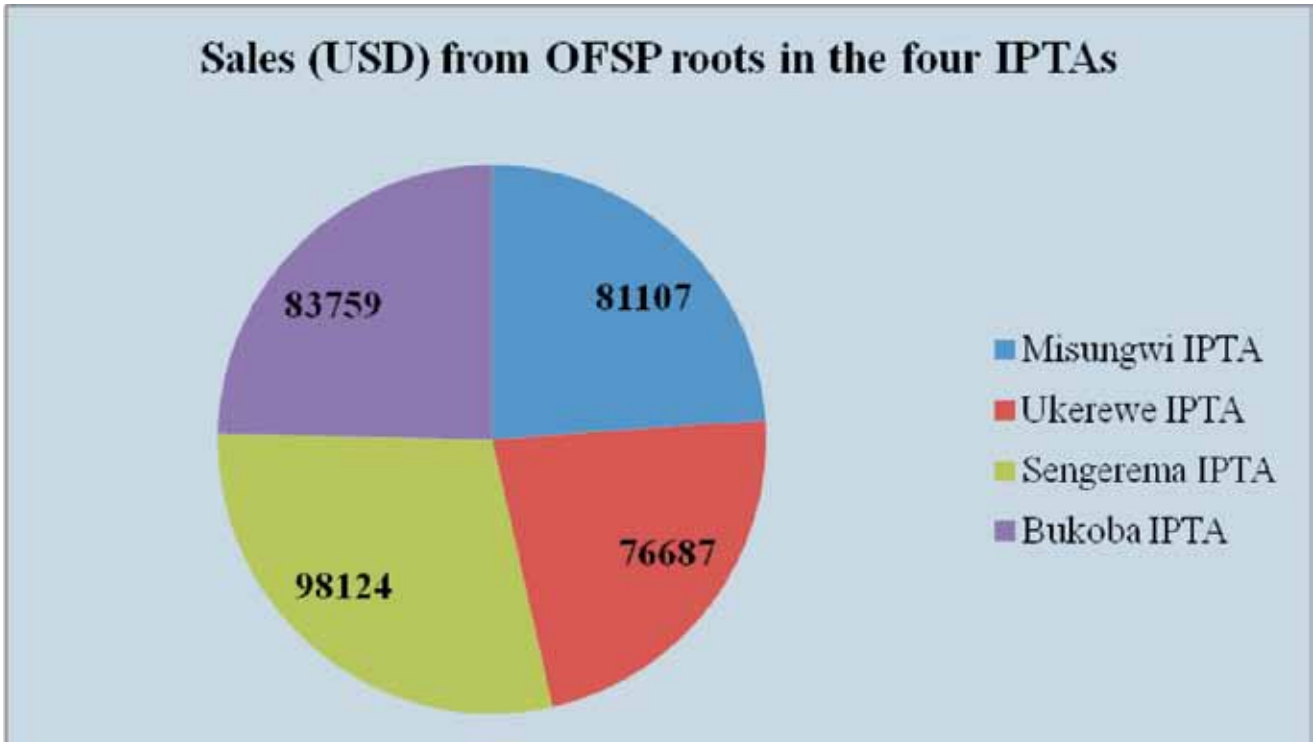

Figure 32: Sales in USD from OFSP roots by participating farmers in four IPTAs in the lake zone of Tanzania

Challenges

Lack of knowledge of the importance of OFSP in the community: In some of the communities in the zone outside the project area, who were not able to access the knowledge during the implementation period, the nutritional importance of OFSP awareness is still low. Many consumers still prefer white-fleshed sweet potato, making OFSP less competitive. Thus, a lot more effort is needed to sensitize the communities on the importance of OFSP.

Shortage of OFSP roots during the dry season: Some parts of Misungwi, Sengerema and Ukerewe districts have a uni-modal rainfall pattern and no access to irrigation facilities. In these areas, sweet potato production is affected by prolonged dry periods and thus become a seasonal crop. This results in a lack of continuity in the supply of OFSP roots to the market. The ultimate result of this is a discouraged group of buyers, which finally affects root producers.

Lesson learnt

Technology dissemination approaches that allow for continuous discussion and reflection within value chain actors such as the IPTA speed up adoption significantly. In the Lake Zone of Tanzania, OFSP products are now available in the market. However, we have also learnt that to increase the demand of any new innovation(s)/ technology(s) for the market, activities for its promotion within communities need to be done simultaneously with its production.

1. It is important to define roles of each actor in the platform at the beginning of the project. This was observed in the Lake Zone and resulted in the duplication of work where others had their own interest on being the actors in the IPTA. Therefore each one has to know and agree to what he/she is supposed to do.
2. Willingness to participate in IPTA activities: IPTA members should be willing and committed to join the Platform
3. Every member of the IPTA is equally important for the IPTA to be effective because every IPTA actor has a different level of understanding and expertise. Therefore the involvement of multi-stakeholders such as Researchers, LGAs, BDS/SIDO, Traders, farmers, processors, transporters, CBOs is important for IPTA success.
4. Conflict of interest among IPTA members should be avoided to give the room for the planned activities to be achieved as per plan.
5. *Communication:* At various IPTA levels, it is important to establish regular meetings, monitoring activities, awareness creations e.g. use of media, reporting and reflection.

Outstanding work and future direction

1. *Low dry matter of OFSP:* One of the reasons why consumers prefer white to orange-fleshed sweet potatoes is the low dry-matter content in many of the varieties of the latter. This makes OFSP roots watery when cooked. This made OFSP less competitive on the market. In the long term, therefore, efforts to improve the dry matter content of OFSP should be enhanced. In the short term, however, the nutritional significance of OFSP should be emphasized in addition to promoting processing roots into other products.
2. Critical studies of the different processes of OFSP drying and Vitamin A content retention to support local processors in better ways of utilizing OFSP.
3. Sweet potato's role in addressing hunger, poverty and macro and micro under-nutrition will continue to increase relative to other staples in the coming decades due to its ability to generate superior levels of food per unit-area per unit-time, compared to other major staples and, in the case of orange-fleshed varieties, vastly superior amounts of pro-vitamin A per unit area (Woolfe, 1992). Therefore, more promotion strategies of OFSP production in areas that have more and well-distributed rainfall like Sengerema, Geita, Karagwe, Tarime, Bukoba and part of Muleba districts, which were not involved in the project are needed. This will ensure that OFSP roots and products are available throughout the year. Also, this will ensure that roots are available at the markets at the time consumers need them.
4. OFSP utilization campaigns need to be intensified in communities in the Lake Zone of Tanzania. This should increase the demand for both roots and processed products, and thus boost production.

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Identifying markets and potential markets for QPM-based products in Kenya

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Background

Several quality protein maize (QPM) varieties have been developed in East Africa but uptake has remained low. This has been attributed to inappropriate dissemination methods, undeveloped markets and few differentiated products of QPM despite the potential and lack of seed. Some efforts have been made by projects such as QPM Development (QPMD) project and a number ASARECA QPM supported projects to address this problems. DONATA project was launched in 2009 with the aim of disseminating QPM technologies and innovations in East and Central Africa. In Kenya the project established several platforms, popularly known as innovation platforms for technology adoption (IPTA), to disseminate QPM technologies and innovations. One way to improve adoption is to develop and identify markets. Understanding of the markets, market niches and preferences of clients will help to develop an enterprise such as QPM and improve farmers' incomes and livelihoods.

Different platforms in Kenya adopted different methodologies to identify and improve markets. The Kirinyaga and Embu IPTAs designed and implemented a study to determine markets for maize flour and determine markets and market potential for QPM based flours. Embu IPTA went further to form producer marketing groups known as the SILCs while Kilifi IPTA formed an Umbrella team to oversee development, promotion and sale of QPM products.

Market identification by the two IPTAs was done along the quality protein maize value chain. Generally in Kenya there are five distinct maize actors involved in quality protein maize spread along the value chain and they include producers (composed of grain and seed producers), the enablers, transporters, marketers and consumers. More often one or two of these actors are involved in multiple functions. The grain producers include the government (e.g. irrigation schemes and the Ministry of Agriculture, Livestock and Fisheries (MoAL&F)) and farmers (both small scale and large scale) while seed producers are both private and public. Examples of private seed producers include Monsanto, Freshco, Western Seed, Pioneer and Leldet while public producers include Kenya Seed and Kenya Agricultural and Livestock Research Organization (KALRO). Enablers include the MoAL&F, KALRO, Kenya Plant Health Inspectorate Services (KEPHIS), Universities, Non-Governmental Organizations (NGOs) and International Research Institutes. While the MoAL&F and NGOs are involved in technology dissemination, KALRO, Universities and International Research Institutes are involved in technology development. Marketers include the National Cereals and Producer Board (NCPB) whose function is market stabilization and the keeping of strategic reserves, private millers and small traders. Consumers include individuals, hotels, restaurants, schools and hospitals spread across the rural areas, peri-urban and urban areas. The transporters serve all these actors and the modes of transportation include lorries, pick-ups, public transporters (popularly known as Matatus), two-wheelers (both motorized and non-motorized) popularly known as boda-bodas, ox/donkey-carts and even human transport.

What was done

The Kirinyaga IPTA identified a consultant to conduct a study with the objective of determining potential markets for QPM maize flour and its related products. The consultant first identified key categories of market outlets through review of secondary information and consultations. The key market outlets identified were retail, wholesale, schools, hospitals, restaurants, hotels and food stores/processors. The retail outlets included supermarkets, market vendors and 'kiosks'. In each of the three major towns of Kirinyaga, Embu and Nairobi, a list of outlets for each market category was developed through the guidance and assistance of staff from the Ministries of Agriculture, Trade, Education, Health and Local Authority. The lists generated were subsequently used to select 43 market outlets for assessment of their potential as market outlets for QPM products (Table 13).

Table 13: Number of market outlets sampled by towns

Market outlet	Owner	Manager	Employee	Owner	Manager	Employee	Owner	Manager	Employee	ALL
	Embu (n=10)			Nairobi (n=8)			Kirinyaga (n=25)			
Retail	1	1	1	2	2	-	5	-	3	**15**
Wholesale	1	-	-	-	-	1	3	-	-	**5**
School	-	1	1	-	1	-	-	5	-	**8**
Hospital	-	-	1	-	-	-	-	-	2	**3**
Restaurant/ Hotel	-	-	3	-	2	-	2	3	2	**12**
Total	**2**	**2**	**6**	**2**	**5**	**1**	**10**	**8**	**7**	**43**

Data was collected from the marketing outlets using two sets of questionnaires. The first questionnaire targeted respondents in the retail outlets, while the second collected information from respondents in schools, hospitals, restaurants and hotels. The two sets of questionnaires were first pre-tested in the market outlets in Kirinyaga. Data was then collected through face-to-face interviews with the respondents by three enumerators assigned for each of the towns, Embu, Kirinyaga and Nairobi.

After the market study, Embu IPTA formed producer marketing groups whose aim was to tour several urban and rural markets to identify potential markets for QPM maize and products. The marketing groups were formed in Embu, Mbeere, Mutuobare and Mwea. Killifish IPTA formed an umbrella body whose role was to manage the processing unit (poshos mill), produce QPM products and identify market outlets.

Achievements

Markets for QPM based flours

The respondents were first asked their level of awareness of QPM and then willingness to buy QPM based flours (Table 14). There was generally low level of awareness about QPM among the respondents. Overall 35% of the respondents indicated that they were aware of QPM, while a larger proportion (65%) had no of knowledge of QPM. Awareness was relatively higher among the respondents in the retail outlet. The term QPM was then explained to the respondents who reported having no knowledge, followed by questions on willingness to buy QPM based flour. A majority of the respondents (95 %) were willing to buy QPM based flour. A small proportion (2%) of respondents were not sure about purchasing QPM and these respondents were in the retail market outlets category. Respondents expressed the need to have the samples to make full judgement. A higher proportion of respondents indicated having been introduced to or heard about QPM in 2009, while 27 % noted having known about QPM in 2007, 20 % in 2008 and 6.7 % in 2006.

Table 14: Level of awareness of QPM and willingness to buy QPM based flours

Outlets	Awareness of QPM		Total	Willing to purchase QPM based flour			Total
	Yes	No		Yes	No	Not sure	
Retail	7(50)	7(50)	**14**	12 (86)	1(7)	1(7)	**14**
Wholesale	2(33)	4(67)	**6**	6(100)	0	0	**6**
School	2(25)	6(75)	**8**	8(100)	0	0	**8**
Hospital	1(33)	2(67)	**3**	3(100)	0	0	**3**
Hotel	3(25)	9(75)	**12**	12(100)	0	0	**12**
All	15(34)	28(65)	**43**	41 (95)	1(2)	1(2)	**43**

Notes: Figures in parentheses are percentages

Among the respondents aware of QPM, 80 % were located in Kirinyaga. Promotional campaigns through the QPMD project as well as DONATA were probably associated with the high awareness level. The respondents were further asked to indicate whether they were willing to purchase QPM products or not. Overall 57 % of the respondents indicated that they had the intention of buying QPM based flour, 19 % indicated that they were definitely going to buy the QPM product, while only 2.4 % categorically stated that they were not going to buy the new product (Table 15).

Table 15: Willingness to purchase QPM based flour

Market outlet	Definitely buying this product	Probably buying this product	Don't know if I will or will not buy this product	Will not buy the product	
Retail	3(23)	8(62)	2(15)	0	13
Wholesale	1(17)	3(50)	2(33)	0	6
School	2(25)	5(63)	1(13)	0	8
Hospital	0	3(100)	0	0	3
Hotel	2(17)	5(42)	4(33)	1(8)	12
All	8(19)	24(57)	9(21)	1(2)	42

Notes: Figures in parenthesis represent percentages

The respondents who stated that they were probably going to buy required the sample to be definite about buying the QPM based product. The potential demand for QPM based flour in the various market outlet categories was determined by asking the participants to give an indication of the amounts they were willing to buy and at what frequency. These were translated to a month's requirement in terms of bags. Overall the potential monthly demand was about 9 bags of QPM based flour ranging from a minimum of 0.04 bags to about 67 bags (Table 16). Respondents in the wholesale outlet expressed the highest potential demand of about 25 bags per month. Hospitals and retail outlets each expressed potential demand of about 8 bags per month. The common supply unit among the respondents was a package bale containing 12 units of 2kg each. The mean price quoted was KS 1011.18 ranging from KS 870 to 1100. This happens to be below the price of most of the nutritionally enhanced maize (with vitamins, soya and amaranthus) flour such as Incas, pendana, jogoo extra and hostess.

Table 16: Potential demand (bags/month) for QPM based flour by market outlet category

Market outlet	N	Minimum	Maximum	Mean	Std. Deviation
Retail	12	1.3	16.0	7.8	4.3
Wholesale	6	4.4	66.7	24.7	24.3
School	8	0.3	8.6	5.4	3.5
Hospital	3	0.0	22.2	7.6	12.7
Hotel	12	1.1	8.6	3.6	2.6
All	41	0.04	66.7	8.6	11.8

Strategies for promotion of QPM based flour

Figure 33 presents the promotional strategies suggested by respondents. The majority of the respondents (86%) indicated that promotional campaigns for the QPM products were necessary to create awareness and encourage demand. Various channels for creating awareness for the QPM based products were sugested; namely the use of brochures or pamphlets, electronic media (TV/Radio), field days (including Agricultural Shows of Kenya (ASK), chiefs' baraza, road shows and promotion of samples in supermarkets and for products to conduct sensory evaluation where possible for other QPM based flours. A sensory evaluation undertaken at the Kirinyaga and Embu IPTAs found that QPM products were preferred to other maize products and there was a significant difference between female and male farmers (Ouma et al. 2012). Field days (62 % (n=37)) were cited as the most effective vehicle for creating awareness for QPM based products. The use of the media (print and electronic media) was cited as the second most important strategy for communicating information regarding QPM based products. Creating awareness through provision of random samples to customers in supermarkets was also cited as another effective means. Another minor strategy cited was promotion through road shows. The respondents further indicated that the promotional costs would be the responsibility of the suppliers or the farmers' groups. All the respondents in the market outlets indicated that they would be interested to receive feedback of the survey and that we were welcomed for any further enquiry.

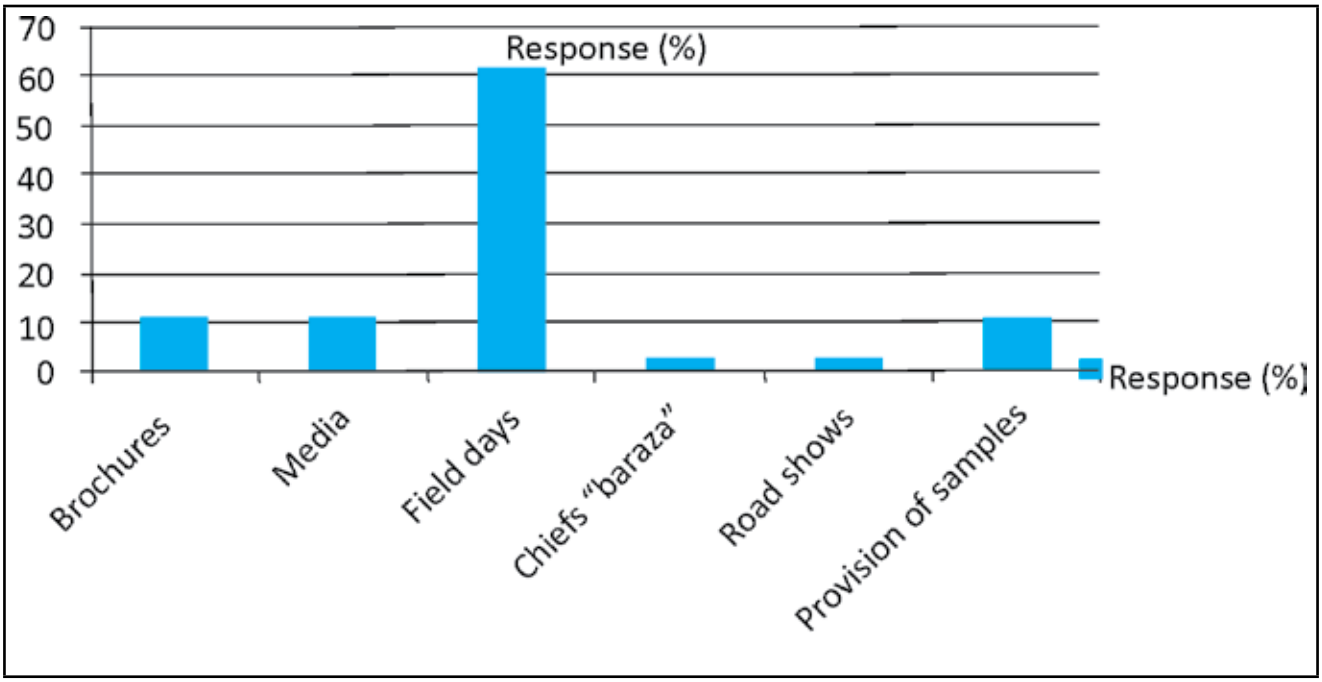

Figure 33: Promotional strategies suggested by respondents

The Embu IPTA producer-marketing group visited several urban centres including Kiritir, Mbeere, Ishiara and Embu to assess the potential for QPM product sales. At the end of 2009 and 2010 QPM grain was sold at the Kiritiri, Mbeere and Ishhiara market centres. A shop opened at the Kiritiri market for sale of QPM products, however, this was closed by the end of 2010 due to lack of QPM grain and drought at the Mbeere site. At the Kilifi IPTA several QPM products (cakes, mandazis and chapattis), were sold during official functions at the IPTA, at the processing site and Kilifi municipal market.

Challenges

Challenges in marketing of QPM maize and products included low volume of maize grain quantities produced, few differentiated QPM products, low awareness of QPM technologies and innovations and lack of clear differentiation of QPM maize and other maize varieties in the market.

Low volume of QPM produced was attributed mainly to scarcity of QPM maize seed. While KH631Q and KH500Q, hybrids, were produced by Freshco Seed Company, WS104Q, an open pollinated variety was produced by Western Seed Company. Seeds of these three varieties were available in the market with the stockists in 2009 but in 2010 and 2011 quantities available were less than what was demanded. This resulted in low QPM maize grain production and thus fewer quantities in the market.

Coupled with the low quantities of QPM grain produced, was limited differentiated products or dishes made out of maize. Although opportunities exist to make many more different products from QPM, stakeholders at the IPTAs were using it just like any other maize. Making differentiated products is a strategy for developing markets by introducing new products.

The study in Embu and Kirinyaga IPTA found that there was low awareness of QPM technologies in the market. If one is not aware of existing products then they will not likely buy it. Furthermore when the product was available in the market the price was the same as the normal maize: thus price not signalling the quality of the product.

In the year 2010, Western Seed Company stopped producing WS104Q, an open pollinated QPM variety, which was being promoted at the Kilifi IPTA. This adversely affected production and promotion of QPM at the IPTA. Because the variety is open pollinated, the IPTA responded by recycling the seed, however, this could only last two seasons.

Lessons learnt

The marketing study in two IPTAs (Kirinyaga and Embu) was designed with the objective of assessing the markets for maize-based flours and particularly potential markets for QPM based products and maize flour. The findings show increasing demand for nutritionally enhanced maize products from the realization to keep healthy. A number of biofortified maize flours exist in the market. Apart from the case of soya biofortified maize flours, the rest are biofortified with vitamins and this therefore forms a market niche for the QPM based maize flours. To penetrate this market farmer groups who intend to produce the QPM based products are required to meet the Kenya Bureau of Standards (KEBS) quality requirements.

It is also important to note that opportunities exist to expand QPM grain and product markets through more marketing campaigns. Demand exists in production areas, rural (Kiritiri, Ishiara) and urban markets (Embu, Nairobi and Kilifi).

To sustain production of QPM grain there is the need to develop more QPM varieties. Only two hybrid varieties (KH631Q and KH500Q) and one open pollinated variety (WS104Q) (which has not been produced since 2010) were being promoted in Kenya.

Outstanding issues and future direction

Production of QPM grain in 2009 and 2010 was low but in the years 2011 and 2012 the seed situation has improved. Freshco this year alone has produced more than 60 tonnes of QPM seed and the seed is available within the IPTAs in major urban centres including Nyeri, Embu, Murang'a and Kirinyaga. This certainly will increase production of QPM grains. Farmers with other stakeholders at the IPTAs will therefore need to organize themselves into marketing groups. The marketing groups should then use the results of the marketing study to identify markets for the expected increased QPM harvests.

The Kirinyaga and Embu IPTA acquired processing mills, ovens and metal silos. The processing mills should now be useful in processing QPM maize and making different products for sale. If there is an oversupply that suppresses prices, metal silos should be used for storage for sale when prices improve.

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QPM Product transformation in Tanzania under DONATA Project

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Introduction

Most Tanzanians depend on maize for food and cash income (Otungeet al., 2010; Barreiro-Hurle, 2012). Maize is also the ingredient used in the highest quantity in animal feeds (Barreiro-Hurle, 2012). However, conventional maize lacks adequate amounts of essential amino acids, lysine and tryptophan. These amino acids are important for protein synthesis in human beings and monogastric animals, mainly poultry and pigs (Alamerew, 2008; Nuss and Sherry, 2011). Therefore an insufficient amount of lysine and tryptophan in conventional maize makes it to be of low protein quality and biological value. In livestock production, the limitation imposed by insufficient amounts of lysine and tryptophan in conventional maize, makes a necessity to supplement maize based feed with essential amino acids produced by bacterial fermentation. This is very expensive and increases costs of production and thus reduces the profit margin. In human nutrition, most families leave out protein-rich foods from their diets because foods such as fish, meat, eggs and milk are expensive. They are therefore forced to depend on staple diets like maize that are poor in protein quality. In order to address the problem of poor protein quality in normal maize, research efforts resulted in Quality Protein Maize (QPM), a type of maize that has double the amounts of the limiting amino acids as compared to normal maize.

Tanzania has released four (4) QPM varieties namely Lishe K1, Lishe H1, Lishe H2 and TAN H611. Efforts to disseminate these varieties for production and transformation started early 2000s in the Eastern and Northern parts of Tanzania. Adoption of these varieties has unfortunately been slow so that the nutritional qualities of QPM have not benefitted people.

In order to address this situation, the Dissemination of New Agricultural Technologies in Africa for QPM (DONATA) project focused on strengthening the adoption of these varieties. Five (5) Innovation Platforms for Technology Adoption (IPTAs) were formed, each with the aim of addressing a specific segment of the QPM value chain. Muheza and Korogwe IPTAs identified themselves for seed production and distribution; Kilindi IPTA for QPM crop management and grain production; and two (2) IPTAs, in Kilosa District and Mikumi Town were formed to mobilize a diversity of stakeholders in the QPM value chain to work together and innovatively find approaches to disseminate QPM post-harvest processing technologies among communities. Transformation of QPM into various products will increase demand and marketing for QPM in the value chain and hence increased marketing of QPM grain and hence farmer incomes. The Kilosa and Mikumi IPTAs were launched in 2009 and

2011, respectively, with members derived from actors along the QPM product value chain from production to consumption. Members include farmers, Grain and Flour Enterprises (GFE), Health Foods (HEFO), District Council leadership (District Commissioner, District Executive Director, Division and Ward Executive Secretaries and Agricultural extension officers), International Tanfeeds. The district extension officers provide agricultural advisory services to farmers. Agroprocessing companies offer skills in product transformation and facilitate promotion, dissemination and utilization through training and QPM product demonstration, tasting and sales.

The use of the IPTA approach attracts many stakeholders with a higher capacity to innovate, develop and promote technologies within communities relatively fast and hence facilitate quick adoption. This paper presents the IPTA engagement in transformation of QPM into various products. Initial efforts in QPM product transformation started in the early 2000s (before the DONATA project) with production of buns, cakes and biscuits. The DONATA strategy aims at building the capacity of stakeholders to be innovative and make a wide range of other products.

What was done

Stakeholder assembly: The project initially identified two IPTAs for QPM processing among the five DONATA-QPM project IPTAs in Tanzania. These IPTAs are KIMSIRU located in Kilosa District and Mikumi located in Mikumi town. These IPTAs are mandated with production of QPM grain that can be utilized within the communities for processing into various products or sold to other enterprises that also process QPM into other products. The IPTAs are composed of various stakeholders. These include farmers, NGOs/CBOs, schools, orphanage centres and food vendors. District councils/District Agricultural and Livestock Development Officers (DALDOs) were also involved, and offered agricultural extension services, technical and logistical support for IPTA activities including coordination and networking. Agricultural Research Institute, Ilongasupported activities for QPM grain production and provided training services in QPM processing and value addition. International Tanfeeds, Grain and Flour Enterprise (GFE) and Health foods (HEFO) are private enterprises that supported the IPTA capacity building through the value chain approach. They are involved in QPM processing, value addition and utilization. Sokoine University of Agriculture (SUA) is part of the IPTA and supports the use of QPM in poultry feeds.

GFE is an enterprise that processes QPM grain and flour. The Enterprise gets grain from farmers through contract farming. Grain from farmers is cleaned, de-hulled, milled and packed for distribution to shops and supermarket. HEFO is a subsidiary of GFE and is an enterprise concerned with transformation of QPM grain/flour into various QPM based food products. The enterprise so far makes and markets over twenty (20) varieties of QPM based food products. Some of the key products are buns, cakes, biscuits, pancakes (“chapatti”), a blend of QPM grain and beans (“kande”), and roasted groundnut coated with QPM flour. One of the activities of HEFO is to promote utilization of QPM based food products through sales of these products to National Agricultural Show participants. HEFO has been recording average daily sales of USD $750 during this time from QPM-based food products and an average of more than 1,000 pieces of QPM snacks per day. International Tanfeeds is a livestock feed processing firm located in Morogoro and it uses QPM as one of the ingredients in processing poultry feed, particularly broiler mash. Both GFE and International Tanfeeds are linked to Kilosa and Mikumi farmers where they purchase QPM grain from Klosa and Mikumi farmers through contract arrangement.

In 2010 International Tanfeeds performed a trial to compare performance of QPM against normal maize and also promoted utilization of broiler mash made from QPM among farmers through training and field days. The trial revealed that QPM based feed is superior compared to conventional maize-based feed in terms of growth and live weight. In the future, the firm also has plans to formulate layers’ mash.

Training: Grain and Flour Enterprises (GFE) trained some platform members in processing techniques. Participants received training on various aspects along the QPM value chain from production to processing and marketing. Initially training sessions were done by GFE alone, but later when some IPTA members (especially extension staff) acquired knowledge, they organized training sessions for other community members. The training sessions

were conducted both theoretically and practically. Trainees included farmers, extension officers, community development personnel, hoteliers and food vendors. Other training was in form of study visits between IPTAs. About 180 people received training and went back to train their colleagues in communities. An example of QPM processing spill-over is Kilindi IPTA which is a QPM crop management IPTA. Kilindi IPTA decided to adopt QPM processing technologies so as to enhance adoption.

Figure 34: Packaged QPM flour and other QPM-based products produced by Grain and Flour Enterprise (GFE)displayed during a training event

Promotion of QPM products: Several promotional activities were carried out on QPM products. These activities were field days and annual national agricultural shows. During these activities, HEFO prepared and served QPM products. Some of the platforms such as Kilosa and Klindi platforms also cooked and displayed QPM products with an average production of 300 pieces of snacks per day.

Achievements

QPM processing innovations adopted: Exchange visits among platforms exposes farmers to several QPM transformation activities. More than 100 Kilindi Platform members learned about the transformation of QPM into various products from the Kilosa platform members. They have since adopted processing of QPM into different products. One of the QPM grain transformation products is “kande”, a product made by mixing QPM with grain legumes. QPM flour is now used to make snacks that have become popular in households. These include bread, buns, scones, cakes, pancakes and others. Products like groundnuts are also coated with QPM flour.

QPM products have become very popular: Quality protein maize based products have become so popular in various communities that QPM snacks are now stocked in hotels. Communities now prefer QPM foods and have

incorporated them in their daily lives. QPM flour has become popular among households so that wherever it is displayed, it sells out faster than normal maize flour. In 2010,Saddiq supermarket in Morogoro recorded sales of QPM flour to be twice that of conventional maize flour.

QPM feed products are very popular: International Tanfeeds is engaged in the production of poultry feed using QPM as one of the ingredients of broiler mash. This feed has become so popular that the company is planning to start producing QPM based layers' mash.

Income generation: Communities are generating income from selling QPM products. Replacement of wheat flour by QPM flour in snacks also reduces cost of production due to the decreased price in flour and hence increased income. For example, QPM buns need 3 kg of QPM flour and 1 kg of wheat flour while wheat buns need 4 kg of wheat flour. QPM buns need 0.125 kg sugar while wheat buns need 0.25 kg of sugar (double the amount). Overall, the cost of producing wheat-based buns cost twice as much as producing QPM- based buns. Farmers are now able to pay school fees for their children and, in some cases. for themselves.

Health Food Enterprises (HEFO) has been selling QPM processed products during annual national agricultural show with QPM grain obtained from IPTAs through a contract arrangement. For a period of five (5) years GFE has reported an income of US $ 30,000 from QPM products. They reported an average income of US $ 6,000 in 8 days' selling QPM products in a national level Agricultural Show.

QPM dissemination activities to be included in district agricultural development plans: Some leaders and policy makers have realized the importance of QPM and have decided to include QPM dissemination activities in their agricultural development plans. Kilindi Platform members inviteda District Executive Director (DED) during one of the training sessions on QPM processing; this in turn motivated the DED who later promised to include QPM as one of the priority commodities for the district also using the QPM IPTA that is already in place.

Challenges

Accessibility and availability of QPM grain: There is a challenge of where to get genuine QPM grain for utilization. It is difficult depending on traders for QPM grain since they always mix the product at the farm gate level. Therefore, consumers need to be assured of the true QPM growers. Currently, consumers prefer buying QPM grains from farmers to traders. This becomes a challenge if farmers are located long distances away from consumers.

Competition for QPM for human food and animal feed requirements: Competition for QPM needs between human food and animal feed deplete grain from the market very fast. International Tanfeeds requires 30 MT of QPM per month in order to produce QPM-based poultry feed. They do not have access to this amount of grain. However, this can be taken as an opportunity of for farmers to increase production of QPM so as to fill the gap of unsatisfied demand. The challenge is how to overcome bottlenecks that are currently hindering farmers from producing enough QPM grain.

Lessons learnt

The IPTA approach has been very useful in facilitating interaction and learning among stakeholders to enhance promotion, dissemination and adoption of QPM technology along the value chain. Stakeholders came to realize the importance of QPM through QPM based products and hence increased QPM adoption and demand that surpasses QPM grain production. This has become possible through capacity building activities made possible by the unique operations of the IPTA approach to technology transfer.

Outstanding issues and future directions

QPM popularization programmes through QPM based food and feed products will continue to sensitise as many farmers as possible. The issue of how to produce enough QPM, however, remains a challenge. TANSEED

International has plans to strengthen seed production with communities so that more seed can be available for increased grain production.

Health Foods Enterprises wants to exploit further avenues for QPM products promotion and therefore has plans to establish a One Stop Centre in Morogoro town whereby the QPM value chain will be demonstrated including QPM processed products. This will help to have a sustainable national platform for QPM promotion and dissemination.

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Theme 4: Nutrition and Health

Introduction to the key constraints and issues in nutrition and health for QPM and OFSP

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Both QPM and OFSP are bio-fortified crops developed through conventional breeding. They have significant improvements in the proteins lysine and tryptophan; and β-carotene, respectively compared to conventional varieties of maize and sweet potato. Lysine and tryptophan improve growth while β-carotene reduces mortality due to vitamin A deficiency related ailments (Sommer and West 1996). An estimated 27 million children in Eastern and Central Africa (ECA) under the age of 5 were Vitamin A deficient in 2007, with a prevalence of around 40% (UNSCN, 2010).

Food-based approaches promoting the production and consumption of bio-fortified maize and sweet potato are among the cheapest and most sustainable ways of alleviating problems associated with deficiencies in protein and vitamin A (Sommer and West, 1996; Hotz et.al., 2011; Hotz et al., 2012; Low et al., 2007; Low et al., 2011; Low et al., 2013). However, while use of food-based strategies for addressing nutrient deficiency is increasingly being pursued, various challenges need to be addressed for them to be effective. A key challenge often encountered when promoting new technologies associated with food and diets is their acceptability compared to the existing ones. Target beneficiaries usually evaluate these in terms of taste, colour, how well and fast they cook, appearance and price.

In the case of QPM and OFSP, which have the additional attribute of enhanced nutritional and health attributes, there are further challenges in scaling out. These include: (i) how to get the buy-in and engagement of nutrition and health, and in some cases education, actors in the scaling out process; (ii) identifying trial mechanisms that can provide evidence and validation of the nutrition and health benefits of the technologies by the intended beneficiaries; (iii) how to harness synergy among activities of different stakeholders involved in taking care of vulnerable people such as the malnourished and undernourished and those suffering from "hidden hunger"; (iv) devising ways of establishing effective linkages with the market and providing the necessary marketing functions to empower small producers to access and exploit market opportunities; (v) how to communicate the technology messages to beneficiaries and other relevant stakeholders ('behaviour-change communication').

The DONATA project adopted the IPTA approach because of its inherent advantage in bringing diverse stakeholders along the value chain and even those beyond agriculture to other relevant sectors and facilitating them to work together towards mutually beneficial outcomes. As discussed in Part 1 on conceptual framework for the innovation systems approach, it has advantages over the conventional linear technology transfer model. Some of the stakeholders in the innovation platforms would have skills and expertise that could be used through the interactions, learning to catalyse innovation to address the issues listed above. Earlier initiatives to promote OFSP used an integrated agriculture-nutrition-marketing approach (Low et al., 2007; Hotz et.al., 2011; Hotz et al.,). These were successful in improving the vitamin A status of mothers and young children. The DONATA IPTAs took a more explicit value chain approach to scale-up the nutritional benefits of OFSP and QPM with a

focus on improving incomes as well. It has been argued that strong linkages between agricultural research and development and key actors in nutrition, health and education sectors can go a long way to ensure effectiveness of interventions that aim to impact on nutrition and health (FAO 2012). Both QPM and OFSP platforms included actors from the health, nutrition and education sectors, which is uncommon practice in ARD. Even with the IPTA approach, stakeholders had to come up with effective ways for awareness and demand creation. The IPTAs have approached this in different ways, using different communication pathways, and demand creation strategies, depending on the type of message, target group and country contexts. The IPTAs have also needed to consider the most appropriate entry point to reach different target groups e.g., women, children, people living with HIV and decision and policy makers and different hierarchy levels. Among the entry points used include health centres, nutrition centres, schools and the media.

The papers in this chapter describe how the IPTA approach and its unique benefit of bringing stakeholders from different sectors including health and nutrition and agriculture to work together was used to support scaling- up utilization of QPM and OFSP for nutrition and health outcomes. They also show how various dissemination strategies and methods were used to create awareness and to communicate the information on these technologies in ways that generated and spread nutrition and health outcomes in the communities where they were promoted.

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Unleashing the potential of OFSP for nutrition and health: experiences from Northern Uganda

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Introduction

Sweet potato (Ipomoea batatas L) is a major staple and food security crop in Uganda (Bashaasha, 1995). In northern Uganda, particularly in the Acholi sub-region, sweet potato is also an important source of household income (DONATA OFSP Project, 2010). Until recently, white-fleshed sweet potato cultivars, which contain negligible amounts of beta-carotene (the precursor of Vitamin A) have been the predominant varieties grown (DONATA OFSP Project, 2010). Varietal choice is dependent upon a host of factors that include taste, plumpness, and earliness in maturity, yield advantage, availability of planting materials and marketability (DONATA OFSP Project, 2010).

Since 2008, orange-fleshed sweet potato (OFSP) varieties have been gaining prominence in northern Uganda, primarily as vehicles for diversifying income streams, addressing food security and Vitamin A deficiency (VAD), which is a serious health and nutrition problem especially among both children and women in the region (Shively & Hao, 2012). Vitamin A deficiency can limit growth, weaken immunity, cause xerophthalmia leading to blindness, and increase mortality (Sommer & West, 1996). Although medical supplementation and fortification of foodstuffs with vitamin A can be effective in combating VAD, coverage is still limited. As a result, food-based strategies, which aim to increase the production and consumption of foods with high vitamin A content, are being strengthened considerably. Food-based strategies are often described as a sustainable approach because the process empowers individuals and households to take ultimate responsibility over the quality of their diet through own-production of nutrient-rich foods and informed consumption choices (Ruel & Levin, 2000). Orange-fleshed sweet potato is a particularly promising food, because levels of beta-carotene are extremely high in many varieties [100–1600 µg retinol activity equivalent (RAE)/100 g for varieties in Africa) and it is generally well accepted by young children (Hagenimana et al., 2001; van Jaarsveld et al., 2006). This paper describes recent initiatives to exploit the potential of OFSP to improve nutrition and health in two districts in northern Uganda, namely Gulu and Amuru, under the Dissemination of New Agricultural Technologies in Africa (DONATA) project: "Enhanced uptake and adoption of OFSP technologies in Eastern and central Africa"(2008-2012). The project was implemented in Ethiopia, Kenya, Rwanda, Tanzania and Uganda, with funding from the African Development Bank through the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA).

What was done

Formation of an Innovations Platform for Technology Adoption: The overall objective of the DONATA project was to bring about improved food security and nutrition, as well as increased incomes through increased production, consumption, and marketing of OFSP fresh roots, vines, and processed products. The complexity of this outcome required working across sectors, partnership types throughout the entire value of sweet potato (see Figure 35 below).

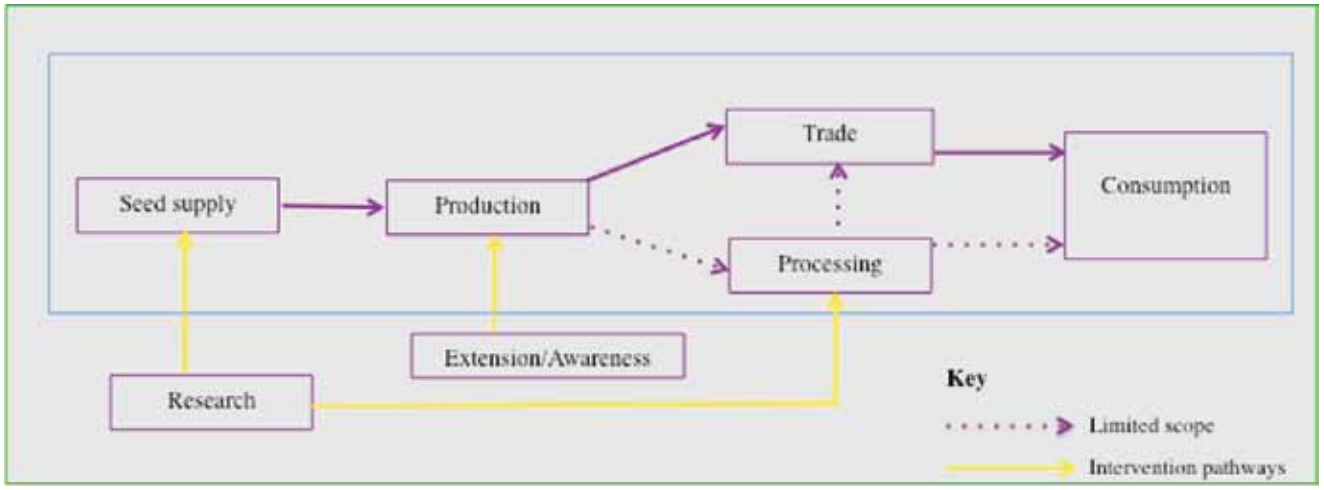

Figure 35: Sweet potato value chain map for Northern Uganda (Source: DONATA Project Data, 2012)

Therefore, one of the key steps in the implementation of the project was the formation of an Innovations Platform for Technology Adoption (IPTA), a multi-stakeholder arrangement capable of catalysing the uptake of OFSP in the region. As a precursor to its formation, a consultative meeting involving local government agencies, NGOs and private sector actors was held, in which the key issues thought to be critical for uptake of OFSP that the IPTA would address – i.e. access to quality seed (planting materials) of OFSP varieties, access to markets, processing (value addition) and transfer of information and knowledge related to OFSP and potential partners with relevant capabilities to tackle the identified issues were mapped out. This event led to creation of the Gulu IPTA, with Mega FM Radio, Gulu District Farmers' Association, Appropriate Technology—Uganda, FAO Uganda and Uganda Red Cross Society (URCS) as members, with Gulu University playing the coordinating role, and the International Potato Centre performing a backstopping role.

The use of radio was seen as a very quick start-up way to create awareness of OFSP. In the arrangement, the OFSP promotion was nested within a one-hour weekly "Farmers' World" programme on Mega FM radio (Figure 36). The partnership proved very cost-effective, considering that an hour of commercial radio airtime costs about $400 and, by partnering, the IPTA could spend only on minor logistics such as facilitation for panellists, which usually came to utmost of $100 per hour.

The other IPTA partners such as Gulu District Farmers' Association, Appropriate Technology—Uganda, FAO Uganda, and Uganda Red Cross Society had already accumulated significant experience working with farmers in the region and, in the process, developed stable farmers' groups and networks that could be used as entry points for dissemination of OFSP varieties in the region. A peculiar case for participating in the IPTA was that of the URCS, which saw the project as an opportunity to enrich its primary programming. Within the URCS, the OFSP intervention was first taken up by a Psychosocial Support (PSS) project, whose focus was on addressing the psychological impact of conflict and war on communities in northern Uganda. The OFSP project received a lot of institutional backing within the URCS that significantly contributed to the decision to add a Livelihoods Component integrating food security, nutrition and income to the PSS project. As a result, the URCS made OFSP available to more households than would have been possible with resources contributed only by the project.

Later in implementation, additional linkages aimed at strengthening precise segments of the value chain were developed. For example, the IPTA partnered with five restaurants (Binen Restaurant, Hotel Katharina, Mamma's Care Restaurant, Golden Gate Hotel and Gulu University Café) to undertake a pilot testing of attitudes of consumers in Gulu town towards OFSP. All restaurants reported customers' liking for the distinct bright colour and sweet taste of OFSP, with some suggesting that if deep-fried OFSP could taste even better. Some preliminary market preferences for OFSP root size were also captured. For example, Binen Restaurant and

Mamma's Care Restaurant preferred the roots to be bigger than those supplied, with at least 30cm in diameter at the mid section, which is easier to peel. These restaurants also shared information on their daily consumption of sweet potato and expressed the need for consistency supply of OFSP roots year-round. Another significant partnership was with two entrepreneurs supplying local market outlets with baked products, which aimed to integrate OFSP into these baked products. Furthermore, the IPTA had to address the need for a continuous supply of quality materials to sustain the production and utilization of OFSP in the region. The strategy used was to develop commercialized seed enterprises owned by selected farmers' groups and individuals, with Mega FM radio serving as a centrally located information and market outlet for their seed.

Participatory planning: After its formation, the IPTA became responsible for preparation and execution of annual and quarterly project work plans (Figure 37). In developing the annual work plans, care was taken to incorporate activities that positively impacted on the multiple target outcomes of the OFSP intervention such as improved diets, nutritional status, productivity, and household income.

Securing community and local government buy-in and participation: The IPTA recognized that community and local government buy-in and participation are a very important factor to the project's success and sustainability, especially if nurtured early enough. Two district-level multi-stakeholder workshops on the project were organized for local government heads of departments, NGOs and private sector actors of each district to give them an opportunity to be informed about key aspects of the project, and to contribute ideas that could be incorporated in the project implementation plans, such as identification and/or selection of potential beneficiaries, and synergies with existing programmes. These workshops achieved consensus on two key aspects of the project, namely: recognition of the potential of OFSP as a promising strategy to deal with vitamin A deficiency, and the multifaceted nature of OFSP–impacting agriculture, health, education and livelihoods, which lent support to use of the IPTA approach to address this multi-dimensionality.

Identification of beneficiaries: As the project had a strong focus on improving nutrition and health, prioritization of the most vulnerable segments of the community was one of the most significant factors considered in selection of beneficiaries. The initial phase of identification of beneficiaries more generally focused on farmers' groups associated with selected NGOs working in northern Uganda and the two apex district farmers' associations of Gulu and Amuru. Later, three high-risk groups namely, schools, health centres, and prisons were identified by the IPTA as possible places where the scale of the problem of malnutrition in the sub-region could be particularly high. This was validated at the district level workshops and follow-up visits to government departments.

Awareness campaigns: The project undertook a variety of public awareness campaigns to highlight the availability, health benefits, and diversity of utilization options of OFSP, and also helped build market demand. The awareness campaigns took the form of public/outdoor events/exhibitions (e.g. National Science Week, Northern Uganda Agricultural Trade Show), training in the areas of (seed and root) production and processing (value addition), and print materials such as brochures and talk shows on Mega FM radio. In the radio programme, guests included farmers, extension workers, production department officers, and other technical personnel in the field of agriculture. By combining the strengths of each campaign tool, the IPTA created a holistic way of bringing their message across, providing communities with useful insights of the new market and nutritional opportunities with OFSP.

Introduction of OFSP varieties: The IPTA supported the introduction and testing of four new varieties of OFSP (*Kabode, Vitaa, Ejumula, Kakamega*) to the local food system. The process of validation involved the provision of planting for testing under farmers' conditions and local agro-ecology so that their agronomic competitiveness and some level of acceptance could be inferred.

Recipe development: In this project, recipes for processing of OFSP into higher value products were developed and/or tested. This was significant because, prior to the project, sweet potato was being consumed mainly as a primary commodity (boiled fresh roots), which, coupled with the highly perishable nature of sweet potato

roots, often led to significant post-harvest losses and low production targets at the household level. This also promoted diversified use of OFSP.

Figure 36: Mega FM Radio Crew recording farmers' experiences with OFSP in Ongako sub county, Amuru district, for dissemination. June 2009.

Figure 37: Participants at the 2010 annual planning meeting at Mega FM radio station, Gulu town. December 2010.

Remodelling of the seed multiplication and delivery system: One of the most pressing concerns and threats to sustainability of any successes of the project in the local sweet potato subsector was the persistent seed supply bottleneck related to high demand for seed, which the existing and largely informal seed systems (DONATA OFSP Project, 2010) could not supply. Addressing these, it was thought, could unlock the potentially commercially-viable OFSP seed system. This formed the basis of IPTA's efforts to develop a seed multiplication and delivery system with a more formal organization/structure and commercial dimension, and potential to assure sustainable supply of better quality OFSP planting material.

Marketing support: In terms of market support, the IPTA focused on building long-term relations between project beneficiaries and other actors in the sweet potato value chain, and this was done through (i) facilitating meetings of the actors to facilitate learning, sharing and communication amongst them, (ii) Mega FM radio serving both as a source of information on OFSP and a centrally located point of delivery of seed to the buyers, an arrangement that allowed seed producers to access beyond their farm gate, (iii) information management, especially maintenance of planting returns for seed producers, (iv) capacity building through training, (v) standardizing the seed vine packaging, and (vi) pilot testing of market potential and consumer acceptance of OFSP roots in selected restaurants in Gulu town (Gulu University Café, Binen Restaurant, Hotel Katharina, Mamma's Care Restaurant and Golden Gate Hotel).

Achievements

Integration of OFSP into the local cropping system of sweet potato: There is evidence of farmers integrating OFSP into their local cropping system for sweet potato, where planting of several varieties of sweet potato in the same field, with each variety planted as a single stand, seems to be the norm. In all the areas where OFSP was introduced, it is now not uncommon to find home gardens with rows of OFSP interplanted with the traditional white-fleshed sweet potato varieties.

Diversity of utilization options for OFSP roots: A broad spectrum of options for utilizing OFSP roots have been developed, ranging from boiled roots to several OFSP-based recipes including OFSP-enriched millet porridge, juice, cakes (queen, party and dry), doughnuts (African and lafier), chapatti, bagiya, flour and bread. In general,

these food systems were designed locally. Moreover, a number of these OFSP-based products were evaluated for consumer acceptance in the local market and in Kampala, where they were well received by consumers in both markets. These are positive indicators of the vitality and sustainability of OFSP in the local food economy, and long-term health of the community.

Schools outreach programme: The schools outreach programme was able to achieve buy-in from the respective district education departments, who were instrumental in expanding the project's activities to schools. In Gulu district where the programme was piloted, the District Education Office facilitated the identification of schools that participated in the project. With seed support from the IPTA, 8 schools including Cwero Primary School, Ajulu Primary School, Sir Samuel Baker School, St Joseph's College Layibi, Bobi Community Polytechnic Institute, and St. Monica Girls' Tailoring Centre were already implementing OFSP production by the end of 2012. In addition, 15 agricultural teachers from the participating institutions also received training in seed/root production and utilization of OFSP.

Figure 38: Gilbert Opiro a leading OFSP producer of vines and roots at his farm in Gulu, Uganda

Health sector outreach: In the health sector, the IPTA piloted with Earth Birth Maternity Clinic (locally known as *Ot Nyawal me Kuc*), based in Atiak sub-county, Amuru district. The centre, which was founded by Oak Grove Midwifery from southern Oregon in the USA, is sustained principally by Traditional Birth Attendants (TBA), whose roles include, in addition to birth attendance, provision of postnatal care. It should be noted that today, TBAs make a significant contribution to primary maternity care in the sub-region. TBAs tend to be older women, respected in the community for their knowledge and experience. Because of these attributes, and their direct interface with expectant mothers and children, TBAs were seen as a viable uptake pathway for empowering them to change behaviours concerning dietary practices regarding utilization of OFSP.

The clinic was supported with a TOT-level training on OFSP seed/root production, and OFSP materials for multiplication. Today, OFSP-based feeding/care is established as a standard practice at the clinic. The adoption

of OFSP has contributed significantly to enhancing the quality of maternity care and antenatal attendance at the clinic. On average, 16-20 women visit the clinic each day. In addition, there are also arrangements to provide feeding during outreaches organized by the health centre. One big challenge is how to keep the vines alive for the next planting season especially when rains stop, as the area has one of the most severe dry seasons in the region. Another problem is the sustainability of the feeding programme. In order to try and find a solution, the clinic had decided that with effect from 2013, the men-husbands to the expectant mothers must also contribute. Initially, it was proposed that each man contribute UGX 20,000 (~USD $8), which is equivalent to what the clinic levies for entire antenatal care. However, they can also contribute labour worth that amount in preparing and planting gardens for the OFSP starting this season.

Prisons outreach programme: At the senior levels of the government prison service in Gulu, the IPTA found a shared vision for an improved and diversified diet for inmates, especially expectant (pregnant) and/or breastfeeding inmates. In 2012, the project supported Gulu Government Prison in Gulu town with start-up OFSP planting material. The prisons service has now extended production to the Patiko Government Prison farm in Aswa County, Gulu district where, unlike the prison in Gulu town, land and water resources for production is not a limitation. With additional seed support of 30,000 cuttings, the farm was able to initiate the process of expanding its production capacity as a sustainable way to enrich the diets of the entire prison services in the region, and to position OFSP as a major source of income for the farm.

Figure 39: A typical sweetpotato vine market in Gulu town

Impacts on household income: To date, the most documented contributions to household income have come from the sale of OFSP vines. Many farmers have taken on OFSP production as a business and have earned substantially through sale of roots and vines. For example, Mr. Gilbert Opiro (Figure 38), who has established himself as a leading supplier of OFSP seed earned UGX 1.6 million (about US $ 620) from the sale of 98 bags of OFSP, with further earnings amounting to UGX 2.5 million (about US $ 960) from the sale of 102 bags in 2012

through Mega FM radio. The IPTA also facilitated market linkage for the Can Pe Rom farmer group–based in Onyona Parish, Ongako Subcounty, Gulu District and one of the groups initiated by the Uganda Red Cross Society (URCS) to have benefited from the project - through which they sold 110 bags of OFSP seed vine to the International Institute for Rural Reconstruction at a cost of US$ 1,000 (UGX. 1,870,000). Part of the money was distributed among the groups while another portion was retained in the group account that will be used to open a bank account. Although pilot testing of market potential and consumer acceptance of OFSP roots in selected restaurants in Gulu town revealed positive attitudes in terms of the distinct bright colour and sweet taste of OFSP, consistency in supply of OFSP roots proved difficult to achieve.

Challenges and solutions identified

Limited opportunities for trial and/or validation of the nutrition and health benefits of the technologies: One of the biggest challenges and most important tasks for the IPTA was to identify a path whereby the nutritional benefits of OFSP are recognized and can be demonstrated by and/or for the local consumer. This was achieved to some extent with the aid of the video clip titled "The Orange Revolution" (CIP, 2008), which was shown in at least two exhibitions including the National Science Week hosted by Gulu University (20-23 September, 2010), and the northern Uganda Agricultural Trade Show (25 August 2011), providing communities with useful insights for into how people with similar conditions have been impacted in using OFSP.

Flavour of boiled OFSP roots is a major impediment to acceptance and consumption: Compared to the relatively neutral aroma of the white/cream fleshed local varieties, boiled OFSP roots display intense undesirable aroma characteristics that significantly limit intake, typically by adults. This was circumvented in part by developing recipes for processing OFSP into value added products with appreciably diminished aroma of OFSP.

Disruptions related to the process of return and resettlement of internally displaced beneficiaries: The project period coincided with improved security in the region, and the process of return of communities, many of who had been forced to flee their homes into internally displaced persons' camps as a result of nearly two decades of armed conflict between the Government of Uganda and the rebel Lord's Resistance Army. Although the project made efforts to track this category of beneficiaries, it achieved only modest success in doing so.

Key lessons

- OFSP varieties present a nutritional leap for northern Uganda; however, the nutritional impacts need to be coupled with food and income security for long-term sustainability.
- In order to contribute to household income security, OFSP farmers will need to be able to access to high value urban markets, including restaurants, hotels, open air markets, and schools. To achieve this, the current limitations in marketing logistics must be overcome.
- Promotion of OFSP with emphasis on differentiating it from white-fleshed varieties is a strong basis for building competitive prices for OFSP and strengthening farmers' pricing power.

Outstanding issues and future directions

The introduction of the OFSP project presents a viable food-based strategy for combating VAD in the Acholi sub-region. However, the market pull for OFSP technology needs further strengthening in order to build sustainability. A number of value added OFSP-based products with proven acceptability to consumers in terms of taste were developed that can, to some extent, circumvent flavour problem that limits consumption of boiled OFSP roots, especially by adults. However, their commercialization can be justified by superior cost-effectiveness, standardizing nutritional parameters and shelf life, which are yet to be established. Whether it is possible to expand this food-based strategy in the present policy environment of Uganda is not clear.

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The utilization of quality protein maize and its impact on health in Democratic Republic of Congo

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Background

Maize is a globally important crop and a preferred staple food for millions of people in Sub-Saharan Africa where animal protein is not affordable by many people (http://www.fao.org/faostat). In Democratic Republic of Congo (DRC), like in many other parts of the world, maize is the main cereal and one of the staple foods. Unfortunately, its nutritional quality is poor (FAO, 1992). Normal maize has limited amounts of essential amino acids like lysine, tryptophan and threonine; lysine being the most limiting followed by tryptophan. In contrast, quality protein maize (QPM) has nearly twice the amount of lysine and tryptophan. This implies that QPM contains about 90% of the protein found in milk. Therefore consumption of QPM supplies more of the essential amino acids needed by vulnerable groups. (Bressani, 1992) On the other hand, normal maize needs protein supplementation from other sources.

For communities that cannot easily access meat, fish, eggs, milk and legume protein, QPM is a useful substitute. Therefore QPM can help to reduce protein malnutrition, improve body immunity and health. In a survey to assess the nutritional status of people in the five provinces of Kasaï Occidental, Kasaï Oriental, Equateur, Maniema, and Katanga, it was revealed that many areas suffered from acute malnutrition (UN News Centre, 2010). One of the causes behind such high malnutrition rates in DRC is poor access of households to good quality food.

According to the latest Multiple Indicator Cluster Survey (MICS) conducted in 2010 in the country's 11 provinces, 24% of children under five years are underweight while 43% suffer from delayed growth due to malnutrition (Kreidler, 2010). A survey conducted in by the Congolese Ministry of Health revealed that some 530,000 children under five and over one million pregnant women needed emergency nutrition interventions. Due to malnutrition, lactating mothers could not produce enough breast milk and therefore relied on imported baby milk. This is not affordable. Poor farmers in this area do not readily access meat as it is not affordable. Most people rely on legumes such as soya-beans, beans, cowpeas and groundnuts as an alternative source of protein. In comparison to maize, these sources are expensive; they cost 2 to 3 times more per kg but provide results similar to those of QPM. Maize, the staple food in the area then became the potential main source of protein for people in the DRC. The superior quality of QPM over normal maize[9] can alleviate protein malnutrition if grown and massively fed to people. In this paper, we present the efforts undertaken in the DRC to introduce QPM, popularize its utilization and how it has been exploited to alleviate protein malnutrition.

What was done

Nine platforms have been established in DRC to promote QPM production and utilization. An analysis of potential challenges to technology adoption was carried out, and information used to aggressively promote QPM in the selected target areas. Demonstrations of QPM nutritional value were conducted on humans and

[9] The term "normal maize" is an international term used to call non-opaque2 maize

poultry to further create awareness and disseminate the QPM technologies for human nutrition and livestock feed. Some of the demonstrations were on malnourished children in health centres to test and demonstrate the results or effects of consuming QPM based diet. Also conducted were protein and amino acids content analyses, which confirmed the information in the literature.

Analysis of potential challenges to promotion of QPM utilization in DRC: An analysis of dissemination approaches was carried out to learn from past QPM dissemination experiences in DRC in order to plan better to ensure that the current efforts succeed. It was noted that previously researchers never involved farmers and other relevant stakeholders in testing technologies. The value of QPM could not be understood and thus it was not adopted. Researchers also sought to overcome potential impediments to the current QPM dissemination efforts. The identified challenges included: (i) identifying the appropriate ways to convince people that QPM was nutritionally superior to many foods, (ii) to convince people that QPM is not a genetically modified (GM) crop, (iii) how QPM can be physically differentiated from normal maize, (iv) how to reach as many people as possible with QPM information, (v) how to handle people who may ask for nutritional analysis of released varieties. These concerns led to the identification of the right actors to involve in the innovation platform for technology adoption (IPTA) and who could help in resolving or answering these questions. Various stakeholders were then involved over time. These include agricultural universities and colleges, nutrition and health centres, nutritionists, doctors, the media, other projects and policy makers. Their respective roles played in the IPTA are described in the paragraphs after the testimonies of people who have had their nutrition and health improved after consuming QPM.

Demonstrating that QPM increases breast milk production and improves health: Researchers identified a lactating mother who was not able produce sufficient milk as she could not afford protein rich foods: she was fed on QPM. While on this diet she realized a great improvement in health for her and the baby. Furthermore, she experienced an increase in breast milk production. When she experienced a shortage of QPM and resorted to normal maize, her breast milk production went down, and consequently she and her baby became less healthy. When next rainy season approached, she decided to grow QPM for her family. Later, she reported an improvement in the healthy status of all her children. She shared these experiences with other women through informal ways (sharing by word of mouth, through neigbours, colleagues, and relatives) and formal ways through testimonies and experience-sharing sessions during IPTA meetings and other events organized by the platforms. This encouraged those who had not yet used it to try feeding on QPM. These subsequent or secondary users of QPM too reported similar results. The following text boxes present some of the testimonies:

Box 2: ***Ms. Enkangaza Malio:*** "When I gave birth, my husband was not able to provide milk diet for me to stimulate breast milk production. I was eating ugali from usual maize but without success. But I remembered having heard about QPM benefits and I tried if QPM could help me getting more breast milk. By eating it as porridge and ugali, I found out breast milk production increased and I had to change blouses 2-3 times per day and the baby was always full and could not disturb me. When now QPM grain and flour was over, I get back to usual maize diet and unfortunately, the breast milk production decreased. From that time I started growing QPM for my family. I found out my children are healthy and the frequency of sicknesses is low and even when they are sick, they remain strong and they do not become weak."

Involvement of a University as a stakeholder in the IPTA:

The participation of a university as a stakeholder in the platform was useful in convincing people that QPM was not a genetic modified organism (GMO). AT The Institut National pour l'Etude et la Recherche Agronomiques (INERA), scientists felt that involvement of university scientists would add value to their efforts to convince people that QPM was not a GMO maize. This team clarified to people that QPM research started in 1920 when

"genetic engineering" was not yet developed (Vietmeyer, 2000). They demonstrated that it was a natural mutant from which conventional breeding methods were used to develop QPM. Furthermore, that one of QPM parents called Opaque-2 variety was common and had been eaten in Kinshasa for a long time where it is locally called "Betake". This approach was very successful to the extent that those who doubted most are now at the forefront of encouraging people to use QPM.

Box 3: Ms. ***Ngalula Véronique:*** "I got information on the benefits of QPM from the National Maize Programme in Gandajika and I got a small quantity of seed which I multiplied to get more. It is a very good material in terms of texture, taste and ugali quality. In addition, with QPM I use less flour to get the same quantity of ugali compared to local varieties and the porridge from QPM is sweet and there is no need to add much sugar. I could not keep this new technology for myself; I shared it with a very poor lady whose children were malnourished. After eating QPM, those children got better within 3 weeks. I do not know how to express my thanks for this type of maize".

The team also clarified to people that there was no difference between the QPM and non-QPM in terms of the ears and grain aspects. They explained that QPM was developed when scientists were aiming to get into a maize a gene (Opaque-2) that makes the endosperm hard so that grains are not damaged by ear rot and storage pests, and also to improve milling properties. However, to avoid confusion, farmers were told that QPM production will be organized in such a way that only reliable and known QPM seed/grain producers and processors/marketers will be involved in its production.

Establishing criteria for selecting sites for QPM promotional events: This was particularly important because QPM had been tried before and people did not appreciate it. The following criteria were then agreed upon: (i) areas most affected by malnutrition and where maize is a staple food and the main source of protein, (ii) areas in which QPM was already adopted. These criteria were also successful.

Protein analysis of QPM: INERA researchers in collaboration with the University of Kinshasa and Laurentian University of Canada analysed MUDISHI 1 variety for protein content. They found out this variety has 9.76% crude protein; and that of this, 4.2% was lysine (Mbuya et al., 2011). Armed with this proof, INERA engaged FAO at their office in Mbujimayi to support production of QPM. After some time, the FAO was given 250 kg of QPM seed to produce grain for itself.

Involvement of nutrition centres to further demonstrate the nutritional qualities of QPM: The nutrition centres were established in order to combat children's malnutrition and were reliant on soya bean. Researchers realized that for the technology to move out fast, they should involve these nutrition centres. With these nutritional centres and hospitals, demonstrations on humans were initiated where malnourished children, pregnant and lactating mothers were fed on QPM and their performance compared with that of similar groups fed on soya bean (which was already in use). Three nutrition centres i.e., Gandajika, Mweneditu and Luputa realized a reduction in the cost of feeding children and mothers at health centres: they started producing QPM and using it to sensitize people.

As a result of the observed nutritional qualities of QPM, nutrition and health centres and hospitals no longer use soya bean to combat malnutrition. They have substituted soya bean with QPM since it has the same effect and is at a much lower cost. After rehabilitation, parents were given a certain quantity of QPM seed for planting so as to prevent malnutrition of the same children or others. Some farmers found this as an opportunity to grow more QPM and sell it to nutrition centres.

As a result of the above, nutritionists were invited to train people on the National Protocol of Nutrition. This protocol is a national document dealing with different ways to manage malnutrition problems in the country.

Here participants were taught the stage in the protocol when QPM could be used. This further made people believe and trust QPM since they realised that it was "officially known and officially recommended". This trust contributed to further adoption of QPM technologies.

Involvement of doctors with QPM: Researchers and nutritionists shared their QPM experience with doctors. Doctors experimented with QPM, realized its importance and started adding QPM diets to medical prescriptions. Doctor Mutombo Dieu-Donné once sent a malnourished child to INERA to be given QPM in addition to the medicine the child had received. Another doctor, Dr. Mudibu Tshimanga Roger realised that wounds of patients who had undergone operations recovered faster when they were fed on QPM – based diets. When people saw doctors prescribing QPM to patients, they became more aware of it and believed even more in its importance. As a result, many people began looking for QPM seed to grow their own for home use and for QPM grain or products from the producers.

Box 4: "QPM has really, really improved nutrition as we can see the great number of malnourished children rehabilitated in this area. We shall keep on supporting this Project".

Alidor MUTOMBO NTAMBWA,
Local Government Representative

Bringing the media on board: The media, through radio and television, was brought on board to promote QPM as these reach a wide audience in a short time. Newspaper articles on QPM and its nutritional benefits were also written. All QPM promotion events were covered and reported on radios, TV and newspapers. Through the media, listeners interacted more with journalists and had opportunities to discuss issues on QPM. Journalists even took QPM samples for themselves to eat and determine whether it had any nutritional advantage. They realized that indeed QPM was nutritionally superior to ordinary maize and many other foods. They then began advertising QPM and talking about it more vigorously because they had undisputable evidence. As members of the IPTA, radio/TV programmes on QPM were subsidized. Because of radio, information on QPM went even beyond the project geographical boundaries and resulted in increased demand for QPM seed.

Involvement of University and College students in IPTA activities: Universities and college students were mobilized to participate in the QPM IPTA activities. It was envisaged that their large numbers could help create more awareness and scaling-out of QPM activities. The Institut Supérieur d'Etudes Agronomiques (I.S.E.A.) Mukongo College Students carried out QPM agronomic and feeding trials, and disseminated their results to farmers and small-scale poultry keepers through sharing experiences events and informal ways. The University of Mbujimayi has a PhD student working on QPM. Involving university and college students facilitated the spread of QPM information through scientific discourse and created more awareness and thus contributed to further promotion of QPM technologies.

Collaborative efforts with other projects to further scale out and up: The IPTA realised that involvement of other funded projects could facilitate dissemination of QPM. The African Development Bank (AfDB) funded a project named "Réhabilitation du Secteur Agricole et Rural" (PRESAR) was brought on board to promote QPM by distributing seed to farmers even in areas where the IPTA was not yet launched. They even distributed QPM seed in neighbouring provinces like Kasai Occidental. They also produced a skit with messages aimed

at promoting QPM and gave it to radio broadcasters. These efforts created and increased awareness about QPM in the population. Another project, "Projet d'Appui à l'Amelioration de la Production Vegetale" (AMPV), a Belgian-funded project that deals with production of seed for improved maize varieties, also came on board. After learning about the benefits of QPM in Gandajika, they requested a QPM seed sample for multiplication. This seed was then passed on to another Belgian-funded project named "Appui au Secteur Semencier" (ASS) for distribution to farmers. This project has now decided to produce seed for sale to farmers. They realized that with massive adoption of QPM, they should not keep distributing free seed. Another project "Food Production, Processing and Marketing" (FPPM) with support from USAID requested and received 100 kg of QPM seed for multiplication to support grain production for people in Kinshasa, Bas-Congo and Bandundu provinces. This project has contributed to the promotion of QPM in the Western part of DRC.

Policy makers: Policy makers have great influence on people and can facilitate adoption of a technology through official speeches or by practising the technologies themselves. The QPM IPTA interacted with policy makers at provincial, district, sub-district and village-clusters levels and discussed the nutritional and health benefits of technology. They encouraged the communities to listen to QPM programmes on radios, TV, and read about it in newspapers. They were also advised to attend QPM promotion events. As a result, they became interested in QPM, were able to obtain seed and many of them went into production of the crop. They reported that their children became healthier on consuming QPM. Another policy maker in Kabinda district was informed on the QPM benefits. He then requested to launch an IPTA to help people in Kabinda town where there is acute malnutrition. As a result, and by involving policy makers, the Central Government is now promoting QPM by purchasing and distributing seed freely to farmers in Kasai Oriental and Kasai Occidental provinces, covering over 346,220 km2 and reaching more than 15,000 beneficiaries to date. The Central Government upon hearing about QPM, through the IPTA promotional activities, availed 500 ha of land to INERA for QPM seed production. An initiative from Statehouse Agricultural Department named "Initiative Kabila" got interested in the technology and is now producing QPM in Kinshasa hinterland. These efforts supported by policy makers have contributed to further promotion of QPM in many parts of the country beyond the initial target province of Kasai oriental.

Farmer involvement in variety selection contributed to fast and wide adoption: Many studies have shown that participatory variety selection (PVS) improves the adoption of varieties (Defoer, 1998; Joshi & Witcombe, 1996; Sperling, 1992). Farmers were involved in the QPM IPTA to ensure that varieties were adopted. Farmers were invited to select from among several QPM varieties those they preferred based on their own criteria. They were given an opportunity to give their views in the selection and were very proud to realize that their views could be taken seriously. They had never been consulted in previous research activities. In this study, varieties were released based on farmers' selection. From here, farmers started planting and using QPM, contributing to its fast spread. The interaction between farmers and other stakeholders during QPM promotion events and IPTA meetings resulted in the name "MUDISHI" for QPM meaning "nutritive maize".

Use different knowledge products to promote QPM: The IPTA found that different knowledge products were necessary for promoting QPM. These included T-shirts, leaflets, posters and caps. As a result of information on these materials, people kept requesting for more information and clarification about QPM. Many people such as Mr. Mastaki Baraka of "Centre National de Développement de la femme rurale au Congo" (CENADEFRUC) requested and received QPM seed for his organization. Mr Dikatuluakila Bukaka Joseph, a nutrition lecturer at Institut Supérieur des Techniques Médicales (ISTM) in Kinshasa, became interested in nutrition research on QPM. The use of knowledge products has been very successful in creating demand of QPM seed and products.
Promotional events: Apart from the participation by relevant actors in the platforms to share experiences and disseminate information and knowledge products, the IPTAs organized events to further promote QPM. Some of these included:

- *QPM exhibition:* QPM products were exhibited to show invitees various ways of utilizing and marketing QPM products.

- *Field days:* Participants were invited to QPM fields to see how the crop performed in comparison to normal maize. They would also see the various recipes from QPM.
- *Testimony sessions/experiences sharing on QPM nutritional benefits:* To create and increase awareness on QPM benefits, testimonies' sessions were organized. During these sessions, people who experienced any nutritional value from QPM were encouraged to share their experiences with the public. In these sessions, lactating mothers, malnourished children, elders and pregnant women shared their experiences with participants. These testimonies excited participants and many were ready to test the technology immediately.
- *IPTA meetings:* Although IPTA meetings are not promotional events, they were used to exchange information and experiences, these meetings were taken advantage of because IPTAs were made up of many and diverse stakeholders who joined at different times. Many of these needed more information on QPM and indeed benefited from experiences already built up within IPTAs.

Achievements

Stakeholders have seen the difference the IPTA approach of technology dissemination can make. Some of their sentiments were captured:

Box 5: An IPTA actor noted that: "If all INERA technologies could have been disseminated the way QPM is being promoted, a lot of technologies could have reached end-users and contributed to the improvement of their lives".

While a lady farmer said: "As you have involved us and recognized our value and potential contribution/role in the promotion process, your work will be successful".

As the information about QPM nutritional benefits spread through the media and other channels, requests were made to INERA to facilitate creation of platforms in other parts of the country. By the end of 2012, DRC had a total of 7 IPTAs. The launch of these IPTAs played a great role in QPM technology promotion. During these events, the importance of QPM in communities for both human and animal production would be presented. Some testimonies on the nutritional value of QPM experienced in other IPTAs were also shared during these launches and contributed a lot to the scaling-out of the technology.

The IPTA approach of technology dissemination has recorded tremendous success in DRC such that other research programmes (cassava, legumes) of INERA are considering using the approach to promote their crops.

QPM-based diet replaces imported milk for babies. Mothers with limited or no breast milk production previously relied on imported baby milk. This was not affordable and babies often never survived. Lactating mothers with limited or no breast milk production were fed on QPM-based porridge and ugali. Their breast milk production was assessed by themselves on a scale of 1-5. These mothers noted that QPM - based diets resulted in increased breast milk production to the extent that they did not need imported baby milk anymore. By relying on QPM, mothers saved an equivalent of US $40 and 80 per month respectively for when they had single or twin babies. The number of mothers relying entirely on QPM for breast milk production rose very fast. They called QPM *"maize-milk"*.

QPM diet replaces soya bean for malnourished children

Two groups of 15 malnourished children were fed with QPM only and with soya bean and normal maize mixture (1:3), respectively in Luputa. Each child received between 250 to 500 g of normal maize-soya bean mixture or QPM porridge daily. Their weights and "anthropometric data" were recorded weekly. Although the effects of the two treatments were found to be similar, nutrition centres decided to abandon soya bean in favour of QPM as it produced the same effects but at lower cost. It costs US $672 to rehabilitate a malnourished child using

normal maize-soya bean diet while a QPM-based diet costs US $403. In Gandajika, the same demonstration was conducted but with a third treatment made of normal maize only. I t was observed that children fed with QPM gained more weight compared to those under a diet of normal maize. Mothers whose children recovered after a diet of QPM called it "maize-meat". At the end of the demonstrations, nutrition centres decided to discontinue the use of normal maize and soya bean, resulting into a high demand for QPM.

Box 6: "Musau Mamy gave birth to quadruplets. When one of them was breastfed, the other three could not get enough milk from their mother and they fell into state of restlessness. When the mother was given QPM she produced enough breast milk for her quadruplets, three of whom survived and are healthy today".

Box 7: Complete recovery from severe malnourishment after QPM diet.

This child reached a hopeless stage of malnutrition (left). He could not walk despite being fed on Plumpy'nut paste diet. After a QPM diet, he was able to walk and run. He eventually could smile (right).

The IPTA approach, which enabled researchers to work with non-agricultural stakeholders such as from health and nutrition and with policy makers and the media, along with dissemination testimonies of utilization outcomes has really contributed to the dissemination and scaling out of QPM in DRC. The role that each actor played has contributed to this, which could not have been achieved if old approaches were applied. If the IPTA approach had not been applied, despite the QPM advantages, its promotion could have been limited like it was for the adoption of soya bean. Indeed, the adoption of soya bean in the same areas where QPM was introduced took too much time compared to QPM despite soya bean's nutritional advantages. However, some challenges occurred on the way and limited the scope of QPM adoption.

Challenges

Designing messages to reach out to parents with malnourished children: Some parents feel ashamed to be out in public with malnourished children. As a result, many children with acute malnutrition are not taken to nutrition centres. The IPTA therefore needs to redesign some of the messages to the public to convince parents that there is a cheap way of improving their children's health and that there nothing to be ashamed of.

Inability to get complete information on indirect beneficiaries: Unknown farmer-to-farmer technology sharing limits the ability to track the exact number of beneficiaries and stakeholders reached by the technology or

indirect beneficiaries. Farmers may produce QPM seed and sell it without informing IPTA so that the information can be collected; some farmers are selling QPM products and generating some income without informing IPTA on the quantity sold and number of beneficiaries disaggregated by gender; others are keeping poultry using QPM feed and generating income without informing the IPTA. Unless it is shared during experience-sharing events, this information is lost.

QPM plant/ear/grain/flour aspect: When QPM is in field, it cannot be differentiated from normal maize. After harvesting, it cannot be differentiated from normal maize ears and grains. QPM flour has the same aspect as normal maize. Because there is not much that can be used to distinguish it from normal maize, some unscrupulous people could try to pass normal maize as QPM, which might undermine its adoption. However, the IPTAs try to inform consumers which people have accessed QPM seed and are producing the grain.

Lessons learnt

The involvement of many and diverse actors result into fast technology uptake: This project involved a diverse group of actors who had not been involved in technology transfer before. For example, the project brought on board lecturers; students, doctors; policy makers; nutrition centres; hospitals; media, testimony sessions and the general public. This group is not simply a collection of stakeholders but the IPTA ensured that they were relevant and came in when their contribution would make sense. As a result, QPM technologies for improvement of health have been widely adopted.

The involvement of trusted professionals helps to get messages accepted: The IPTA brought doctors on board to promote QPM technologies. Doctors interact with patients (malnourished children, pregnant and lactating mothers), treat them and are generally trusted by the public. T he public has always looked to them to have their health issues solved. Therefore, their acceptance and prescription of QPM-based packages for malnourished children makes an impact on technology acceptance by the public and thereby enhances dissemination and adoption.

Policy makers influence action: One lesson learnt in this project is the role policy makers play in technology dissemination if they are convinced of the technology. By virtue of their roles, policy makers interact with diverse members of the public more often than other professionals. People listen to them and therefore their involvement in the value chain of any commodity adds value in its dissemination. In this IPTA, policy makers were involved several activities: they made speeches during promotion and sensitization campaigns; grew QPM in their own fields; supported seed distribution activities; provided land for production of QPM etc. All these increased peoples' belief that indeed the technology was safe and useful, thus contributing to its adoption.

The media is important for technology dissemination: The media is special in that it reaches out to many people at once. In this project, the media has been very instrumental in creating awareness of QPM and QPM based technologies. QPM promotional programmes aired on TV and radios and those written in newspapers have reached very many people including policy makers.

Outstanding issues and future directions

QPM varieties are sensitive to drought: The current varieties of QPM are not tolerant to drought. Efforts should therefore be made to develop more drought resistant/tolerant varieties. New drought tolerant varieties will easily be taken up since the technology itself is accepted.

QPM plants look the same as other maize: Failure by farmers and consumers to visually distinguish QPM from other maize is still a problem. Known and well- organized farmers in recognized sites should therefore produce QPM. This would help reduce the chances for consumers to be cheated by unscrupulous traders. The market should also be organized in such a way that reliable QPM products sale points are established and known by consumers.

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Sweet potato in Rwanda: for utilization, health and incomes under different IPTAs

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Introduction

Sweet potato (Ipomoea batatas) is one of the most important staple crops in densely populated parts of Rwanda (Ndirigwe, 2006). It fits well in farming systems characterised by limited land, labour and capital; hence suitable for small-scale farmers as those found in Rwanda. One of its greatest values is its amenability to piecemeal harvesting, thus it can be stored in soil for some time. Farmers in Rwanda grow a wide range of sweet potato varieties usually in mixtures of between 2 to 6 to satisfy their eating preferences but also to reduce risks associated with pests and diseases, weather uncertainties and poor adaptability.

Orange-fleshed sweet potato (OFSP) varieties were recently, introduced in the country to combat Vitamin A deficiency (VAD). In developing countries, vitamin A deficiency is considered as the single most important factor in childhood vision impairment, blindness, and in high risk cases it can lead to severe illness and death from its deficiency link to common diseases like measles and diarrhoea (WHO). It is estimated that 39% of the children under five years suffer from VAD. It is estimated that 23% of childhood mortality, due to vitamin A deficiency, can be reduced through supplements and fortification. Although supplements and fortification are effective for immediate control of the deficiency, sustainability is a concern (WHO). Most poor families in Africa lack the financial means to buy supplements or fortified foods and therefore an integrated approach that includes diets rich in vitamin A is more sustainable. Sweet potato has been described to have immense potential in human nutrition, food security, and poverty alleviation in developing countries (Hagenimana et al., 1999)

Since 2005, MINISANTE (Ministry of Health) has put OFSP in its strategic plan to combat malnutrition, and vitamin A deficiency targeting children, pregnant women and people living with HIV/AIDS. OFSP are a rich source of beta-carotene, the precursor of vitamin A. Raw OFSP may contain between 10.8 and 40 mg/ 100 g, dry weight basis, of β-carotene (Kidmose, U., Christensen, L.P., Agili, S.M. and Thilsted, S.H., 2007; Bengtsson, A., Namutebi, A., Alminger, M. L. and Svanberg, U., 2008; Bechoff, A., Dhuique-Mayer, C., Marouzé, C., Reynes, M. and Westby, A., 2009). The white-fleshed varieties predominant in Rwanda contain negligible amounts of beta-carotene.

OFSP varieties are believed to represent the least expensive, year-round source of dietary vitamin A available to the poor families in the region (Kimura et al., 2007). Those varieties have a comparative advantage over other common staple foods especially cereals and legumes which provide zero to minor traces of beta-carotene. Children below 5 years, 7-10 years and adults need to eat about 30g, 40g and 80g of the vitamin A rich sweet potato respectively, to meet the daily requirements (Failla et al., 2009 and Bovell-Benjamin 2007). The World Health Organization (WHO) indicates that several nutritional disorders can be easily alleviated by consuming the vitamin A rich sweet potato (WHO, 2009). Recent estimates based on geo-referenced data show the magnitude of the potential impact of replacing white-fleshed varieties with high dry matter orange-fleshed cultivars in six East and Central African countries (Low, Walker and Hijmans, 2001). It was shown that in Tanzania, about half of the population at risk attains the full-impact outcome. In Kenya 72.6% receives partial benefit while in countries like Rwanda, Uganda and Burundi more than 80% of the population at risk receives full benefit. In Ethiopia, the mean intake increases by only a modest 2% of recommended daily allowance (RDA). Full impact is equivalent to an increase in provitamin A intake to 40% of RDA.

DONATA was a project that was initiated in Rwanda, Uganda, Kenya, DRC and Tanzania aimed at scaling-up the consumption of OFSP varieties to maintain sweet potato status as a food security crop, and also to stimulate its transition into a market-oriented commodity for rural income generation. A secondary goal was to alleviate vitamin A deficiency among children, pregnant and lactating mothers and people living with HIV/AIDS. This paper gives an insight into project performance in Rwanda with regard to utilization of OFSP for health, nutrition and income.

In addition the DONATA project has been assisting OFSP farmers to improve sweet potato production to enable processors get raw materials consistently. Farmers and processors were trained on post-harvest handling and processing of sweet potato roots to increase and add value to OFSP as well as boosting the availability of OFSP products on the markets all over the country.

DONATA employed an Innovation Platforms for Technology Adoption (IPTA) approach for scaling out OFSP based technologies. The project aimed at availing improved OFSP varieties and distributing high quality planting materials to provide the foundation for achieving the broader goal.

What was done

Formation of IPTAs: A country-wide sweet potato stakeholders' meeting was organized at the onset of the project to identify and define the roles and responsibility of each partner in different zones. Four IPTAs were established in the country following the selection of the most suitable provinces to enhance uptake and adoption of OFSP technologies using innovative findings. IPTA-East was lead by World Vision, IPTA-North by Urwibutso Enterprise, IPTA-South by UDI (Union pour le developpement integré) and the Western IPTA by Caritas. All actors in different IPTAs were involved either in seeds system or processing and marketing.

Selecting OFSP for promotion: Sweet potato varieties with good agronomic and organoleptic traits for high acceptability named Ejumula, Cacearpedo and Gihingumukungu (97-062) were selected based on β-carotene content and consumer preference (e.g. dry matter content and skin and flesh colour) for promotion.

Establishing a community-based sustainable seed multiplication and distribution: The sweet potato research programme of the Rwanda Agricultural Board (RAB) provided high quality orange-fleshed sweet potato of clean selected OFSP varieties. These were rapidly multiplied using tissue culture in collaboration with Kenya Plant Health Institute (KEPHIS) to ensure adequate quantities of clean planting material for secondary multiplication sites in collaboration with Catholic Relief Service (CRS) and Urwibusto. Clean planting material was then distributed to secondary vine multipliers (farmers) at the village level through CRS, World Vision, Africare and UDI. The Rwanda Agriculture Board (RAB) was also tasked to train subsequent vine multipliers at SMS and TMS in rapid multiplication techniques and in integrated pests and disease management to ensure quality planting material production across IPTAs.

Nutrition education: Orange-fleshed intervention was initiated through key partners along IPTAs working in nutrition education to reduce Vitamin A deficiency in Rwanda Communities. This merged with Rwanda's policy which is "increasing investment in health and nutrition" through scaling-up. Emphasis was given to preventing malnutrition in young children and women, particularly pregnant women and children. The IPTA approach was used to reach more households to enhance OFSP sweet potato uptake. The intervention identified vulnerable groups and communities growing sweet potato for fresh roots consumption.

Post-harvest processing for market and for home consumption: It is well established that technologically, some wheat flour can be replaced with non-wheat flour in bakery products without necessarily sacrificing bread qualities such as loaf volume, crumb structure and organoleptic characteristics. Such substitution with locally produced flours results in substantially lowering the cost of the product. It was hoped it would lower the cost of baking flour, which would be sufficient basis for the bakers to lower the cost of products. It also results in

some saving of the foreign exchange for the country. The Rwanda Agriculture Board (RAB) has then developed wheat-sweet potato composite baked goods (oven breads, cakes, biscuits and fried doughnuts) with acceptable organoleptic characteristics.

Recipes were developed in which OFSP in the form of either flour or mashed sweet potato replaced between 20 and 40% of wheat flour. The secondary processing of OFSP involves the production of products such as bread, cakes, biscuits and doughnuts. The substitution of mashed OFSP for wheat flour in bakery products resulted in a product with sufficient B-carotene to be considered a good source of vitamin A and was economically viable. Profits were found to rise from 54 to 92 % for bakers, primarily due to the lower cost of OFSP compared to imported wheat flour. One advantage of using OFSP is that it is produced locally, whereas wheat flour is often imported and transported long distances. Due to the high labour and cost of flour production, boiled and mashed sweet potato were used instead of flour.

IPTA members across provinces were trained in many OFSP processing products to add value to sweet potato and increase its viability. Individual famers, famers' groups and cooperatives received different modules in OFSP processing and promotion developed for scaling up and out of the products. RAB Post-harvest unit taught IPTA members in the production of OFSP flour by converting OFSP roots into smaller sized products through slicing or chipping, drying and milling.

Promotion through social marketing: Transferring OFSP technologies, knowledge and skills to farmers (end-users) or partners across IPTAs was a fundamental activity. Individual members and cooperatives used various channels to promote OFSP products including radios and agricultural shows, which took place in Kigali and many districts. These agri-shows were helpful, since it was an opportunity to promote OFSP technologies. Women played a key role in the promotion, consumption, and marketing.

Achievements

Seeds system improvement through IPTAs: An efficient and sustainable seed system for multiplication and distribution of clean planting material for different partners was set up. A farmer-based approach was used to develop an effective, rapid and sustainable chain for multiplication and to disseminate clean basic sweet potato planting material from in vitro laboratories to subsequent multiplication sites. OFSP cuttings have been widely distributed. Through tissue culture, OFSP varieties of Cacearpedo, 97-062 (Gihingumukungu) and Ejumula were cleaned in collaboration with Kephis-Nairobi and multiplied at Rubona in vitro laboratory at the rate of 3000 to 5000 cuttings per month. The in vitro plantlets were hardened and rapidly multiplied at primary multiplication sites (Rubona and Karama research stations) on 0.8 to 1 ha per season. Rapid technical multiplication was applied at stations and subsequent Secondary Multiplication Sites (SMS) at partners' levels across all IPTAs at Kamonyi (UDI), Bicumbi (DUHANGE Cooperative), Nyamagabe (Africare), Nyamata (World vision), Karongi (CRS) and Caritas (Rusizi) who received appropriate training. In total, an average of 89 ha were used for multiplication which produced 42,151,200 cuttings and were disseminated at TMS. CRS, World Vision and Africare organized cooperatives and farmers' groups through which these planting materials were distributed and grown.

Some cooperatives are selling cuttings. For instance, UDI cooperative sold vines for 5,000,000 Frw (equivalent to US $7,936.50) to Muhanga and Huye districts. Farmers reported that they preferred growing OFSP varieties because they mature earlier compared to sweet potato white fleshed varieties and than traditional crops like cassava.

The baseline and end project surveys showed that since the implementation of the project, acreage and consumption levels of OFSP have increased. It is estimated that OFSP varieties occupy 5-8% of farmers' arable land compared to less than 1 % before. Most farmers in IPTAs are primary consumers whose acceptability of new OFSP varieties is determined by taste, texture and level of dry matter content.

Figure 40: In vitro multiplication at PMS in Rubona Figure 41: Field multiplication at PMS in Karama

OFSP social promotion and marketing: All cooperative members across the IPTAs were producing roots for home consumption and selling. Other farmers' groups and cooperatives were well organized through the regular supply of fresh roots to local markets, boarding schools, and private sector (Sina Enterprise and Duhange cooperative). For instance UDI harvested 4,450kg of OFSP, which were sold at ICETAR secondary school at 130Frw/kg. Cooperatives in Abisunzimana, Tujyinama and Icyizere have also harvested their fields and one part of the produce was sold to the local market and different secondary schools while the other part was consumed by cooperatives.

Figure 42: Jean Marie Vianney (JM)V, farmer whose cooperative has transformed a village with one of the farmers

Farmers learnt several OFSP based food recipes from fellow farmers: The IPTA facilitated farmers' visits to other IPTAs to share experiences and learn. Visits were organized within villages, between villages in the same district, between districts, or between IPTAs. From these local and foreign training sessions and visits, farmers

learnt new food recipes from fellow farmers. Farmers often adopt practices from farmers working under similar conditions. Members of the Kotemu farmer group in the North IPTA are processing OFSP into doughnuts for local markets and supply other fresh roots to the SINA factory. This North IPTA has a renewable contract with the factory for fresh supply of roots. In East IPTA, farmers' groups working with World Vision have integrated OFSP in kitchen gardens with various approaches or innovations such as double-dug beds for vine multiplication and conservation.

Figure 43: Farmers processing OFSP in North IPTA

Farmers' incomes have grown through OFSP sales: Incomes from OFSP have steadily grown through sales of orange-fleshed roots and vines. A farmer, Mr. Habamuremyi Jean Marie got an income of 5,600,000 Frw (about US $9500) in only one year through selling OFSP vines. Many other farmers were able to send children to schools, to pay for health insurance and to buy land and other household items through selling OFSP roots and vines. Duhange cooperative are also underway to assist other groups in promoting production, utilization and commercialization of orange-fleshed sweet potatoes and to help farmers to access seeds and to implement a programme of roots' supply to the factory with the objective to empower farmers' groups to grow orange-fleshed sweet potatoes as a commercial crop and to link them to potential markets. The new OFSP varieties have become very popular with processors. New OFSP processors are attracted to OFSP because of the production potential of the improved varieties (Gihingumukungu) and because of their early maturity, which helps farmers produce up to double the crop through crop rotation.

A network of partners has been built: A network of agencies with interest in the OFSP value chain has been created through the linkages created within the platforms. World Vision, CRS and AFRICARE are the lead partners in the project. Also involved are the Centre for Treatment and Research on Aids, Malaria, Tuberculosis and other epidemics (TRAC-MINISANTE) and stakeholders in nutrition and agriculture. These have agreed to work together to extend the impact of orange-fleshed sweet potato in different districts of Rwanda.

The IPTAs cooperatives used various channels to promote OFSP products including radio and agricultural shows which took place in Kigali and many districts. These agri-shows were helpful, since it was an opportunity to promote OFSP products, such as cake, bread and biscuits. The successful uptake of the OFSP technologies were due to effective mechanisms for dissemination of IPTAs' activities via strong NGO's; accessible promotional materials in local languages (brochures); national agricultural shows: field days: weekly markets as point of

promotion (because these places are always crowded); interactive participation on rural radio programmes at provincial level and two national radio programmes in connection with other nutritional agencies. The IPTAs across the zones constituted a major opportunity for all to share experiences and learn new skills at home an abroad. The IPTA networking stimulates innovation ideas, for example, the case of double-dug bed innovation to produce and maintain clean planting material.

OFSP based supplement for people living with HIV produced: In Rwanda, the nutritional value of the orange-fleshed sweet potato has attracted non-governmental organizations (World Vision, AFRICARE and CRS) working in nutritional and health mandates with mainly vulnerable groups. People living with HIV/AIDS and poor households are encouraged to grow and consume OFSP roots for more Vitamin A intake and process products for more income. One of the notable achievements of this project was the production of an OFSP based nutritious porridge by World Vision and Africare. This porridge is used as a supplementary food for people living with HIV to improve their immune systems. In total, an estimated 2,350 direct households[10] (with 1676 women) and 12,084 indirect households have benefited. Testimonies shared by those who have experienced the nutritional benefits of OFSP enhanced the dissemination and outcomes of the technologies.

Box 8: NYIRAHABIYAMBERE Patricie said: "Orange sweet potato is a crop which is not known by many. Only those who have a chance to know it can testify how much it is very nutritious." She added: "I can now eat all parts of Orange sweet potato (roots and leaves). Both roots and leaves are rich in vitamin A. I often prepare leaves with other vegetables like amaranths, spinach and beetroot leaves and they constitute a delicious meal for completing our daily diets in my family. Roots can be eaten cooked in their skin, fried or processed into doughnuts. I consider it as crop very important in terms of content in vitamin A and generation of revenue. When I started to use orange sweet potato in my family, I had 587 CD43[11] but during six passed months, I had reached 894 meaning that I gained 307 CD4 during six months. I had a weight at the beginning of 48 kgs and after six months I have 56 kgs that is why I sensitize everyone hearing this testimony to grow orange sweet potato and consume it in all its parts for having a good life. I now know how to cook the leaves into a delicious and nutritive meal while before learning their importance, they didn't interest me. In the dry season when the other vegetables are not available, I don't feel any problem because I can use the sweet potato leaves". She said that "Grow it, your life will be advantageously built! Long Live DONATA, RAB and Africare".

Conclusion and lessons learnt

IPTA's approach has responded most effectively to the needs of the OFSP community in Rwanda. Sweet potato visibility in Rwanda has been increased through the IPTAs and policymakers have started to give more importance to sweet potato by providing more land for the crop. Sweet potato has been incorporated in some districts among the crops of intensification programmes and included in local performance contracts by local authorities. The IPTAs have equipped farmers with post-harvest knowledge, innovations and technologies which have the potential to increase household incomes by reducing OFSP losses and improving market access along the value chain and across IPTAs. IPTAs have increased nutritional awareness among vulnerable farmers. This has brought on board many agencies such as CICA in promotion through production of leaflets and free local radios talks to local people through IMIRIRE MYIZA (better nutrition) spots. Many lessons have been drawn through IPTA's approach. It has been demonstrated that the IPTA model facilitates scaling out and up, building and/or strengthening partnerships within partners or between partners and the private sector such as the case of Affricate and World Vision in nutrition involvement (Nyamagabe Case). The IPTAs have facilitated development of a much stronger collaboration between famers, researchers and NGOs.

[10] Estimated number where one famer shares with 4 neighbours; females normally share more technologies than males e.g. cuttings have been dispersed through OFSP promotion across the 4 IPTAs

[11] 3CD4 is a measure of immune function. By measuring someone's CD4 levels you can see how HIV has affected their immune system, showing the progression of the virus. A high CD4 count is good

Future direction

OFSP producers will need to produce higher quality products, and deliver them on time and in sufficient quantity and in staggered manner. District officials are considering adopting the IPTA model used in this project for implementing similar projects in future. In addition, lessons learned from this project will possibly have on-going effects and be used to support other farmers' groups and cooperatives seeking to expand production and commercialization of orange-fleshed sweet potato varieties and its products.

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PART III

Analytical Synthesis

Analytical synthesis, lessons learned and guiding principles

Part III is organized in 3 sections. The first presents the synthesis of the countries' papers. This is followed by a description of institutional and technical support that contributed to the functioning and performance of the Innovation Platforms for Technology Adoption (IPTAs). In the last section, key emerging principles are presented as preliminary guidelines for use in application of the IPTA approach to promote and scale out improved technologies.

Synthesis and lessons learned

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In this section we reassess what the IPTA approach, and how it was implemented, contributed to the observed outcomes. The aim is to provide a synthesis of how the approach enhanced dissemination and utilization of the technologies and contribution to the impact on production, household food and nutrition and incomes; the key lessons learned and use these to generate emerging guiding principles on application of this approach in scaling out improved technologies. The synthesis is a reflection on the value added approach to dissemination and scaling out the technologies, learning and innovation.

However, as stated in the introduction and the methodology chapters, the emerging lessons, guiding principles and the experiences from which they are drawn are not based on an experiment designed to compare efficacy and cost effectiveness of the IPTA approach with the conventional linear ARD model. Instead, DONATA was implemented in a broader context of the PSTAD programme where focus was not to research the approach, but rather it was to apply innovative approaches that could enhance dissemination and adoption of new technologies able to contribute to productivity and welfare of end users, especially smallholder farmers. In this regard, the synthesis of the countries' case studies serves to pull out key lessons on the establishment and operation of innovation platforms. The synthesis also serves to demonstrate how the IPTA approach was found able to address key challenges to technology adoption that had been identified by the stakeholders, such as limited access to quality seed; inadequate information and knowledge; limited market access and poor marketing arrangements how to promote value addition technologies to produce various products for home use and for enterprise development. Therefore, the assessment looks at whether the IPTA approach including the composition of platform members, the roles they played and the stakeholder interactions that emerged were effective in terms of facilitating innovation, addressing these challenges and improving adoption and impact on production, nutrition and incomes. The synthesis is organized along the four thematic areas under which the countries' papers were presented.

Seed systems

The introduction to Part II thematic area on seed systems noted a number of challenges for seed systems, which the IPTAs sought to address. This section synthesizes highlights from these experiences on how the

IPTA approach helped address the challenges and draws out some of the lessons, which can further be used to provide guiding principles on how an innovation platform approach can add value to efforts to strengthen seed systems for both orange-fleshed sweet potato (OFSP) and Quality Protein Maize (QPM).

Availability of seed of the improved varieties

Limited availability of QPM seed was noted as key constraint to adoption and up scaling efforts. The IPTAs on QPM seed systems in Tanzania and Uganda addressed these issues by bringing the different actors in the seed value chain together, training and organizing farmer groups to produce certified seed in Tanzania in partnership with participating Seed Companies and quality declared seed (QDS) using Open-pollinated QPM varieties in Uganda. With seed companies and organized farmers' groups being members of the platforms, it was possible in some countries, for example Tanzania, to link and broker contracts between them where the farmers produced the seed, which was bought and sold to other farmers by the companies through their distribution channels. IPTAs also provided the opportunity for farmers and other actors along the value chain to test and select new QPM varieties for local adaptability, utilization and market demand. For example, farmers in Uganda were able to switch from "Longe 5" to "Longe 5D" which was more adapted to drought prone environments.

Similarly for OFSP, earlier efforts at promotion of these varieties had faced challenges because those that were available had low dry matter content, and were also more susceptible to sweet potato virus disease (SPVD) in some agro-ecologies. The link to the backstopping institution, the International Potato Centre (CIP) achieved with the IPTA approach provided the channel through which improved OFSP varieties with higher dry matter and less susceptible to SPVD that were released in a few ECA countries could be introduced for evaluation and release in other countries. In addition, the innovation platforms provided avenues for wider varietal testing and evaluation involving diverse actors along the value chain, and for feedback on the research of other trait preferences. The linkage to the ASARECA work on harmonization of seed policies and regulations made possible for an accelerated national release process for the varieties.

Seed multiplication innovations

Through the IPTA, various seed multiplication and distribution innovations were tested and promoted and in the processes, increased production and availability of quality seed primarily in the target districts. The inclusion of organized farmers' groups, seed companies and seed certification agencies in the IPTA membership where each had well-defined roles, and the facilitated interactions and linkages, contributed to increased capacity of farmers to produce and sell QPM quality seed (either certified or quality declared seed (QDS)). This, in turn, made seed production by smallholders a viable business as noted in Tanzania and, to some limited extent, in Uganda. In some countries the involvement of seed companies, who had wider distribution networks and the brokering of partnering arrangements between them and organized farmer groups, enhanced the production and spread of improved seed both with target districts and beyond. For example, for QPM in Tanzania, we see Aminta and Tanseed international seed companies in Muheza IPTA forming contractual arrangements with farmers' group seed multipliers in Tanga region whom they train to produce certified seed. The promotional activities of the platforms increased farmers' awareness, which contributed to the sale of QPM certified seed by the companies who were able to reach farmers in distant districts such as Kilosa, Kilindi in Morogoro region. In Uganda, we see farmers' groups that were members of the QPM seed IPTA testing different crop production and management practices, including spacing regimes to determine which gave higher yields according to soil type.

In the platforms involved with OFSP, the Rapid Multiplication Technology (RMT)[12] was adapted to the conditions in each country. The countries' papers show that as an innovation, RMT was most appropriate at Primary Multiplication Site (PMS) or Secondary Multiplication Site (SMS) levels. The IPTA provided a framework in

[12] The RMT is a method used to speed up the multiplication of vines either at secondary multiplication sites (SMS) or primary multiplication (PMS) level. Vines are cut into very small pieces (25-30 cm with 3 nodes) and planted very close (20 cm by 10 cm). Small cuttings are harvested every 6-8 weeks and planted in other plots to multiply the material further.

which multiple dissemination partners were trained in the application of this technique, which in turn enabled a faster and wider spread of planting materials than would have been the case in the use of a single partner. To address the challenge of the long dry season that hampers sustained availability of OFSP vines over extended dry periods, system innovations which linked vine multipliers to other institutions where they could source loans for irrigation equipment were promoted. Due to improved communication and information flow within IPTAs, the coordination and timing of vine multiplication across the different tiers of the seed system (primary, secondary to tertiary level) was greatly improved.

Quality assurance of seed

Different ways for quality assurance were tried and promoted within the IPTAs. All IPTAs emphasized training of farmers in good seed production practices, and the identification and management of seed borne pests and diseases and the cleaning and grading of seed. IPTA members with the necessary skills took up the training roles.

For OFSP, the case studies have shown the training of farmers in their organized groups to use negative selection of symptom-free planting material and rouging out of off-types helped to maintain the quality of the planting materials. New technologies such as low-cost net tunnels which can protect mother plants[13] from virus infection have been piloted in Kenya and Tanzania and through the experience and knowledge-sharing feature promoted through this approach, lessons learned were scaled out across platforms and could further be used to scale the technology to other countries. Also, depending on country contexts, researchers from the national agricultural research institutes (NARI), seed companies and the relevant government agencies responsible for seed inspection and certification who were all partners in the platforms, provided various kinds of support towards seed quality assurance, either on behalf of the IPTA or at the request of an buyer who was not a member of the IPTA. For example, in the case study of QPM seed systems from Tanzania, we observe seed companies provide training to organized farmers' groups in the production of quality seed and supervise the cleaning and grading of seed by farmers. For the QPM seed IPTA in Lira Uganda, it is noted that each stakeholder along the value chain was involved in monitoring farmers' seed production. Moreover, the IPTA cultivated trust among its members, such that platforms that were supplying seed or planting materials did so based on trust and the IPTA's own reputation. In at least one case, in the early stage of the OFSP project, a member of an IPTA distributed poor quality planting material for his own individual gain. This destroyed trust among the members and jeopardized future contracts for material. When shared within and across platforms, this discouraged others from the malpractice.

By using the IPTA approach, members have been able to organize cost-effective training of trainers (ToTs) and training of farmers in pest and disease identification and management in the multiplication of seed and planting material according to recommended practices. The IPTA approach meant that different expertise could be brought in more easily and with economies of scale in ToTs, and also through the sharing of resource materials. Government and NGO extension workers visited sites to provide technical support and learn as well. In Kenya and Tanzania, researchers regularly conducted inspection visits at the OFSP secondary multiplication sites. The multi-stakeholder interactions and information exchange, other programmes and ARD players with interest in scaling out OFSP who sought to buy vines in large quantities offered to cost-share or subsidize the costs of the visits by the Kenya Plant Health Inspectorate Service (KEPHIS) to inspect the multiplication sites. In Kenya, Ethiopia, Tanzania and Uganda, the formal standards and regulations for inspection of sweet potato and other vegetatively propagated planting materials are now underway in collaboration with the various stakeholders.
In some platforms, for example the seed IPTA for QPM in Tanzania, the member devised and institutionalized some by-laws and used them to monitor and police the seed multipliers to ensure they adhere to the formal

13 Mother plants refer to the starter planting material that is used in PMS level or SMS level for further multiplication. This material is often tissue culture derived and usually disease free.

procedures and requirements set for production of certified maize seed. One of the procedures was on-farm destruction of the seed crop if the producer had contravened the rules (e.g. producing a different variety other than agreed). Without this system of self-regulation, policing and sanctions, the Tanzania Official Seed Certification Institute (TOSCI) would have been unable to manage by itself to effect this. Therefore, the IPTA provided the mechanism, even at local level, for the farmer seed-producers to self-police and sanction to ensure recommended seed production practices were upheld.

In addition, we note also that in the same platform, farmers cleaned and graded their seed under supervision of the staff from the seed companies and IPTA leaders. In this example, the IPTA approach facilitated and built a mutually beneficial relationship between the regulators, farmers and seed companies, which is reinforced by a contractual agreement. The companies deliver the foundation seed to farmers, purchase the quality certified seed after multiplication, and then distribute it to agro-dealers. The IPTA farmers were also able to understand the value of producing quality seed, which was bought by seed companies. In this example, through its promotional activities, the IPTA created seed demand and served to broker the link between the farmer seed producers and the input and output markets provided by the companies. The companies have benefited by being able to access organized and trained farmer groups for contracting to produce seed. However, the case study points out that the system was not perfect as there were cases of contract violation as farmers sold some of their seed as grain as they needed cash before the company could collect the seed. Moreover, the company would only make partial payment until the seed had passed laboratory quality tests. In some cases, the company made advance payments. In the seed IPTA for QPM in Uganda, which did not have in-built sanctions in their governance structures, each stakeholder along the value chain was tasked to monitor farmers' seed production and to participate in bulk marketing. In both Tanzania and Uganda farmers have found it difficult to adhere to isolation distances and good storage practices for QPM seed. One way round this issue was to saturate the villages within the IPTA area with the same variety to minimize contamination. Some farmers have reinvested proceeds from sale of QPM seed into maize cribs to improve storage.

Alternative pathways for seed dissemination and farmer access

Different approaches for seed distribution were used across IPTAs and the two commodities. For QPM, a formal seed system is the dominant distribution method especially for the hybrid varieties and marketing system. However, for OFSP, an informal seed system through the use of farmers' groups as tertiary multipliers provided a decentralized access to seed, with different payment modalities, including free access for group members, pass-on-the-vine, and direct selling. Evidence exists that previously vines were "not valued" and now farmers are willing to pay for them. The advantage of the IPTA approach was that the modality of distribution (e.g. price, or seed loan system) could be agreed across a number or organizations, thus avoiding conflicting approaches. Use of schools as channels for distributing OFSP planting material was common in most countries, suggesting secondary diffusion of improved technologies to farmers by school-going children. However, one novel institutional arrangement identified in some of the OFSP platforms was vertical coordination across different segments of the value chain. For example, in Kenya, a processor producing OFSP flour contracted farmers to produce roots, but on realizing that planting material was still a limiting factor also contracted farmers to multiply vines and then linked them to the root producers.

Balancing seed supply with seed demand

The seed supply and demand and how this was addressed varied in the IPTAs for the two crops. All IPTAs have used a range of promotional activities to stimulate demand (e.g. on-farm demonstrations, field days and exhibitions, meetings in the chief's "baraza", World Food Day activities and agricultural shows). It might be argued that these are typical 'extension' activities and therefore lead to questioning whether the IPTA made any difference.

The nutritional qualities of the crops provided the catalyst to bring in non-conventional actors to the IPTA e.g. schools and health facilities, which led to wider coverage due to the multiple stakeholders involved. There was also the confidence to try out different demand-creation approaches – e.g. the use of murals, painting bus shelters orange and advertising the availability of vines at nearby multiplication plots. Again, radio programmes are a common channel for extension messages. However, the difference which the IPTAs made was to be able to provide different types of expertise (agronomic, processing, utilization) for the content of the programmes, and to link the listeners directly to multiplication sites. In Kenya, the programmes were also recorded as cassette tapes which could be distributed to farmers' groups as oral resource materials for their meetings. In Uganda[14] the radio show presenter, who was an active IPTA member, brought a different perspective and specific type of expertise to IPTA promotional activities. The balance and sequencing of production, utilization, marketing and promotion activities remains a key challenge for OFSP. Without being able to demonstrate the product (root or vines), it is difficult to promote and this has to be matched with the corresponding amount of seed or planting material to meet demand that would have been created. As more farmers joined the QPM IPTA, they started to produce grain for household consumption and sale. This then catalysed a change in the mandate for a platform that was focusing on seed or grain production to include the QPM grain utilization and gave rise to the development of other livestock enterprises including poultry and piggery. By the IPTA members working together, they were able to reach more potential consumers with consistent messages. This is noted especially for QPM in Tanzania. In Uganda, where the QPM seed IPTA was able to produce sufficient seed for bulk marketing, seed companies were not willing to invest in transport to fetch the produce, and the IPTA ended up selling the seed as grain.

Institutional innovations to ensure timely availability and adequate quantities of quality vines

We can identify examples where the IPTA approach enabled seed system stakeholders to come together to develop collective strategies to address seed system constraints for OFSP. The three tiered sweet potato seed system was adapted, though in different ways across the IPTAs. Firstly, there were different organizational and management arrangements for the secondary multiplication. The Kenya Bungoma IPTA and Tanzania IPTAs used farmer groups; the Kenya Busia IPTA rented land for multiplication plots which were then managed by the NGO members in the IPTA; and, in Ethiopia, the secondary multiplication sites were researcher managed. Secondly, at the tertiary level of multiplication which was carried out by farmers' groups or individual farmers, most used a spacing regime which allowed for both root and vine production. This diversified the risk in an uncertain market for vines and provided two sources of income. In Ethiopia where commercial vine multipliers already existed, these supplied vines by tender or contract to FAO and international NGOs involved in disaster recovery activities.

System level changes for seed systems?

Interesting changes emerged in the OFSP seed system across the countries. In western Kenya and parts of Tanzania sweet potato vine multiplication was not considered a viable enterprise in the past – it was taboo in some communities to sell vines – but now the sale of planting material has become a reality with farmers' groups, NGOs and institutions being the main customers. The use of the linked up three-tiered system has meant that farmers know what varieties are available and where to get them. As we read from the Kenya OFSP case study, there are now networks of seed multipliers at the secondary multiplication level who are linked to both the primary multiplication sites and root producers who purchase the vines. The diversity of actors in the IPTAs, means that the different players get information about what is going on in the seed system, sources of planting material and where the demand for roots is. Because the research system is part of this network, farmers are able to get new varieties more quickly than previously.

There are indications that the changes noted in the seed system have in turn impacted on production practices. For example, previously in western Kenya, sweet potato root production did not take place in the long rains

14 See paper by Manasseh et al .in Part2 Theme 4-Nutrition and Health

(April – June) due to the shortage of planting material after the dry period, which fell between January and April. However specialized vine multipliers now use wetlands, banana plantations or irrigation during January and February thus increasing the availability of planting material at the beginning of the long rains in March – April. This has enabled farmers to use this season for sweet potato root production. This is turn has increased the volume of fresh roots for home consumption, sale in local markets and as raw material for processed products.

Challenges and Lessons

Technical

1. The diversity of actors in the IPTA ensures that the preferences of different end-users are brought to the attention of researchers. Research and dissemination should aim to broaden the portfolio of QPM and OFSP varieties in order to meet the needs and preferences of diverse end users in the respective value chains
2. For crops, seed productivity and survival is affected by unreliable rainfall. Where feasible, IPTAs should seek ways to ensure greater access to water sources, for example, some were able to negotiate with local government authorities to offer farmers rights to use the rivers to irrigate, while in other cases IPTAs were able to lobby for access to loans for small scale irrigation equipment. To the extent that the IPTAs were able to bring on board and negotiate favourably with local government decision makers for access to land near water sources, or lobby for loans, demonstrates the potential advantages of the innovation systems, but also the need to have stakeholders with facilitation and brokering skills.
3. *OFSP varieties are more susceptible to disease.* Cleaning up can take a long time, is expensive and may not be successful, therefore several routes can be tried at the same time i.e. negative selection for healthy material, linking with regional bodies responsible for clean up and germ-plasm management. The CGIAR centres played this role in DONATA and it is possible to continue through networks such as the sweet potato for Profit and Health Initiative (SPHI), sweet potato support breeding and germ-plasm management platform for ECA.
4. *There is no formal seed system for sweet potato.* However, the IPTAs have been able to harness synergies among different members to organize and coordinate a three-tiered system to enable decentralized access to new varieties by farmers. In Kenya and Tanzania in particular, this involved training and organizing farmer groups to produce clean seed throughout the year and by siting nurseries in the wetland areas where irrigation is possible. This approach also leverages farmer-to-farmer dissemination of seed to neighbouring farmers. The communication which takes place across the different tiers also provides a good feedback mechanism.
5. Access to adequate quantities and quality of early generation seed or planting material is crucial to ensuring the availability of quality seed or vines to farmers. Insufficient breeder and foundation seed for all the QPM varieties (it is a function of NARI or seed companies to produce this category of seed for the varieties they breed) affected the quality and quantity of seed produced. In many areas where the IPTAs were operating, seed companies had distant distribution networks for farmers to access seed.
6. A fragmented seed market and unpredictable demand was a challenge that the IPTA could not adequately address. This, in most cases, resulted in the private seed companies being unable to predict the market situation well ahead to facilitate production planning. The widely dispersed smallholders and their fragmented small purchases of seed was a challenge for most seed companies. The effects of these challenges were felt within the platforms where there were contractual arrangements between farmer seed producers and seed companies.
7. The lack of an easily recognizable physical characteristic or feature for QPM (such as the colour in the case of OFSP), made it difficult for buyers to be sure they were buying QPM. While this did not emerge as a significant problem in the promotion of QPM through the IPTAs, perhaps due to the inbuilt trust in the community within the platform area, it is an issue for future research.

Institutional

1. Flows of information have improved: In the past, farmers who were interested in planting OFSP could not access seed of the varieties their choice. The three tier seed multiplication system promoted within the IPTAs has made it possible for farmers to know the type of varieties available, how and where they can be found. There are now networks of seed multipliers at the SMS level who are linked to the PMS and root producers. Since the IPTAs were made up of different actors across the value chains, it is now possible for the different players to know what is going on in the seed system and the sources of planting material.
2. The ability to facilitate multiple multi-stakeholder interactions remains a skill and capacity not readily available among ARD stakeholders. The same skills are also crucial for facilitating reviews and reflections on the IPTA processes and for distilling lessons that can be shared. In most countries, this role was, by default, assumed by the NARI focal institution where it was performed by a researcher. In a few cases, this role was held by an NGO. In all cases, it was apparent that this is an area that requires investment in development of the required skills.
3. Sustainability of IPTA arrangements. Regular communication, face-to-face meetings together with joint activities formed the basis of improved coordination of the seed system. With the approaching end of DONATA, IPTAs are investigating alternative strategies to resource these activities. For example, forming an association of seed and root or grain producers which can raise funds through membership dues; or transforming the IPTA into a value chain facilitator/ service provider, brokering linkages in the value chain, and providing capacity strengthening on a fee basis.

Social

1. The IPTAs, through diverse membership and activities incorporating the whole of the value chain were able to disseminate technologies more quickly. For OFSP, this established a mass of producers, which included more men. Men started to realize that sweet potato root and vine production can be a profitable enterprise. This has led to more land being allocated for sweet potato production and a change in the gender division of labour with both men and women performing tasks jointly. However, there is a risk that women will start to lose out: therefore training activities need to incorporate both men and women and include topics related to intra-household decision-making on allocation of income benefits.
2. Cross learning among IPTA partners has allowed farmers to access more knowledge and practical ways of doing certain things. This has enhanced wide dissemination of the seed, and the production technologies.
3. The seed system for OFSP is only likely to be sustained if there is a strong and sustained market for roots offering prices for farmers, which in turn can translate into a demand-pull for the quality vines. This is in turn dependent on diversifying the preparation and use of sweet potato, and sensitizing new types of consumers. In countries where the IPTA incorporated the whole value chain it was possible to demonstrate varied forms of utilization and link to processors.
4. Some OFSP varieties have lower dry matter, and other characteristics which consumers need to be aware of. Demand creation activities need to promote the nutritional benefits and use uptake pathways which will reach those consumers who will see the benefit of the varieties or are more open to change

Grain and root production

This section presents a synthesis of key issues on application of the IPTA approach, challenges and lessons learned from the countries' papers under thematic area QPM grain and OFSP root. It draws up some key lessons learnt on how the innovation platform approach can add value to efforts to improve productivity and quality standards for both OFSP and QPM. In all the cases, the IPTA areas chosen for up scaling the technologies were far from technology development centres and farmers in those areas previously had limited access to improved

crop varieties and food security challenges were rampant. While both crops are important food security crops, levels of adoption of improved technologies have generally remained low thus affecting their productivity especially in farmers' fields. Below we point out some key changes emerging from up scaling OFSP and QPM technologies using the innovation platforms in the four countries with different levels of adoption.

Diffusion of improved varieties and crop management practices increased production and productivity of OFSP and QPM

Despite the fact that there are a number of improved technologies available for both QPM and OFSP from research institutions, the uptake and diffusion of improved varieties is still very low: less than 40% among farmers and average yields are extremely low compared to the genetic potential of the crops. The IPTA approach addressed this issue by facilitating linkages to actors (both up and downstream) on crop value chains. In this way, the farmers were able to access clean planting materials and their capacity built to enable them to appropriately apply the technologies.

For OFSP, novel approaches for local clean vine production free from viruses and their complexes were developed and planting materials of stress tolerant and high yielding varieties were distributed through uptake pathways within the platforms. Since the IPTA consisted of researchers, traders, farmers' groups and farmers capitalized on their knowledge acquired through training. In this way there emerged groups of farmers who specialized in the production of clean planting materials, which they shared among members but some also sold locally. Other farmers used the clean planting materials to produce high quality roots for sale through the market linkages facilitated through the IPTAs. For example, in all the papers, there are examples where the IPTA linked producers to markets both for roots and vines both within the communities and outside. As noted in the case studies, the access to planting materials locally encouraged timely planting and enabled crops to escape some of the problematic pests and diseases. The farmers produced crops based on recommendations and profitably benefiting from the training conducted in the IPTA by value chain actors and the market linkages.

In general, the IPTAs provided opportunities for farmers to evaluate and access new varieties and markets. For example, new stress tolerant OFSP varieties- Vitaa and Kabode were introduced from the Uganda sweet potato breeding programme within the collaborative arrangement of the IPTAs and evaluated with farmers in the IPTA in western Kenya. Following selection and popularity of these varieties, they were recommended and eventually released for wide-scale multiplication. These varieties were preferred because of their high dry matter and floury texture when cooked. The varieties were then multiplied by the IPTAs through a three-tier seed multiplication system of primary, secondary and tertiary multiplication sites increasing the rate of access of the new varieties for the farmers. Generally, the seed systems for vegetatively propagated crops such as sweet potato are not well developed in the region. In DR Congo, it was through the IPTA approach that new QPM varieties were introduced, evaluated and released through participatory varietal selection within the IPTAs.

This approach made farmers embrace the varieties early and easily adopted them because it facilitated interaction and feedback from value chain actors. Due to the capacity building efforts, the farmers provided perfect choices to host the on-farm trials and participate in varietal selections. Since all the IPTAs emphasized training and other capacity-building initiatives for increased uptake and adoption of OFSP and QPM technologies, it was easier for farmers to appreciate the value of the new crop varieties. These training sessions enabled a faster and wider spread of improved technologies.

Improved post-harvest management and storage

One of the biggest challenges under smallholder conditions is high level of post-harvest losses arising from poor storage facilities and knowledge of how to effectively manage and control some of the storage pests. The IPTAs in Kenya and Uganda demonstrated low cost improved metal silos for long-term maize grain storage during the implementation stages. The use of metal silos for improved storage was associated with the need to identify

and train artisans who made them locally for sustainability. Similarly for OFSP, due to its high perishability and the sweet potato weevil, storage of fresh roots remains a challenge. Some technologies for underground and in-sand storage of roots are being tested. Processing into various products e.g., chips; flour and bakery products have been promoted through the platforms and are gaining popularity both at household utilization level and for small and medium enterprises in the target countries.

IPTA processes increased the awareness of improved OFSP and QPM technologies

The experience obtained in the dissemination of OFSP and QPM technologies using IPTA indicated that most farmers have limited access to information. Identification of appropriate uptake pathways is important for the increased diffusion of information. The use of radio programmes, for example Mega FM in northern Uganda, increased coverage of farmers and reached beyond the IPTA areas. Most often, radio station programming does not have time allocated to agricultural issues, understandably, because most media companies are privately owned with the major purpose to increase popularity and listenership and thereby to make a profit from advertisements. Our experience indicated that by involving the media as partners in agricultural development issues from the start, they became part of an important source of information to farmers. Various follow up surveys conducted indicated that >75% of farmers owned or have access to radios and local FM stations are popular and important sources of information. The participating radio station was able to slot farming into its programmes and using innovative approaches became popular. They hosted actors who were experts in the value chain and introduced agricultural quizzes rewarded by packages of seed and planting material accompanied by planting guides. Farmers were able to get information on sources of inputs and planting materials. The radio's efforts were augmented by local agricultural shows, which brought together successful farmers to showcase their technologies. This approach facilitated interaction and experience-sharing at a local level and revolutionized the dissemination of extension messages.

Increased access to markets from bulking and improved quality standards

As the IPTAs evolved, some registered as a community based organizations (CBOs) and this provided a platform for planning production together and bulking. Various training on business and record keeping empowered farmers to farm as a business and encouraged investment in the purchase of inputs. The private companies saw an opportunity for new markets and encouraged local agro-dealer developments to bring inputs closer to the farmers. This arrangement was considered a win-win situation as farmers could locally access inputs relatively cheaply without transport costs being involved. The organization of farmers in CBOs also attracted other development agencies to provide complementary services and enabled them to easily access loans. In Lira, SG 2000 established a one-stop approach that empowered farmers to bulk their produce for sale and negotiate on price without middlemen. The bulking and organized marketing resonated in all the IPTAs. In Democratic Republic of Congo, the IPTA farmers were contracted by feed processors to produce grain in bulk and in Kenya, Azuri Health and Kirinyaga millers purchased OFSP in bulk from IPTA to process into nutritious flour. These are good market opportunities, but the challenge for smallholders to supply adequate quantities of quality roots in a sustainable manner remains a significant obstacle to their exploitation.

Mixed dissemination approaches play an important role

IPTAs were empowered to determine their dissemination strategies to suit their situations and work context. The fact that there was no standard or blueprint prescription, but a loose concept to guide in the establishment and operation of the platforms largely left implementing teams to interpret the IPTA concept to suit their country and commodity contexts. The diversity of partners and their capacities varied markedly across the countries. This affected not only the understanding and operationalization of the IP but also the uptake and scaling up pathways that emerged. As a result we see a rich mix in the way the platforms were established and managed, the outcomes and the extent of reflection and sharing of experiences and lessons across countries

and commodities. While this is good, it also makes it difficult to make comparisons in a statistical way.
It was observed that the strategy adopted by each IPTA was a function of location; focus; stakeholder composition; production stage and the technology or innovation. The common thread in all IPTAs was the multiple interactions involving diverse stakeholders. They also applied multiple dissemination methods and channels and different combinations. For example, during field days several dissemination tools would be used including demonstrations, farmer-to-farmer interactions, agricultural shows, farmer field schools, poems and drama to promote the qualities and benefits of QPM and OFSP technologies and innovations.

Lessons learnt

1. Timely availability of quality and quantity planting material is important for timely planting, and increased production. Sweet potato was majorly regarded as a woman's crop but through sensitizations and awareness creation on the nutritional and commercial aspects of OFSP by the IPTAs, both genders are now involved in its production and marketing.
2. Use of IPTA enhanced collaboration and information-sharing among the partners in the OFSP value chain resulting in increased production and marketing from collective bulking.
3. The market pool stimulated farm level increase in the demand for quality planting material and enhanced root production. The IPTAs used this to organize farmers into clusters for bulk selling of the roots and grains.
4. It is possible to develop a commercial seed system for vegetatively propagated crops (in this case sweet potato) provided there is demand for clean planting materials and a marketing channel for the product.
5. Use of the radio is a cheap method for wider dissemination of information.
6. Appropriate dissemination strategy is the key to increased diffusion of crop technologies

Product transformation and marketing

Part 2 had six countries' papers under the thematic area on product transformation, marketing and income. The papers showed that a number of IPTAs made considerable progress in improving OFSP and QPM product acceptability through innovative transformation processes. This led to an increase in demand, sales and subsequently incomes for the beneficiaries who were engaged in the enterprises that emerged. However, several factors contributed to these outcomes and therefore it is important to highlight them.

These factors were largely institutional and notably among them were changes in policy framework in Rwanda and Kenya for OFSP, and in Tanzania for QPM. In Kenya, for example, sweet potato had previously been classified as an orphan crop, while in Rwanda, valley bottoms and swamps were reserved for production of 'important' crops during the dry season, which excluded sweet potato. In the DRC, maize was regarded as a low income-generating crop; hence minimal investment had been made towards processing and value addition. Reclassification of orphan crops in Kenya was accompanied by positive resource changes and attitudes, while allowing the production of sweet potatoes in valley bottoms during the dry season was a positive indicator of the increasing importance of the crop in the Rwandese economy. Another factor was in social context. In Kenya where there was a significant increase in the marketability of OFSP, it led to increased involvement of men in the sector, which previously had been the realm of women. While this spurred commercialization, in future it may affect the access to and control of benefits arising from sweet potato within farm households. On a positive note, cultural beliefs and taboos were overcome leading to the establishment of a lucrative vine market in Kenya.

Effectiveness of the IPTA approach in addressing the marketing challenges

In nearly all the platforms, the learning, collaboration and desire to improve the value chains resulted in innovative strategies that saw the IPTAs venture to launch new businesses and business models successfully.

Initially, the IPTAs identified business opportunities, recognized the challenges, and together members looked for innovative ways to overcome them.

In Kenya, for example, one of the IPTA partners (Farm Concern International (FCI)) identified several marketing opportunities e.g. fresh roots for an urban market. Although this did not work out, it led to concerted efforts to ensure that other markets were satisfied. Subsequently, inter-IPTA linkages, establishment of commercial villages, and production and marketing strategies were devised to meet the previous identified market (processor's) demand. The lead actor, Siwongo Company realized the need to support seed and root production and moved to assist the emerging commercial vine and root producers in western Kenya. In Tanzania, the challenge to be addressed was a need to diversify products from QPM grain. This was partly overcome through vertical integration. Tanseed International, a seed company, which was a member in the QPM seed IPTA, opened a new subsidiary which dealt with the grain and food sectors of the value chain. The company and its grain and food enterprise subsidiary vigorously promoted the QPM products, and the resulting demand flowed backwards in the chain, leading to increased seed and production. The IPTA actors in DRC realized the need for diverse ways for utilizing QPM, which had been identified as the major challenge inhibiting uptake and commercialization of the crop. The IPTA actors conducted consumer studies to establish acceptability of various forms of QPM products, as well as their profitability. Similar studies were conducted for OFSP in Rwanda. The results informed the product transformation and marketing strategies.

The value added of the IPTA approach in the dissemination and uptake of the OFSP and QPM

IPTA's members recognized the need to identify novel uptake pathways for promoting the various QPM and OFSP products and stimulate demand for them. A key pathway was collaboration amongst partners that had never been thought of before. The collaboration among IPTA members opened up potential uptake pathways for the emerging products. In the DRC, for example, poultry farmers had never worked closely with researchers and veterinarians but through the IPTA arrangements, they learnt about using QPM in feeds. Similarly in Kenya, close interactions amongst officials in agriculture and health ministries, value chain actors and NGOs made possible through the IPTA approach created synergy and increased awareness about the various possible products from the OFSP and QPM. The IPTAs ensured that various partners were empowered to promote the products through sensitization, capacity building and provision of promotional aids. The joint campaigns that were conducted in most countries increased outreach to various categories within communities. Other novel pathways included Tradition Birth Attendants (Uganda, Kenya); engaging with stakeholders from health and education officers and institutions as well as the presence of the media in the IPTA, all emerged as effective ways of reaching a wider range of potential end-users in all the countries and across the two commodities. Innovative pathways were shared and replicated amongst IPTAs during exchange visits, training and meetings. Such pathways would not have been easy for individual members to utilize, and required the collaboration of all members to take root.

The extent to which platforms served as forums where learning and innovation thrived

According to Nederlof et al. (2011) innovation, or "doing something in a new way" is understood to be a mix of appropriate technical, organizational and institutional elements (in the sense of formal or informal rules and regulations). The authors further argue that innovation is premised on new ways of doing things resulting from interaction. The IPTAs allowed for exchange of ideas, collaboration and joint learning to take place amongst the members. In so doing, the IPTAs stimulated interaction which resulted in innovations that were applicable to the local setting, as classified below:

Technological innovations: Technological innovations comprise new products and processes and significant technological changes of products and processes (OECD, 1993). In this case, existing snacks and confectionery products were modified through the incorporation of QPM/OFSP in the ingredients. Most of these products were highly acceptable by the consumers as exhibited by the taste tests performed in DRC and Rwanda. Other innovations included poultry feeds (DRC). New processes were also instituted by the IPTAs – notably innovative

ways to combat the erinose mite, which led to increased sales of vines in Western Kenya. Simple techniques like ideal ways of steaming OFSP roots, as exhibited by farmers in the Gulu IPTA, also led to increased consumption and sales of roots.

Institutional innovations: IFAD defines institutional, organization or methodological innovation as a "new type of partnership implemented between groups, communities and actors or stakeholders working in institutional, economic or social fields to improve their living conditions". The IPTAs led to the establishment of 'gentleman's agreements' which facilitated marketing of various products. Though these were instituted with the aim of solving problems of product flow to buyers/ processors, they also increased transparency and trust amongst the chain actors. Creation of commercial villages improved collective marketing and sharing of proceeds in Western Kenya, while formalization of IPTAs in Tanzania led to improved financial transactions through banking. The media played a large part in awareness creation and linking farmers to buyers in the Gulu IPTA. The farmers trusted the local radio station, Mega F.M, which was an IPTA member, and would deliver vines and roots for sale to the radio premises, and later pick up payment from there as well. This arrangement spurred sales over a wider area and increased visibility of the producers.

Challenges

These challenges will broadly be classified under two themes: (i) Multi-stakeholder engagement related challenges (ii) value chain related challenges

Multi-stakeholder engagement related challenges: Harmonization of roles and responsibilities was a significant challenge in some platforms. For example, in the Lira IPTA in Uganda, the processor was continuously asked to train farmers groups on processing and adding value. Later, other IPTA members felt that this should have been a role for the BDS provider. Subsequently, the members realized that a number of partners may have to take on additional functions, and this was agreed upon after a series of meetings.

Value chain related challenges: The biggest challenge faced by most IPTAs was synchronizing demand with supply. New buyers were usually disappointed by the failure to obtain desired amounts of produce, especially where they incurred high transaction costs. This was counter-effective especially after the promotion campaigns that IPTA members had made. Other challenges included failure to honour contractual agreements, especially as exhibited by QPM farmers groups in Tanzania. Inadequate handling facilities (driers and stores) were a major challenge that resulted from the expansion in operations in a bid to address the growth of demand.

Lessons learned

Various lessons have been drawn from implementation of innovation platforms from the context of product transformation and marketing.

1. Most IPTAs realized the need to have knowledgeable people in all the different nodes of the chain. This deficiency was especially felt in marketing and value addition, particularly where that expertise was not on board. In Uganda, consultants were hired to conduct market surveys, while recipe development was referred mostly to the NARIs. Thus having the NARIs steer the platforms was an advantage in that the focal person was able to request other departments to provide technical support to the IPTAs. However, this also meant that a strategy was needed to devolve this role from the NARIs to the public to private sector members to build capacity and effective leadership after project closure (as was the case in the Bungoma IPTA).
2. Presence of established administrative and financial structures and procedures amongst NARIs also meant that IPTAs could receive this support. Member organizations in Busia IPTA, for example, that were still fledgling at the beginning reported to have improved their financial and technical reporting skills and procedures. In addition, they also claimed to have learnt a lot from other partners, and had better working relations, including joint development of proposals for funding. In addition, joint implementation of activities also

improved outreach at minimal costs, which also contributed to accomplishment of individual organizational objectives. Furthermore, the ability to be in control of their work plans and budgets enabled IPTAs to direct their developmental agendas, and also provided a sense of ownership.

3. Inter-IPTA linkages played a vital role in learning and dissemination of technologies. New IPTAs progressed much faster through learning visits to older IPTAs, as was the case in Kenya. Cross-border exchange visits to other IPTAs also proved very useful, as judged by the adoption of new practices by the visiting team. Another vital lesson is the importance of private sector players in the chain. Large companies were able to drive upgrading of the two value chains through diversification and investment which helped in addressing challenges e.g. creating ready markets for products, providing seed and linking producers to markets, among others.

4. Will the various IPTAs be able to sustain their presence and value to members after the DONATA project ends? The answers to this question are varied, and will vary from IPTA to IPTA. What is important to note, is that several IPTAs have already thought ahead and have already instituted sustainability mechanisms. Formalization of IPTAs in Tanzania is one such strategy that, however, needs to be further cemented by the development of concrete business plans. Joint proposal development and project implementation is another sound sustainability strategy. The identification of institutional partners to work with is also a worthy strategy, as exhibited in Kenya, Uganda and Tanzania. Fundamentally, there is the need for the IPTAs to define their future roles and how these would be sustained beyond project mode.

Utilization for nutrition and health

In Part II, three countries' papers were presented as case studies on the application of the IPTA approach in dissemination, and scaling up adoption of QPM and OFSP for impacts on nutrition and health. Though their context is country and commodity specific, these papers provide insights into the value added and effectiveness of the IPTA approach in terms of addressing the challenges associated with disseminating and scaling out technologies with nutritional and health attributes. For example, (i) how to get the buy-in of stakeholders from nutrition and health sectors; (ii) mechanisms for beneficiaries to try or validate and be convinced of the attributes; (iii) how to communicate the technology messages to effect behaviour change among beneficiaries and other relevant stakeholders. The countries' papers also gave evidence to some extent on the acceptability of the IPTA approach for scaling out technologies that have strong nutrition and health attributes. They also provide insights into key challenges and lessons learned on application of this approach.

Value added and effectiveness of approach: The papers show that the approach added value to the classical linear dissemination and scaling out approaches. It was effective in addressing the constraints often encountered when promoting new technologies such as QPM and OFSP that aim to improve diets, nutrition and health. In all the case studies presented, the platforms enabled the creation of various system innovations[15], which served as alliances between the researchers who are originators of the technologies and the target users: notably farmers and consumers. The platforms served as a forum that brought together potential beneficiaries, especially the nutritionally vulnerable, a range of agricultural advisory service providers, and relevant actors in the health, nutrition and education sectors to interact and learn about the technologies. Much of the value added of the approach was in the creation and strengthening of linkages between research and development practitioners and actors in health, nutrition and education. Such strong linkages are known to enhance effectiveness of interventions that aim to impact on nutrition and health (FAO 2012).

In DRC the approach helped to foster linkages between the promoters of the QPM technologies and doctors in hospitals and care-givers in nutrition centres. These interactions enabled systematic validation of the use

15 In innovation literature, different types of innovations are classified: product innovations are changes in products and services such as improved varieties, equipment and tools; process innovations are changes in the way in which products and services are created or delivered; system innovations, which are changes in relationships and include forging or strengthening linkages

of QPM in the rehabilitation of severely malnourished children and in improving the nutrition and health of pregnant and lactating women. The testing and endorsement of QPM's nutritional benefits by the health and nutrition practitioners and their addition of QPM diet into medical prescription for treatment and management of malnutrition created confidence in the beneficiaries in QPM and helped to minimize any socio-cultural negative perception about the technology and enhanced its adoption and spread.

A similar effect was noted in the dissemination of OFSP to expectant mothers in Uganda, where traditional birth attendants (TBA) became viable uptake pathways. In this case the approach provided a forum for interaction with the TBAs, who because they are older women respected in the community for their knowledge and experience, became powerful pathways. In Rwanda it also served as a framework for interaction between the ARD practitioners and stakeholders working with vulnerable groups and communities in areas with chronic food insecurity and malnutrition. In that way the linkages served as uptake pathways for the technologies to spread in different regions of the country. In the paper by Ndirigwe et al., we note for example that through the linkages created within the platforms, a network of agencies with interest in the OFSP value chain was formed, where NGOs like World Vision, Catholic Relief Services (CRS) and AFRICARE worked as lead partners in the promotion of OFSP in different zones of the country. Also involved in the network are the centres for Treatment and Research on Aids, Malaria, Tuberculosis and other epidemics (TRAC-MINISANTE) and stakeholders in nutrition and agriculture, who have all agreed to work together to extend the impact of OFSP in different districts of Rwanda.

The platform approach provided a mechanism for effective engagement with the media and with policy makers who have a lot of influence on the people. Through the platform activities we note, for example that, the central government in DRC became convinced by the technology and supported production and distribution of QPM seed. The resulting linkages and interactions collectively contributed to the enhanced scaling out of QPM, not only in the initial project areas but its spread into other parts of DRC. In Tanzania, various forms of system innovations emerged, notably the enhanced relationships between the promoters of the technologies and different potential end-users such as food vendors who use maize to make different meals in local markets, grain millers, supermarkets, schools and orphanages. These end-users created the demand pool that led to increased production of QPM seed and grain.

In summary, the approach provided a forum and mechanisms for interaction between stakeholders in agriculture and those from the relevant non-agricultural sector, some involving high level policy makers. To a great extent, the demonstrated evidence of the nutritional benefits of QPM and OFSP, especially in areas where malnutrition was prevalent, was major driver that attracted decision makers from non-agricultural sectors such as health and education to get involved in the platforms. This created an unusual but quite effective set of scaling out pathways for the technologies and their nutritional and health impacts.

Learning and innovation: The manner in which the platforms provided forums for the exchange of knowledge, experiences and how they encouraged learning and innovation differed across countries and commodities. The key message though is how the IPTA approach provided forums where a broad range of stakeholders could share and exchange experiences, and used this to learn from each other. In DRC, testimonies from beneficiaries shared at field days, IPTA meetings and through local radio programmes were key avenues for exchange and learning about the QPM technologies and their outcomes. Through these avenues, many actual and potential beneficiaries, as well as higher-level policy makers, were reached which contributed to scaling up. The ARD practitioners quickly learned how effective the beneficiary testimonies and the media were and exploited them as much as possible to extend the reach of the technologies. Also, actors in the platforms have made use of the value addition technologies and information to diversify the products promoted for utilization and in the process widened the market opportunities, which has served to accelerate scaling out.

In all the countries' papers the use of institutions such as schools, orphanages and health centres, among others, to scale out the nutritional benefits of OFSP and QPM technologies is one of the key innovations that emerged

and was adopted in most platforms. Also, different ways of using mass media channels, such as interactive radio programmes and facilitated radio listening groups were tested and validated in some of the platforms: for example, in the promotion of OFSP in Uganda and QPM in DRC. These have been shared along with other lessons and experiences during regional experience-sharing events that brought together stakeholders from the two commodities across the six countries involved in DONATA.

Recognition and acceptance of approach: The case studies also indicate a growing recognition and acceptability of the innovation platform as an approach for scaling up technologies which have nutrition and health attributes such as QPM and OFSP. Across the three papers, stakeholders in the platforms included the beneficiaries such as farmers and the enabler type of actors such NARIs, NGOs and policy makers in relevant line ministries. Both end users and policy makers have expressed satisfaction with the IPTA approach and recommended it be adopted in promotion of other technologies[16]. In DRC and Rwanda, the innovation platform and its link with the value chain framework, has created a lot of interest to such an extent that some practitioners have accepted it as one of the approaches they can use in their ARD interventions. We note in the paper by NIndirigwe et al. that the ministry of agriculture in Rwanda has established a desk on innovation platform and DONATA experience is being used to inform on-going and new ARD efforts in the Rwanda Agricultural Board (RAB) and in the ministry in general.

Sustainability: Sustainability of the scaling out efforts in general and the IPTAs in particular will vary with country and commodities. However, in this case where the platforms succeeded in establishing strong linkages with stakeholders involved in nutrition and health interventions, particularly institutions such as health centres, ministries of health and hospitals there are good prospects for the continuity of the scaling out efforts in the post-project period. The linkages that have been formed with hospitals and nutrition centres in DRC and the interest and support from the central government to make QPM seed available in different parts of the country is an indication of the possible continuity of the scaling up efforts in that country. Similarly, the involvement of schools and health centres in the promotion of QPM and OFSP through IPTAs as indicated in some of the countries' papers increases the chances of sustainability. However, whether the established IPTAs will remain functional in their current or different forms long after the project has ended cannot be fully ascertained. Moreover, the sharing of successful case studies and beneficiary testimonies on the impact of using QPM and OFSP is likely to continue to serve not only as a powerful driver for scaling out but also for sustainability because of the demand-pull they generate for the technologies.

Promotion of diverse QPM and OFSP based products, which has opened business opportunities for entrepreneurs, is another sources of IPTA sustainability. Where small and medium scale enterprises have been created and have good linkages to markets, as noted in all three papers, the chances for sustainability are higher because the increased demand for these products provides incentives for farmers and entrepreneurs to invest and, in turn, demand various services from the platforms.

Challenges and lessons learned: A key challenge encountered in the scaling out of the nutritional benefits of OFSP, particularly during the early period of the project, was how to change dietary preferences. In most communities where sweet potato is a staple crop, consumers tend to prefer varieties with high dry matter, which most of the OFSP are not. Therefore, the manner of communicating the messages about the nutritional and health benefits of OFSP in ways that could influence dietary behaviour change was a tough challenge. Several lessons emerged on how to address this challenge.

1. Inclusion of information of the different kinds of products that could be made using OFSP in the promotional messages and conducting training on the different ways to prepare OFSP-based products helped to address

[16] One of the beneficiaries observed that "As of now INERA is involving farmers and other actors in the value chain to promote QPM because of the IPTA method and we can see the technologies are spreading well. They should do the same with other crops" (Biuma Kadima Rosalie from DRC).

this challenge. Above all, the use of beneficiary testimonies in different community fora and through institutions such as schools and mass media campaigns, proved effective and is a key lesson learned.

2. Another important lesson learned was the effect of the inclusion of nutrition and health stakeholders as partners when using the IPTAs to scale out technologies that have nutritional and health attributes. Their inclusion, especially at institutional level, enhances the beneficiary behaviour change favourable to the technologies and accelerates adoption and impact. As evidenced in the paper by Mbuya et al., inclusion of doctors and care-givers at nutritional centres resulted in the adoption of QPM-based diet in the treatment of malnutrition.
3. A methodology-related lesson that can be drawn is the use of combinations of different dissemination and technology uptake pathways rather than a single one. Thus, across the platforms, we see use of the different forms of mass media such as interactive radio episodes and programmes; use of institutions such as schools, testimonies and farmer-to farmer dissemination.
4. Finally, it can be noted that a broader stakeholder base created with a platform approach provided ARD practitioners with a forum in which to learn from each other about different technology delivery and uptake pathways.

Technical support to the platforms

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Given the fairly general description of the innovation platform for technology adoption (IPTA) methodology with which teams had to start implementing DONATA and with the subsequent realization that there were limited documented practical examples from which to draw guiding principles on its application, efforts were made to provide technical assistance and guidance to the platforms and the NARI country focal institutions. From conceptualization through establishment and operations of the innovation platforms, The Forum for Agricultural Research in Africa (FARA), ASARECA and technical backstopping institutions comprised of CIP for OFSP and CIMMYT for QPM provided technical assistance to NARS country teams involved in DONATA. These inputs were provided at different times and different levels and ways throughout the five years of project implementation. The technical support was pivotal to the design, establishment and functioning of the IPTAs but also to the teams' reflections on their experiences and to the successful capturing and documentation of outcomes and lessons.

Both CIP and CIMMYT provided technical inputs through interactions with the DONATA countries' focal points and directly with the IPTA partners during monitoring visits, planning and review meetings and during training events. Some of the inputs were through coaching and mentoring of the focal points, who in most cases were also the platform coordinators and facilitators. Where they were not the platform facilitators, they served as the link to the facilitator and the platform at large. Inputs from ASARECA were provided at the regional level through joint QPM and OFSP training events or experience sharing workshops, through monitoring visits and feedback from review of projects reports.

Just before implementation started in mid-2008, a joint regional workshop was organized by ASARECA and used to elaborate the IPTA conceptual framework and ensure that there was a common understanding among the NARI focal persons, CIP, CIMMYT and ASARECA about the innovation platform concepts and value chain framework. This workshop also aimed to ensure that there was a consensus about key elements of an operational IPTA. Obtaining such an understanding was crucial before countries began to establish their IPTAs. The DONATA focal point at FARA attended that first workshop and elaborated on the IPTA approach and showed how the platforms are established along the value chain. This elaboration was fundamental to the formation of the initial set of platforms but also others along the way. Throughout implementation, the focal persons and the platform members received continuous technical backstopping on the approach through coaching, mentoring and through joint reflections during planning and review meetings. Other forms of support were provided in the following processes.

During project implementation, FARA organized continental workshops, one in 2011 and the other in 2012, which provided a forum for teams from the different sub-regions to share experiences and learn from each other. The first workshop, held in Accra Ghana in January 2011 was an immediate follow up of the PSTAD mid-term evaluation of 2010. The reflection and exchange of experiences between DONATA in ECA and in West Africa generated the interest to document experiences and lessons learned in a book. The first draft was a regional paper on how IPTA were conceptualised and established to promote QPM and OFSP in ECA target countries. The second FARA-convened experience-sharing event was in form of a PSTAD conference, which was held in

Mwanza Tanzania in 2012. During this event, the NARS from all sub-regions benefited from technical input from monitoring and evaluation consultants from the Natural Resources Institute (NRI). Through the facilitation of the NRI consultants, the NARS mapped out the value chains in which they had established the IPTA and reflected on the diversity of multiple multi-stakeholder linkages and interactions, the different technological processes and system innovations that emerged from the IPTA process. Though held toward the end of the project, this conference was extremely useful and served as a thought process through which more lessons were identified and shared.

Initial efforts to review the IPTA partnering arrangements and scaling out processes: Early in the project's life, a study was initiated within the platforms to analyse the effectiveness of IPTA approach in dissemination and scaling out technologies and outcomes. It was aimed at generating lessons including key elements for achieving desired outcomes with IPTA approach. It was also meant to provide IPTA members with a mechanisms for self-assessment, lesson learning and for adapting the approach to suit their circumstances. However, due to limited funds, the study was suspended. Nevertheless, during its short period of implementation it enabled members to reflect and, based on their country and commodity contexts, to make incremental adjustments in the way they formed new platforms. The study also shaped the evolution of the IPTAs during the life of the project to enhance the effectiveness of the approach.

Joint regional experience sharing at ECA level: To boost sharing of experiences in the implementation of the IPTA and to draw out lessons both intra-country and across the two commodities, ASARECA organized joint regional experience sharing and learning workshops facilitated jointly by ASARECA and the backstopping institutions. The workshops were phased in nature and allowed for IPTA members to comprehend and visualize how the IPs could broaden and strengthen their outreach through a value chain approach. In this way, representatives from the various platforms along with the NARI focal DONATA and RAILS focal points were able to reflect on the ways the IPTA institutional arrangements and processes were supporting technology dissemination, learning, innovation, adoption and scaling out impact of the technologies. Lessons were drawn from the cross sharing of experiences and this reflection informed much of the IPTA dynamism and evolution noted across the countries. They also informed establishment and operation of new platforms. For example, though IPTAs established to promote QPM had initially been intended to focus on distinct segments or nodes of the value chain (such as seed systems or product transformation and marketing) they quickly realized that they needed to include other aspects of the value chain in order to meet expectations of some stakeholders, especially farmers. The QPM IPTAs learned this from OFSP platforms, which were based on an entire value chain. Also through these workshops, it was noted that there was a lack of soft skills, especially IPTA facilitation or service brokering skills as well as a general understanding of value chain development among the platform members and the supporting NARI focal points. Through this realization, ASARECA prepared a concept note for the development of skills in IP facilitation and a better understanding of agricultural innovation systems and value chain frameworks.

Capacity building: Realizing the limited knowledge about value chain frameworks, agricultural innovation systems and the IPTA approach in particular as well as lack of platform facilitation skills, ASARECA organized a two-phased regional training to provide for these skills and knowledge. The training was organized in two phases with a period in between where those trained were expected to implement action plans developed during the first phase and later to bring feedback during the second phase. The trainees were encouraged to share what they had learned with other members of their platforms. A total of 40 NARS stakeholders, 20 drawn from OFSP and 20 from QPM platforms, from the six DONATA countries in ECA participated in the training. A value chain framework expert was contracted to facilitate the two-phased training. There also various short-term training courses organized to enhance capacity of the NARS in both the technologies and innovations and the IPTA scaling out processes. Other forms of capacity strengthening and learning were through organized intra platform and cross-country exchange and learning visits. These visits were encouraged, supported and perceived to be beneficial by the IPTA stakeholders since in some cases the visit helped to 'unlock' some constraints or

challenges when they adopted the techniques and innovations (processes as well as systems) observed during the visit.

Development of tools: Through the technical backstopping support from CIP, the OFSP platforms benefited from a number of tools aimed to strengthen the IPTA and also encouraged documentation of emerging innovations and experiences to support improved performance. These included production and marketing plans which the various IPTAs used to forecast and synchronize demand and supply of vines and roots. This tool was majorly used during preparation of annual and quarterly work plans, and enabled planning for resource allocation (e.g. for seed multiplication sites) and also for tracking progress towards market development using technology inventory forms which IPTA members used to capture new innovations emerging from IPTA processes.

The Hawassa IPTA members in Ethiopia, for example, used the forms to document emerging innovation in the reconstitution of OFSP flour and tef to make '*enjeera*' and other snacks while the Eastern IPTA in Rwanda did the same for OFSP based snacks. The inventory forms enabled other IPTAs to learn what was happening in other areas, and also to try out some of the innovations as the forms provided a 'how to do it' section. Other tools, which had been successfully used by other partners in other programmes were adapted and promoted for use in the IPTAs. For example, the IPTA partnership health assessment forms, which were used to assess strengths of the partnerships, the performance, relevance and sustainability of the IPTA. This exercise was done once a year by all the IPTAs during their annual review and planning workshops. The information was collated and feedback provided on areas that needed strengthening (e.g. communications amongst IPTA partners), as well on themes where the IPTAs were doing well. The information also provided a basis for identifying strategies to strengthen weak areas e.g. the Lira IPTA planned for a learning visit to Kenya IPTAs in a bid to improve the harmonization of roles and responsibilities, and learn from successful marketing strategies.

Participating NARIs, NGOs and CBOs provided technical and material support from their own programmes towards the functioning of IPTAs. The NARIs hosted the PMS, and trained host farmers of SMS and TMS in setting up and pest and disease management among others. KARI, LZARDI and Ngetta ZARDI, for example, provided brochures or translated existing technical guides for production and recipes in local languages. Gulu University coordinated the training of Primary and Secondary school agricultural teachers, and provided technical guidance as well as vines for setting up school gardens.

Roles of NARIs in the platforms

NARIs played a critical role in the implementation of the DONATA project. The NARIs were responsible for: overseeing implementation of DONATA activities at IPTA level; production of breeder and foundation seed; carrying out research activities to address emerging constraints; coordinating seed production activities; and backstopping seed companies to produce quality seed (certified seed). NARIs were also responsible for liaising with relevant institutions to undertake socio-economic studies (impact assessments and outcome mapping); facilitating linkage of farmers to agro-input suppliers; and monitoring project activities at IPTA level.

NARIs also facilitated capacity building for IPTA stakeholders. At national level, NARIs conducted in- country training to build the capacity of the stakeholders in the various IPTAs. The same training was organized at IPTA level and for TOTs who later trained other value chain actors. Capacity building initiatives were undertaken in order to strengthen the commodity value chains (QPM & OFSP). Capacity building included (but was not limited to): backstopping activities of platform facilitators, sensitization and training of smallholder farmers for effective platform participation; facilitation of local seed companies and producers through training of trainers and farmers in good agronomic practices, planting, seed multiplication and provision of training materials and breeder and foundation seed.

Linkages with the Regional Agricultural Information Learning Systems (RAILS)

DONATA employed different methods and channels to disseminate information about the technologies, the

activities and outcomes from the innovation platforms. A lot of information was shared on email with IPTA coordinators including articles, scientific reports and links to useful websites such as the sweet potato knowledge portal, which was subscribed to by most IPTAs on OFSP. In addition, some of the DONATA platform actors were also members of the learning teams under Regional Agricultural Information Learning Systems (RAILS). The countries' RAILS focal persons with backstopping from FARA and ASARECA organized training sessions for DONATA IPTA members and impacted them with skills to document and upload their experiences onto the RAILS portal for wider dissemination. Some of the platforms managed to create their own web-pages through which they shared their experiences and achievements.

Emerging guiding principles

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From the countries' case studies and analytical synthesis the following principles on IPTA application emerged. These are only emerging and can be taken as preliminary, thus they can be adapted to suit specific applications of the approach.

i. *IPTA Composition*
A diversity of actors is critical to support learning, innovation, technology generation and dissemination processes. The right mix of people (technical, age, gender, experience) and organizations needs to be identified and brought on board according to the objective and functions of the IPTA. The DONATA experience shows that the promotion and dissemination of crops with high nutritional value attracted non-conventional actors to the platform – e.g. health and education professionals. Value chain and stakeholder analysis should drive the identification of the actors. Such analysis should be iterative and therefore the IPTA membership be dynamic, to be able to respond to changes in, for example, market opportunities, macro-economic conditions and the political and policy contexts. The IPTA approach also aims to achieve a greater impact with the technologies it is disseminating, so composition could include organizations, which could support this scaling process. All partners (at both the individual and organization levels) need to see a benefit in order to remain committed; incentives may not only be financial, but may also include an increase in knowledge, status, recognition and becoming part of a wider community of practice or movement for change.

ii. *Tools and processes*
A range of tools and processes can support the establishment and functioning of the IPTA. Value chain analysis is critical to understanding the relevant commodity, its challenges and opportunities. Stakeholder and SWOT analysis can help members to analyse issues jointly so as to enhance a feeling of belonging, responsibility and transparency as well as empowering partners. Joint monitoring tools and activities also strengthen joint accountability. Roles and responsibilities of individual members need to be agreed and understood. The IPTA partnership health assessment forms, which were used to assess strengths of the partnerships, the performance, relevance and sustainability of the IPTA is another type of process tool that can be useful. The diversity of actors in the IPTA can contribute new tools, processes and combinations of different elements of uptake pathways for more effective scaling of technologies.

iii. *Capacity and competencies for supporting innovation processes and IPTA functioning*
Identify a suitable champion for the platform and, where necessary, strengthen his or her facilitation and other soft skills. The IPTA needs a motivated champion who can mobilise and broker the partnering arrangements and facilitate interactions among the IPTA members, balancing the need for participatory processes, with clear direction when required. This requires skills and experience in leadership, coordination, and facilitation together with sensitivity and awareness to tackle or harmonise power asymmetries, and negotiate through conflicts, which may need to be resolved. Ideally the champion will have the backing of his/her organization, which will also support the coordination and advocate on behalf of the IPTA. A systematic pro-active approach is needed to encourage joint learning out of which new innovations may

emerge. A safe "space" for this learning and reflection process can encourage a more honest appraisal of what needs to be done differently.

iv. *Lead organization*

Just as a good champion for the platform is necessary for successful functioning and performance of an IPTA, so is the choice of a lead organization to coordinate and advocate for the IPTA at institutional level, especially for favourable policy and for resources.

v. *Governance and management*

It is crucial to take time to establish democratic, participatory governance and management processes. Experience has shown that both formal and informal institutional and partnering arrangements can be effective governance structures and management procedures: these should be clearly understood and accepted and respected by all members of the platform, including informal rules such as ethical or moral behavioural norms. Some platforms are established under informal or semi-informal rules and, as the IPTAs progress, the partners see the need for formal rules. Even where there are formal rules, it is advisable to allow for flexibility to be able to change rules, regulations and orientation of the IPTA to new opportunities and challenges. In management it is advisable to employ the principle of subsidiarity so that decisions are made at the level of those who will implement them. The bottom line is that sufficient time must be made available to allow these processes to mature without undue pressure to be completed in some prescribed short-term period such as the one year period for platforms stipulated in the initial project documents. Experience in DONATA and from the SSA CP proof of concept evaluation have shown that at least 5 years are needed for IPs to fully mature and to contribute to outcomes and lessons for the future.

vi. *Communication*

The flow of information in the platform is one of the key elements for successful functioning of an IPTA and for innovation and growth of the platform and its enterprise. Therefore, take time to put in place processes and channels that can enhance the flow of information including feedback from different stakeholders.

vii. *Innovation and dynamism*

IPTAs, by definition, should engage in processes that can trigger innovation. They should deliberately innovate as means of either addressing challenges or threats and for exploiting emerging opportunities. In this regard, besides the implicit innovatory character of a platform, for example being a forum that brings together a wide range of actors with different perspectives and experience, IPTAs should have explicit actions that encourage innovation and pro-actively seek opportunities for improving the benefits for members. However, it should be borne in mind that the level of success and quality of innovations delivered or catalysed through the platform processes would vary across country contexts but more so depending on the quality and strength of governance, the variety in the approaches to delivering the innovation to beneficiaries and in the types of partnership organizations.

viii.*Sustainability*

For sustainability, platforms should be founded on a sound business model and efforts should be made to employ business management principles including record keeping, making use of various economic analyses such demand and supply analysis and cost-benefit analysis. In addition, the ability to document and disseminate verifiable evidence of success and outcomes from IPTA interventions and processes is one of the most powerful means for gaining support for scaling up and sustainability.

ix. *The cost of multi-stakeholder platforms*

One of the challenges encountered in using the IPTA approach is the relatively high costs in terms of personnel time spent in organizing, coordinating and facilitating the platform operations; costs associated with face-to-face interactions, monitoring and evaluation and on communication. The general thinking in

the international ARD community is that that IPs have high transactional costs especially with regard to the bringing together of stakeholders on a regular basis. However, the information obtained from the platforms across the DONATA countries is not adequate and not in sufficient consistency to allow its decomposition into different costs' headings to allow meaningful analysis. Despite this, it is useful to take note that due to the complexity that is the reality of smallholder African agriculture and based on emerging learning from the Sub-Saharan Africa Challenge Programme (SSACP), multi-stakeholder platforms built around value chain frame works take a long time to become fully operational and to generate the desired outcomes: they are generally resource intensive.

X. *Evolution and growth of IPs:* Though the case studies were not based on statistically designed comparison of the IPTA approach and the conventional linear agricultural research and extension, the outcomes demonstrate the utility of the approach and its use should be encouraged to complement the existing and emerging ARD approaches. The existing IPTAs that have a strong partnership base and are contributing to impacts on welfare should be encouraged to grow and evolve organically from local initiatives rather than to be made to follow a prescribed blueprint. However, whether IPs can be fashioned or engineered to be pro-poor and gender neutral is likely to depend on the nature of the agricultural enterprises or value chain they are built upon. IPs established around commodities that contribute towards food security and human nutrition (such as OFSP and QPM) are more likely to deliver pro-poor and gendered outcomes than those established around cash crop value chains.

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