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Dissemination and commercialization of orange-fleshed sweetpotato varieties through FFS and VITAA partnership: Experiences from eastern Uganda

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Abstract. Integrated Sweetpotato Management through farmer field schools was incorporated into the already established IPPM FFS (Integrated Pest and Production Management Farmer Field Schools) programme in East Africa. It was aimed at promoting sustainable sweetpotato production and post harvest management. After four months field implementation of this technology-based and farmer education project, partnership was forged with the VITAA (Vitamin A Africa) initiative to disseminate and promote commercial production of orange-fleshed sweetpotato (OFSP) varieties. Since then a cumulative total of 1622 bags of vines each containing 1800-2400 cuttings ready for planting worth Uganda Shs 9,732,000 (US$ 4866) have been distributed to farmers through farmer-oriented organizations within Soroti district. More than 600 bags of OFSP vines have been distributed to farmers through FFS and VITAA promoting partner organizations. Whereas the other partners reported complete crop failure due to the adverse weather conditions during the first crop cycle, 2 FFS managed to produce orange-fleshed roots for processing and delivered about 1 metric ton of chips to Maganjo processing factory in Kampala. Of an estimated total of 72 acres of OFSP planted during the second cycle, 20% of the planting material was supplied by the FFS vine bank plots. Two sub-counties have priotised sweetpotato as a commercial crop through the NAADS programme. CIP provided two chipper machines to FFS and other sweetpotato producer groups in a bid to transform sweetpotato into an industrial crop and is spearheading the search for linkages to find alternative markets for chips. Although the pilot venture into commercialization through processing did not appear to be profitable, the idea of selling OFSP to boarding schools and other institutions seems to be a more promising alternative market.

Introduction

Sweetpotato is grown as a food crop in many Sub-Saharan Africa countries and covers an estimated 2.1 million hectares with annual estimated production of 9.9 million tones of roots. It is the third most important food crop in east Africa and ranked seventh among the food crops produced in the world and has an annual production of 138 million metric tons (Edison, 2000). Uganda is the world's second largest producer of sweetpotato and first in Africa. Sweetpotato plays a primary role in food security in Uganda especially in the eastern region where two crops per year are grown for both home consumption and to supplement household income by sale to local

markets and urban centres. Although crop utilization in urban centers was previously limited and often kept secret as it was considered to reflect the low income status of the consumer, it is becoming increasingly important in urban food systems and there has been tremendous positive change in attitude towards the crop.

Inspite, of the increasing popularity of sweetpotato in both rural and urban food systems, most local varieties grown throughout the region have white or cream-coloured flesh, and supply little or no pro vitamin A in the body (Draft Sweetpotato Technical manual, 2003). Vitamin A deficiency is one of the major health problems which most developing countries currently face. This micronutrient is critically deficient in the diets of the majority of people in the east African region especially in rural areas, particularly young children. Severe deficiency leads to night blindness, while less severe forms reduce a person's general health and capacity to fight off malaria, measles, diarrhea, AIDS associated illnesses, pneumonia and other diseases. Vitamin A deficiency has been identified as the leading cause of early childhood death and a major risk factor for pregnant and lactating mothers in East Africa (FAO/WHO, 1992).

Whereas Food and Agriculture Organization's (FAO) food balance sheet indicates an improving trend of Vitamin A in the diets for most developing countries in the last 20 years, in East Africa the overall vitamin A supply is actually decreasing (United Nations, 1992). According to International Food Policy Research Institute (IFPRI) projections 2000, the number of the malnourished children will continue to increase from 33 million in 1997 to somewhere between 39 and 49 million in 2020.

According to FAO/WHO report 1992, vitamin A intake is often inadequate because of the seasonality of food sources, the early abandonment of exclusive breast feeding, high morbidity levels, and practice of not giving vitamin A-rich food to young children. Dependence on capsules donations from UNICEF and use of fortified foods is quite costly and not implemented widely. The best sources of beta-carotene are liver and fish-liver oils, which are very expensive for the rural poor. The best plant sources of beta-carotene, which the body turns into vitamin A as needed, are carrots, green vegetables and orange-fleshed sweetpotato (OFSP). Whereas most rural people especially in eastern Uganda associate carrots with rich families and greens are regarded as inferior vegetables to be used during periods of scarcity, sweetpotato is traditionally regarded a famine crop that can substitute for cassava and fits in many food mixtures (blends) and forms.

To date countries tackling the Vitamin A deficiency problem are focusing actions largely on a combined approach of supplementation as a curative measure, promoting the increased production and consumption of Vitamin A-rich foods, and use of fortified products. Beta-carotene (precursor of vitamin A) reported as units of vitamin A activity in many studies is the most prevalent source of vitamin A in our foods (Colgan, 1995), and thus, the introduction of Vitamin A-rich sweetpotato in farmer-oriented programmes can play an important role in improving their nutrition and is amenable to agriculturally-based interventions (FAO and WHO, 1992). The OFSP varieties, which have previously been relatively uncommon in Africa, are providing their worth as a low-cost, easily available, natural, dietary source of pro-vitamin A. The total carotenoid content of sweetpotato has been found to range from 0 to > 20 mg/100g of fresh weight depending on the variety (Akoroda and Teri, 1998). Sweetpotato has a comparative advantage over other common staple foods especially cereals and legumes which provide zero to minor traces of beta carotene equivalents. Children below 5 years, 7-10 and adults need to eat about 30, 40 and 80g of OFSP respectively, to meet the daily requirements of pro-vitamin A therefore even if OFSP is not a preferred diet for an individual consumer, one needs only a small portion in addition to

the preferred choice and farmers with small plots can adopt it as a back garden crop to supply roots and leaves for daily household dietary supplementations (Third Draft Technical Manual, 2003).

International Potato Center (CIP) is providing support towards modern technological dissemination to improve on production, post-harvest handling and processing to add value (Tara, 2003). This would improve on the current fragile food security, low per capita income, and very low availability of Vitamin A in the diets, which according to the United Nations report 1992, Vitamin A supply in the East African region is actually decreasing due to seasonality of food sources, early abandonment of exclusive breast feeding and high morbidity levels. In recent years, technology dissemination through Farmer Field Schools (FFS) has been introduced to East Africa and is seen as a promising approach for sustainable technology adoption. Participatory systems approach is well suited to increasing rural incomes because they are tailored to the requirements of the villagers and build on the strengths and knowledge of the smallholder community (Chandra, 2000). Therefore, piloting promotion of OFSP activities through the recently started sweetpotato integrated pest and production management farmer field schools (SP IPPM FFS) groups set up as part of the UK Department for International Developments (DFID) Crop Protection Programme funded project 'Promotion of sustainable sweetpotato production and post-harvest management through farmer field schools in East Africa' would strengthen dissemination and technology uptake among farmers and other end users.

World Health Organisation (WHO) estimates that in many of the under developed and developed countries, several nutritional disorders are prevalent, and could easily be alleviated by consuming root and tuber crops like sweetpotato (Edison, 2000). According to VITAA Newsletter (2001), the Vitamin A for Africa (VITAA) partnership is promoting consumption, production and marketing of OFSP varieties which have been lacking in the traditional farming systems. The partnership is extending the impact of OFSP varieties through community awareness of nutritional benefits. International Potato Center in collaboration with Soroti district agricultural extension agencies/National Agricultural Advisory Services (NAADS), research institutions, community-based organization such as Soroti Catholic Diocese Development Organisation (SOCADIDO), World Vision launched as an immediate action plan for establishment of OFSP varieties by facilitating distribution of planting material and awareness raising about vitamin A deficiency to potential sweetpotato farming communities. Since the launching of OFSP in Gweri sub-county in September 2002, CIP has continued to support sensitization seminars, workshops, radio talk shows and press articles involving a cross section of stakeholders. International Potato Center (CIP) facilitates the provision and delivery of planting material for commercialisation and evaluation, and is spearheading the promotion of OFSP as an industrial crop by encouraging processing and searching for viable market options.

Farmer Field Schools (FFS) are an effective and popular method of farmer education in which learning is through discovery and adoption. Farmer Field Schools have been found to be a successful technology dissemination approach in a number of countries including Indonesia, Sudan, Benin, Ethiopia and East Africa Federation (M'Boob, 2002**)** they facilitate increased farmer understanding of crop ecology and farmer experimentation combining and comparing indigenous and researcher developed technologies that allow farmers to evaluate and develop appropriate pre and post harvest crop management strategies for their specific farm conditions and needs. Farmer Field Schools have become popular entry point for most agriculturally -oriented programmes in Uganda including NAADS and Acquired Immunity Disease Syndrome (AIDS) Awareness activities. Technical staff in the traditional extension service or graduates of

previous FFS are contracted to facilitate the FFS throughout the cultivation season.

Participants are led through the growth and development stages of both the above and underground plant parts by using a hands on approach, or inciting leading to discovery and action. The language of guidance or instruction is preferably indigenous. Group dynamic exercises enhance togetherness and their sub-group session rotation as hosts, computation and result presentation leads to expression of their value of togetherness, mission understanding and leadership challenges. This has been manifested in a number of FFS graduates from previous Integrated Pest and Production Management (IPPM) FFS being elected to responsible positions within the community leadership councils, and the evolving of farmer facilitators' association with the aim of competing for provision of selected community services.

Inclusion of OFSP variety growth and performance assessment in FFS learning and commercial plots enhanced their dissemination and highlighted their nutritional importance. Participants sensitized on the use of OFSP, multiply varieties that have already passed consumer acceptance tests, evaluate agronomic performance of candidate accessions, produce OFSP roots for commercialisation, process OFSP for commercialization and grow them side by side in their own fields. Achievement days during which the community and influential people are invited are held to display the activities done during the season. Therefore the objectives of the partnership were to: 1) promote sweetpotato integrated field crop and post harvest management; 2) make orange-fleshed sweetpotato available on large-scale, demonstrating the potential of crop-based approaches in alleviating micro-nutrient deficiencies; 3) promote commercialisation through processing and utilization.

Strategies used for promoting OFSP varieties

Linking farmers to market. A meeting on linking sweetpotato farmers to markets was held on 5th Sept 2002 at SOCADIDO, Soroti chaired by Father Martin Aeho and attended by the marketing manager of Maganjo Grain Millers; sweetpotato farmers from potential sweetpotato growing areas in Soroti district, community development organizations (SOCADIDO and World Vision), researchers involved in sweetpotato improvement and post-harvest programmes, agricultural field extension workers, the CIP regional breeder, the SP IPPM FFS project assistant, and nutritionists. The goal of the meeting was to promote the socio-economic development of OFSP farmers and processors through integration of production, processing and marketing thereby linking a wide range of public and private sector institutions. During the meeting community-based organisations and farmers emphasised the lack of market as the most important limiting factor for large scale production because farmers tend to avoid excess root harvest for fear that they would not be able to dispose of them while in contrast processors represented by Maganjo Grain Millers singled out lack of chips from sweetpotato producers as a factor delaying effective inclusion of sweetpotato in their composite flour mixtures. Therefore strategies developed to promote both production and processing included: a) acquisition of vine stocks from central region, establishment of rapid multiplication plots and swamp nurseries to buffer up supply especially for immediate planting after prolonged dry seasons were components sighted for sustaining the seed systems in Soroti and Kumi; b) establishment of a sustainable rural-based sweetpotato processing enterprise to supply quality dried chips to identified market opportunities. CIP/PRAPACE pledged to provide two processing machines for the two groups that would be

identified as potential processors; c) identification of contract farmers to multiply seed vine of Ejumula, Kakamega and Naspot 5 orange-fleshed varieties for distribution to other farmers; d) a field day was planned to be held at Gweri sub-county as a central and potential sweetpotato growing area to sensitize the community on combating vitamin A deficiency and promote on-farm production of sweetpotato for home consumption and market.

The viability of commercializing production of OFSP varieties was estimated by assessing the expected production costs and compared with the processors' price offers. It was observed that during slack seasons leading to limited root supply, processing was not profitable because the open markets would offer better prices for roots. However, participants noted the viability of piloting orange-fleshed processing as a first step towards promoting industralisation of sweetpotato and stimulating increased production. Costs and profits at different levels of sweetpotato production and processing were estimated and indicated that commercial processing was not economical (Table 1).

Field day to launch OFSP varieties. Promotion activities for OFSP varieties launched at Gweri sub-county in Soroti, eastern Uganda in 200.

Table 1: Costs for processing 100 kg of dried sweet potato chips using powered chipper and raised tray dryers.

Item/activity	Details	Quantity	Unit price (US$.)	Sub total (US$.)
Fresh tubers	Farm gate price	3 bags (320kg)	4.00	9.00
	Peeling 3 bags	6 pers @ 4.5 hrs	0.13/pers/hr	3.38
	Washing	3 pers. @ 6 hrs	0.13/pers./hr	2.25
	Water	6 jerry cans (120 lts)	0.03/jerry	0.15
Slicing	Labour	2 pers.	0.13/hr/pers.	0.13
	Fuel	0.5 litres	0.70	0.35
	Oil	0.5 litres	0.50	0.25
Drying	Labour	2 pers./1.5 days	0.40/pers./day	1.20
Packing	Gunny bags	1	0.25	0.25
	Inner polythene	1	0.25	0.25
Transport	To Maganjo	100 kgs	0.01/kg	1.00
Total processing cost	Slicing, drying and delivery of to factory	3 bags of fresh roots (320 kgs)	6.07/bag	18.21
Production cost of dried chips	3.2 kgs fresh roots = 1 kg dry chips	100 kg	0.18	18.00
Factory price/ kg chips	I kg of dry chips delivered at factory	1 kg	0.18	0.18
Gross income	Sale of chips	100	0.18	18.00
Net profit	3 bags of fresh tubers or 100 kgs chips			0

The CIP regional breeder highlighted the efforts being taken by different partners and the importance of OFSP program for combating Vitamin A deficiency. During the function the VITAA Coordinator reported that the occasion was part of a series of planned promotional activities to be held in the country and other parts of Africa through the VITAA initiative. Success stories associated with OFSP cultivation and use in the central region of Uganda were shared with other participants. Demonstrations were carried out on sweetpotato production and processing and exhibition of sweetpotato products such porridge, and processed flour from Maganjo processing factory were displayed. Some planting materials of OFSP were also distributed.

Public and farmer - awareness seminars, talks, workshops. The district policy making body urged councilors to advocate for consumption of OFSP varieties. They also pledged to encourage educational boarding institutions to include OFSP in their weekly menus. Radio talk shows involving policy stakeholders were organized to promote production, consumption and marketing of OFSP varieties. During technical review workshops OFSP was highlighted as a cost-effective nutritional strategy for the majority of rural people. One commonly highlighted issue during the meetings was the comparison of vitamin A levels in common staple foods and the vitamin A requirements (Table 4) which served as evidence to help justify the adoption of OFSP into the production systems and dietary habits.

Provision of the most limiting inputs. International Potato Center (CIP) in liaison with National Agricultural Organisation (NARO) and district farmer-oriented organizations namely NAADS and SOCADIDO facilitated the supply of OFSP planting material and two chipper machines on credit for pilot processing.

Promotion of production and post-harvesting technologies. Two pilots SP IPPM FFS with a total of 60 participants successfully completed the first field season in July 2003. A field day was held and OFSP products (doughnuts, pancakes, chapattis, cakes, crisps and chips) exhibited. These products sold off very fast and stimulated the demand for vines of these varieties and the scaling up of the project to a wider section of the communitycoverage. Therefore, 4 sweetpotato farmer field graduates who excelled during the first pilot cycle were selected for a week-long induction skills empowerment training at Namuloge Research Station so that they could boost the 2 extension-led facilitators and the number of could then be tripled during the second pilot cycle.

Table 2: Vitamin A levels (average per 100g edible portion) in common foods in East Africa.

Source	Form [Beta carotene equivalent (g)]						
	Fresh	Boil	Skin boil	Dried	Porridge	Bread	Leaves
Sweet potato	0-20,000		0-20,000	7,820			2,700
Cassava		0-20					8,280
Fresh maize		240					
Maize flour					0	0	
Rice		0					
Beans		Trace					
Carrots	12,000						
Tomato	600						
Cabbage		Trace					Trace

Table 3: Root flesh colour of sweet potato related to dietary supply of vitamin A

Age/sex	Vitamin A requirement (µg RE)	Amount (g) of fresh sweet potato roots required to supply the daily requirements of pro-vitamin A			
		Araka (white)	Osukut (yellow)	Kakamega (orange)	Ejumula (deep orange)
1 day-3 years	400	3636	265	78	35
4 to 6 years	500	4545	331	97	43
7 to 10 years	700	6364	463	136	61
Females over 10 years	500- 850	7273	530	156	69
Males over 10 years	500- 600	9091	662	194	87

Source: (Technical Manual, 2003).

Production profile of OFSP. Inspite of the poor weather conditions (drought) during the first pilot season the SP IPPM FFS participants managed to produce and supply OFSP roots for processing and conserved vines for subsequent season otherwise the non-FFS growers lost all their crop. Total OFSP acreage increased from 10 acres during first season to over 70 acres in the second cycle. About 10 tons of OFSP chips were produced by FFS in the first and second cycles respectively.

Promotion of processing and marketing. To kick-start the processing and marketing of chips, the NARO post-harvest programme extended a revolving fund to processors to pay for the roots and meet the costs involved in processing and transportation of dried chips to Maganjo flour milling factory. Continued efforts have been directed towards attracting alternative markets for dried chips such as Kirinyaga millers in Nairobi, Kenya and Ugachick poultry feed producers in Uganda. Maganjo flour products are available in most Supper Markets in Uganda. Preparation and utilization of various recipes is being encouraged through FFS.

Field achievement day.A joint field day organized by SP IPPM FFS project and Abuket Oyuunai Sweetpotato Processors to appraise the activities of farmer field school activities was held at Okunguro Farmer Field Schools (FFS) and attended by a cross section of stakeholders. The event was officiated by the Local Council V (LCV) Chairman, the highest policy making organisation in the district. Field guided tours and demonstrations were conducted to explain the improved field production technologies, commercial sweetpotato chipping and preparation of various OFSP recipes were demonstrated and exhibited for sale. Local songs and a poem were sang and recited to express the usefulness of the SP IPPM FFS project.

Achievements - The partnership made the following achievements:

a. Rapid dissemination increased production and consumption of OFSP varieties,
b. Farmers appreciation of the commercial potential of sweetpotato and the successful linkage of primary processors to flour millers,
c. Intra-institutional participation in promotion of OFSP varieties,
d. Inclusion of sweetpotato on the priority list of Gweri and Kyere subcounties, and subsequent approval of funding by NAADS.

Lessons learnt by promoters and farmers

- Commercialisation through processing did not seem to be profitable while the sale of OFSP roots to boarding schools appeared

more promising. Further promotional strategies are being geared towards increased food processing and local fresh root consumption. It is important for food processors to focus at flour mixtures for both the medium class and traditional rural markets whose stocks often run out during prolonged post-harvest seasons.

- Whereas farmers recognize that their production approaches result in low yields, they avoid opportunities that

Table 4: Institution responsibilities and significance of linkage to promotion process.

Institution(s)	Responsibilities	Importance of promotion process
NARO	Provision of basic seed and training in production techniques and post harvest handling	Availability of improved clean seed, product utilization /acceptability & technology empowerment
SOCADIDO/ World Vision	Seed distribution to communities and farmer group formation	Household food security, wide dissemination and adoption in every household in the communities, wide seed distribution
CIP	Provision of advanced clones and technical support	Variety dissemination, adoption and utilization/ acceptability & sustainability
SP IPPM FFS project (Global IPM Facility, CIP, NRI, NARO, KARI)	Project development for SP IPPM FFS, sourcing funds for FFS activities, project implementation, reporting, M&E, dissemination, mirror activities in W. Kenya & W. Tanzania	Implementation (Set up, fund, support and monitor all SP IPPM FFS activities and plan scaling up)
PRAPACE	Technical support	Market orientation and technology adoption
NAADS/DAO	Enhanced variety and technology dissemination and adoption	Modernisation of agriculture (Food and poverty alleviation)
Farmer groups	Field and post harvest evaluation, proper management and commercial production	Enhanced production, processing and marketing skills
COARD	Training farmers in seed multiplication, conservation and quality chip production	Enhanced production, processing and marketing techniques at farmer level. Training farmers in clean seed production and conservation, and quality chip production
Flour millers	Flour processing	Value addition and creating vertical sweet potato marketing
Policy makers	Sensitisation and project activities backing	Increased adoption, acceptability and approval of scaling up
Educational institutions	Provision of market and in-depth sensitization	Sustainable wide utilization multiple dissemination and adoption

result in excess harvests that may not be disposed off. The marketing opportunities being created for OFSP have enhanced technology up-take because farmers want to take advantage of presumed profitable opportunities.

- Orange-fleshed sweetpotato chips have poor mashing characteristics during local dish preparations (Atap). This may lead to their poor adoption. However, processing OFSP into other products may encourage farmers to adopt them.

- Embracing Extension officers from the existing traditional service is a disincentive to technology dissemination and adoption unless they are closely supervised. Farmer facilitators, with a good grasp of the technologies and approach were found to lead to better learning by the FFS.

- Rallying local stakeholder support speeds up the process of promotion and dissemination.

- Machine-sliced chips are not easily affected by storage weevils as compared to traditional manual slicing method.

- Commodity market potential is a crucial sustaining ingredient of technology reception and adoption.

Discussion

Although significant progress has been made towards promoting production, processing and consumption of OFSP varieties, there is a general need to search for more competitive markets for both roots and chips. Existing opportunities such as exportation of organic fresh roots to European Union countries avenues to supply local markets should be explored. Farmers are also encouraged to stagger their planting periods to avoid over supply during peak harvest seasons.

Research should among other tasks develop varieties that fit the traditional cooking and eating qualities of white-fleshed roots. Farmers/consumers have already reported problems with the poor fragmentation of boiled orange-fleshed chips during preparation of local dishes. Processors could investigate the potential for packing sweetpotato-cassava composite flours to increase their shelf-life so that it can be supplied to Super Markets and local shops. This would increase the level of use of OFSP flour as most potential consumers would like to avoid laborious processes of preparing local foods. OFSP varieties especially the most popular Ejumula is highly susceptible to viral infections implying that they cannot be recycled for more than three generations. Therefore arrangements should be made to replenish them with clean vines periodically.

Collective appraisal of the of approaches used by different stakeholders would probably lead to wider appreciation and advocacy for institutionalization of the FFS approach among different stakeholders both as a technology and input-based approach for agricultural-oriented communities.

Conclusions and Recommendations

- Orange-fleshed sweetpotato promotion through SP IPPM FFS has resulted in fast and effective dissemination and adoption of IPPM sweetpotato technologies.

- More initiatives are needed to widen the market opportunities and improve on prices.

- Research should focus at improving disease resistance, especially viruses and dry matter content of OFSP varieties. Opportunities to conserve vines during dry season should be encouraged to avoid continuous purchases of vines from the central region where the virus pressure is much higher.

- Follow-ups on FFS graduates and increased support to backstopping the farmer-facilitators through the farmer facilitators association to establish a sustainable technology dissemination system.
- Policy makers should spearhead the institutionalization of the FFS approach
- Farmer processors chipping roots should explore opportunities of acquiring soft loans from community-based credit institutions.
- Millers should aim at composite formulations for both local and foreign markets.
- Further sensitization on quality maintenance especially of grated products.
- Scaling up dissemination of OFSP varieties within and outside Soroti district.

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