

**CROP POST HARVEST PROGRAMME**

**An enterprise approach to commodity system improvement:  
sweetpotato in Uganda and Kenya**

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## 1.0 EXECUTIVE SUMMARY

Rural micro scale enterprises commercialising sweet potato-based food and other food products in Uganda and Kenya offer potential for income generation and employment for women usually responsible for food processing and marketing as well as for enhanced utilization of the root crops. This creates supply and demand for the new food products both in the poor household and for the local market sales, and contributes towards reducing poverty and improving nutrition and food security. This project aimed at identifying strategies, methods and technologies to improve both micro-enterprise performance and the quality, processes, and markets of sweet potato-based food products.

Multidisciplinary efforts involving CIP, NRI, local and national research and development institutions in East Africa, regional networks, producers and consumers both in rural and urban trading centers of Uganda and Kenya, have been collaborating on the development of new products to add value to sweetpotato, reduce poverty among sweetpotato growers and improve their food security and nutrition. The achievements to date have been :

Efforts involving producers and consumers in rural and urban trading centers of Uganda and Kenya demonstrated the feasibility of using fresh sweetpotato or sweetpotato flour (in mixture with other flours) in fried and baked snack food products (buns, chapatis, mandazis, and pancakes) with sweetpotato as an ingredient. The availability of new orange-fleshed sweetpotato varieties high in pro-vitamin A gave added impetus to the work, due to the enhanced nutritional value and attractive appearance of products produced with these new varieties. As a result, small-scale businesses owned mostly by women, and selling home-cooked foods at local markets emerged at several locations in Kenya and Uganda. Micro-scale women processors were eager for exposure to such technologies and were ready to invest their limited resources in the pursuit of higher incomes through exploiting the emerging demand for new products. Efforts aimed at promoting products (*chapatis* and *mandazis*) having sweet potato as an ingredient, continued in Kenya, and, community-based organisations (CBOs) in Busia, Siaya, and Teso Districts with a network of thousands of poor micro-scale sweet potato growers and women`s groups were involved.

In the household economy of the northeast Uganda (Kumi, Soroti, and Katakwi Districts) 80% of sweet potato was found being traded in the fresh form and sweet potato flour was identified as a most promising product for urban markets (sweet potato flour of acceptable quality was produced at the farm-level in Soroti at a commercially attractive cost: Ushs140 about US\$0.14/kg). Soroti area was identified as a favorable site for the development and evaluation of the sweet potato flour production technology based on the current importance of the crop in the area; the potential for increased production; the favorable climatic conditions for seasonal drying; and the existence of indigenous processing technology which served as a base for production of commercially acceptable flour.

Costs of producing and processing swetpotato have been analysed and compared with other crops and other small scale enterprises. It was found that in Soroti, Uganda, and Teso, Kenya, costs of sweetpotato production are currently higher than those of cassava, but lower than those of sorghum, millet and maize. The annual profit margins for producing major crops in Soroti, Uganda, suggested that the investment in sweetpotato, cassava and groundnuts was a good way of combating poverty in the poorest households from the remote areas. Poor households were found characterized by inadequate food supply throughout the year, were casual labourers in neighbours' fields for food or money, had limited purchasing power (did not have cattle but could have a few goats or pigs, did not have oxen nor utilities like a plough for cultivation), had very poor health conditions and incomplete knowledge about nutrition.

Constraints to the wide adoption and development of food processing have been identified and ranged from the product quality, the limited understanding of market and consumer needs, lack of standard process and adapted equipment and utilities, and lack of financial support for risk-taking. The survey of 29 such micro-scale enterprises indicated that the

technical factors influencing their consolidation were a) lack of support for risk-taking (94%), b) product quality (92%), c) lack of standard process and adapted equipment (75%), marketing (70%), d) consumers needs (40%), e) local taxes (40%), and f) competition (50%). Also, they were socio-economic factors related to the lack of clean water, energy for mechanization of operations, poor transport facilities, poor health and illiteracy which should have required heavy investments far beyond the scope of this project activities.

Technologies for improving the sanitation and quality of dried sweetpotato products to meet market need have been developed and evaluated in the field, and village-level adapted sweetpotato processing methods involving the cleaning, washing, slicing, sun-drying, and adapted storage processes of dried material have been introduced into the farming system. The current indigenous sweet potato processing technology of drying was found not profitable due to the high cost of labour and lack of adapted tools. We then introduced the sweet potato slicer into the farming system, which reduced the labour by 10 times and increased the profitability of processing sweet potatoes into dried chips by 4 times. More than 500 sweet potato slicer were manufactured by a local private enterprise and sold to farmers/processors in the area. Ten out of 17 sampled farmers/processors and exposed to the holistic process of producing clean dried sweet potato chips went ahead and started the processing of the product for the households and the neighboring markets. The sanitation levels of the dried sweet potato products produced by local villagers using the new introduced and improved schema increased significantly, and more than 95% consumers found that the improved flour made high quality local bread (*atapa*) and porridge for their children. Dried sweetpotato was found to have a local market particularly in the area of the nomadic Karamojongs and Katakwi District. Because of their pro-vitamin A contents, dried orange-fleshed sweetpotato from the newly introduced variety Naspot 5, was of exceptional interest for existing NGO programs, particularly in the mode of disaster relief in the far North of Uganda and Southern Sudan.

Students, technicians, extensionists, and farmers/processors have been trained, young scientists supported in the initial research on sweetpotato post-harvest issues; a working group on post-harvest sweetpotato research has emerged in both Uganda and Kenya;

Considerable interest and support have been stimulated among research directors, NGOs, rural development projects, church leaders, institutional linkages on sweetpotato post-harvest and processing issues within and between Uganda and Kenya have been fortified, and made more inclusive and effective in the process;

A body of locally generated scientific literature has begun to be developed to provide the foundation for longer term efforts aimed at addressing sweetpotato post-harvest problems and opportunities;

In different agro-ecological zones of East Africa, a number of high yielding, early and tasty cultivars which are high in both dry matter and pro-vitamin A have been identified. The levels and stability of pro-vitamin A have been evaluated, and their potential use in locally processed foods has been assessed and validated;

A multidisciplinary team approach has been found essential to ensure that new products are commercially viable in the market and can be profitably produced using low-cost techniques.

## 2.0 BACKGROUND

Sweet potato is an increasingly important crop in Uganda and much of the densely populated mid-elevation region surrounding Lake Victoria in eastern Africa. Millions of poor small-scale farmers, mostly women, produce the crop primarily for home consumption and to a lesser extent for commercial sales in local or urban markets. The increasing importance of sweet potato in the Lake Victoria region and elsewhere in sub-Saharan Africa is largely attributable to the crop's relatively high productivity across a range of environments, and its short cropping season, and flexible planting and harvesting schedules (Ewell, 1993, Hall et

al., 1998). Periodic droughts and the rising costs of grain production have also contributed to the increasing importance of sweet potato both for food security and income generation (Scott et al., 1999). Table 1 highlights the importance of sweet potato in Ugandan food crop production.

**Table 1.** Ugandan food crop production, 1987-1989 vs. 1995-97

Crop	1987-89		1995-97	
	Production (1000 t)	%	Production (1000 t)	%
Matoke	7,267	50.3	9,153	57.0
Cassava	3,313	22.9	2,253	14.0
Sweet potato	1,683	11.6	1,888	11.8
Maize	474	3.3	804	5.0
Millet	569	3.9	525	3.3
Sorghum	335	2.3	330	2.1
Beans	341	2.4	282	1.8
Potato	207	1.4	360	2.2
Groundnuts	134	0.9	120	0.7
Rice	-	-	80	0.5
Soybean	13	0.1	83	0.5
Sesame	35	0.2	72	0.5
Pigeonpeas	38	0.3	58	0.4
Cowpeas	38	0.3	46	0.3
<b>Total</b>	<b>14,446</b>	<b>100</b>	<b>16,055</b>	<b>100</b>

In Soroti and surrounding districts of north-east Uganda and W. Kenya, sweet potato has become very important in recent years due to serious disruption of basic food supply (cassava) by an epidemic of African cassava mosaic disease (ACMD), and the decimation of cattle (draft animal) populations during a period of civil strife in the late 1980s (Otieno, 2000). In this area, sweet potato has become both an important household food, and a source of cash through sales to the fresh market in Kampala (Versteeg, 1998). Opportunities for further expansion of commercial production of sweet potato in this area are likely to increase, as resistant cassava regains its importance through the introduction of ACMD-resistant varieties, and as cattle restocking takes place, provided that markets for sweet potato can be expanded (Otieno, 2000, Mudiope et al., 2000).

In sub-Saharan Africa, sweet potato is mainly marketed in the fresh form, and is consumed boiled, steamed or roasted (Woolfe, 1992, Westby, 1999). Fresh sweet potato roots are bulky (being over 65% water) and quite perishable due to water loss and rots (Gatumbi et al., 1994, Karuri and Hagenimana, 1995; Tomlins and Ndunguru, 1999). These factors seriously limit demand and commercial potential for sweet potato in the region.

However, in some drier areas, such as north-eastern Uganda and the Lake Zone of Tanzania where sweet potato is a major crop, slicing or crushing and sun-drying of sweet potato are widely practised by local people to produce a dried food product that can be stored for some months (Hall et al., 1998). This indigenous product is ground into flour and mixed with sorghum, millet or maize to produce staple dishes. Although dried sweet potato products are very important in local diets where they are produced, there is little commercial trade in these products. The quality (Van Hal, 2000) of sweet potato flour produced at the household level is generally very low, due to low levels of sanitation used in the processing

and handling, and the potential for use by bakeries is untapped.

CIP's efforts on sweet potato research and development in sub-Saharan Africa are aimed at enhancing the role of the crop for both food security and income generation for small farmers in the region. This work is currently focused in Uganda and Kenya, and is conducted in close collaboration with partners from the national agricultural research and extension systems, universities, and NGOs, and other international partners such as the Natural Resources Institute (NRI) and IITA. The effort is interdisciplinary in nature, involving crop production (plant breeding, plant health) postharvest and socio-economic research. In Uganda, this work is concentrated in Soroti and surrounding Districts, where sweetpotato production is important and the potential for expanded production and processing are high.

New varieties, including an orange-fleshed variety with high dry matter content developed by the Ugandan breeding program, have already been introduced at the primary sites of this project. In different agro-ecological zones of East Africa, a number of high yielding cultivars, which are high in both pro-vitamin A and dry matter have been identified (Gichuki et al., 1997; Carey et al., 1999). The levels and stability of pro-vitamin A have been evaluated (K'osambo et al., 1998; Hagenimana et al., 1999a), and their potential use in locally processed foods has been assessed and validated (Omosa, 1997; Hagenimana and Owori, 1997; Hagenimana et al., 1998, Fawzia et al., 1999).

Small enterprises producing commercial food products based on sweet potatoes are a reality in both Lira and Soroti in Uganda, and Teso, Busia, Siaya, Kakamega in Kenya (CIP, 1996; Hagenimana and Owori, 1996, Owori and Hagenimana, 2000, Nungo et al., 2000, Wanjekeche et al., 2000). Project X0263 studied individual enterprises, and identified technological innovations that could improve enterprise performance (processing, product formulation etc.) and critical aspects of raw material quality. This project also identified some of the more general enterprise development needs, such as improved business skills, better market information and access to credit. One area that was highlighted was that most products sold were made from either fresh, grated roots or cooked, mashed roots. Dependence on a perishable, seasonal raw material (with fluctuating prices) hindered continuity of the product in the market and increased labour costs. These could be overcome through the use of sweet potato (SP) flour as a stable, easily transportable intermediate product.

Dried sweet potato chips are produced traditionally, and flour (from milled chips) is used by some enterprises, but products are inferior compared to similar ones made from fresh roots. Identification of appropriate, cost effective methods to improve the quality of sweet potato flour, and the products made from them, would benefit enterprises in many ways. One output from this project was therefore procedures to improve the quality and marketability of sweet potato based products, especially those based on sweet potato flour.

This output was promoted to collaborating national research institutes and, through them, to NGO's and others directly involved in enterprise support activities. The links between national research institutions and NGO's operating in the project areas was strengthened through their joint involvement in the activities of this concluded project.

To obtain region-wide impact from the previous research and the new activities of this project, it was necessary to have a broader understanding of the role the small enterprises play in the project areas, and their future potential. This involved a more comprehensive assessment of sweet potato compared with other crops, of processing compared with other types of crop utilization, and of the food products compared with others at the household and market levels. An analysis of the above provided a guide to the raw material supply and product markets, which assisted with the development of a strategy for the development of the micro-scale enterprise sector working with sweet potatoes. The strategy also included the dissemination of project results. The following sections provide more detailed information on the present state of knowledge on sweet potato production and utilization, resulting from this project and other related activities.



## Sweet potato production and harvesting

Sweet potato is a classic food security crop characterised by small-scale production, low inputs, and modest yields (Ewell, 1993). It is vegetatively propagated and the storage roots have a low dry matter content (30% of the root) with starch being the major component (Hagenimana, 1994). The high moisture content of the roots means that they have poor storability and high transport costs. These aspects have made sweet potato essentially a crop for rural consumption in settings where the chain from the producer to consumer is short.

Sweet potato is a major staple food in Uganda, Rwanda, Burundi, and Eastern Zaire, and a secondary food crop in the grain-based food systems of Eastern, Southern and Central Africa. Sweet potato roots are usually harvested piecemeal over an extended period, and this provides a flexible source of food for households (Smit and Ocitti p'Obwoya, 1994). There is no long-or even intermediate-term post-harvest storage of sweet potato roots in East Africa. The kind of storage regularly practised in the region is in-ground storage, by which farmers keep un-harvested mature sweet potatoes in the field until they are needed for consumption or sale. However, after maturation, pest infestations by sweet potato weevil (*Cylas* spp.) become severe and cause production losses up to 50% (Ndamage, 1988). Since 1993, research on integrated pest management for sweet potato weevils has taken place in Uganda, as a collaboration between the NARO sweet potato programme and CIP. Presently the most promising IPM components appear to be cultural control practices, such as crop sanitation, selection of healthy planting material and avoidance of adjacent planting. Mass trapping of weevils with sex pheromones might also hold some promise (Nicole Smit, personal communication).

The fresh root is most often consumed boiled or roasted (Hall, 1996), and studies conducted by the team of the NRI-Uganda project on non-grain starch staples have shown that using simple pit or clamp storage, sweet potato could be stored for up to eight weeks under ambient conditions in Central Uganda with only minor losses (Devereau and Bockett, 1994). NRI (with funding from the DFID Crop Post-Harvest Research Programme) in collaboration with CIP's breeding programme is currently developing recommendations for appropriate cultivars and practices which improve root quality and extend fresh shelf-life in the relative short-term, but also to develop an understanding of the physiological mechanisms involved in deterioration which will enable the development of improved cultivars in the long-term for East Africa and other areas of the world (D. Rees, personal communication).

## Current utilisation of the crop

Sweet potato utilisation is remarkably narrow in East Africa. In some parts of Uganda (Bashaasha *et al.*, 1995) and Tanzania (Kapinga *et al.*, 1995) with a long, hot dry season, serious attacks by weevils limit the length of time that roots can be stored in the ground, and farmers harvest, chip, and sun dry the roots as a way to preserve and store the crop. In Uganda, dried sweet potato has always been an important staple during the long dry season (Hall, 1995). It ensures food security not only for those households holding stocks but also for the community as a whole because those without food reserves work for those who have them, in exchange for dried sweet potato.

*A. fasciculatus* has been identified as the major loss causing organisms of dried sweet potato chips (Agona, 1995). Management methods to reduce its pest status and damage levels including parboiling of roots prior to slicing and drying, storage of dried chips in sealed containers, varietal trials, salting prior drying and other desinfestation methods focused on solar energy have been studied at Kawanda Postharvest Programme, Uganda, with NRI Crop Post-Harvest Programme support.

Vines are fed to livestock particularly in central Kenya where small-scale dairying in zero grazing management systems is well developed. They are also being used as starter feed

and partial milk replacer for young calves (Orodho *et al.*, 1995), and source of protein in pig feed formulations (Peters, 1997).

### **Sweet potato products for small enterprises in East Africa**

Collins and Abdul (1982) testing the effect of sweet potato flour as an ingredient on quality of yeast-raised doughnuts found the overall quality not significantly lowered by addition of sweet potato. The assessment of the current and potential demand for fresh and processed sweet potato products in Nairobi and Kisumu (Kenya) (Omosa, 1997), Kampala (Hall *et al.*, 1995) and Lira (Uganda) (Hagenimana and Owori, 1996) has been completed. Consumers from these East African towns found the various proposed products (bread or buns, chapatis (indian flat-type bread, and mandazis (doughnuts) highly acceptable and competitive to similar products.

A recent evaluation of pilot experience sweet potato based food enterprises in Western Kenya (International Potato Center, 1996, Nungo *et al.*, 2000) has established the existence of a substantial and fast growing market around urban trading centres for sweet potato products and identified early maturing, yellow fleshed and floury textured roots as the ideal sweet potato varieties for processing into a range of food products, including mandazis and chapatis. Factors influencing the quality of the above sweet potato fried products and information on technical problems related to the processing have been studied (Hagenimana *et al.*, 1996), and sweet potato germplasms have been evaluated for their suitability for processed products (Owori, 1997; Hagenimana *et al.*, 1999). Laboratory results on the use of orange-fleshed sweet potato root flour in processing buns, chapatis, and mandazis have shown that the incorporation of orange-fleshed sweet potato roots in the processing of above mentioned products increased the pro-vitamin A content by 20 times (Hagenimana *et al.*, 1999). Orange-fleshed sweet potato varieties have been introduced for production and processing into indigenous foods in W. Kenya to combat vitamin A deficiency in a food-based approach and the first results are promising (Low *et al.*, 1996, Hagenimana *et al.*, 1999b, Hagenimana and Low, 2000).

Results of research on the standardisation and development of sweet potato-based food product formulation, conducted at Kawanda Research Institute and Lira Municipality (Owori *et al.*, 1997) showed that the quality characteristics of sweet potato processed products are highly acceptable to consumers and the gross margins were attractive to processors. Owori *et al.*, (1997) have been regularly visiting sweet potato processors in Lira and the major constraints to the establishment of their enterprises were the regularity of supply in sweet potato raw material (fresh or dried) and the inconsistency in quality of their products. The more easy-to-use and storable sweet potato flour was not yet commercialised at a large scale, and the quality characteristics were influenced by variety and the poor sanitation associated with indigenous flour production.

Flour has several advantages over fresh roots for processing. It is easy to handle and transport, storable, more acceptable for use in bakeries and other clean food preparation areas. These are potentially important to small enterprises in a range of situations.

In small bakeries of rural areas, raw material costs would be low and the products more competitive with wheat flour. In urban centres, trials with cooked, mashed sweet potato roots in bakeries gave highly accepted products, but the fresh root was not suited to use as a raw material on these premises (Hall *et al.*, 1995). Flour would be a more acceptable and familiar alternative for bakers. However, the quality of products made using flour, reflecting the quality of the flour currently available, needs improvement.

In addition to the technical issues of flour quality, other factors affecting the use of sweet potato as a raw material for a range of enterprises have been identified. For small enterprise based processing to take off (Agne *et al.*, 1997), there is a need for multidisciplinary post-harvest research, to actively pursue innovative linkages with local agencies capable of enhancing individual enterprise performance through better management and use of market



information. This is in addition to the organisation of individual small-scale and village level food processing enterprises as a sector, with potential for influence in the political process. This project attempted to foster such linkages between technical and enterprise development research as an effective means to resolve constraints, and take advantage of the opportunities that exist around the sweet potato crop.

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WESBY, A. (1999). Getting to the Roots (and Tubers) of Development. Inaugural Professorial Lecture. University of Greenwich Press, Greenwich, UK.

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### 3.0 PROJECT PURPOSE

The project contributed to the programme purpose, which was “More efficient and cost effective methods of processing developed and facilitated” (see Project Logical Framework in Annex 1) when the project was initiated. Following the revision of the Crop Post-Harvest Programme logframes the purpose of the project falls in “Strategies developed which improve food security of poor households through increased availability and improved quality of root crop and horticultural foods and better access to markets”

The technical outputs of the project (appropriate methods for the production of marketable sweet potato-based food products by small enterprises) contributed to increased efficiency and cost effectiveness. The outputs from enterprise development activities facilitated the implementation of these methods by target small enterprises.

### 4.0 RESEARCH ACTIVITIES AND OUTPUTS

This report summarises the activities and outputs of the project. Publications and technical reports are listed in Section 5 of this report. A number of the outputs are available on a ZIP Disc and these are listed in Annex 2. The project logical framework is given in Annex 1.

This section of the report is organised according to the outputs of the project.

### **Output 1: Strategies developed and promoted for the successful development of the small enterprise sector based on sweet potato products.**

Activities were conducted in both Soroti and Lira, Uganda and W and S Nyanza Province, Kenya. This project was interdisciplinary and some research activities of output 2 were concomitantly undertaken with Activity 1.2.

All activities were implemented with the main collaborating institutions: National Potato Programme of Tigoni and Regional Research Center, Kakamega, KARI, Kenya, National Post-harvest Programme, NARO, Uganda; Makerere University, Uganda; University of Nairobi, Kenya; and Natural Resources Institute (NRI), and most activities also involved the participation of local development agencies, community based organisations and NGOs.

#### Activity 1.1. Identify factors contributing to success or failure of existing small enterprises.

In the area of Lira, Uganda, a representative sample of existing small enterprises was identified. An enterprise was considered as an individual or a group of individuals who were growing, processing or closely associated with the production/processing of sweetpotato.

The sampling took into account the following variables: enterprise type (individual or group), gender, processes and products made/marketed (including whether enterprise produces only sweet potato-based products, or uses other basic raw materials for a wider range), type of market outlet, volumes traded and access to support systems. In addition, a number of small enterprises producing and marketing other (similar) food products not made from sweet potato were included for comparative purposes.

Using PRA methods, twenty nine micro-scale enterprises trading foods were surveyed. Half of them were women's groups, and the remaining were private individuals. Each village-based women's group had an average of 15-15 members. 25% of the groups had an organization committee, 11% had a sale/finance controller, 11% were led by churches and 4% of them were led by local NGOs. 82% of the microenterprises surveyed indicated that they received the information on how to use sweetpotato through a training in product development. The training was conducted by the National Postharvest Programme of Kawanda (32%), the District Agricultural Extension Office (32%), or they learnt from their neighbours (22%). Women interviewed said that they had trained their friends (71%) and some of the on-job trainees had started to make products in their homes (64%). They were mostly engaged in trading mandazis (50%), pancakes (18%), chapattis (11%), crisps (7%), millet/maize flour (4%), and other (15%). 39% of people interviewed thought that the by-products had no value, while 28 thought they had.

The average number of employees was 2.2, and each employee was being paid Ushs 3300 per week (US\$2.80). However, 67% of microenterprises had not costed the labour since the activity was communal for women's groups or familial for private individuals. 68% of interviewees found the activity profitable while 25% did not see it as enough profitable.

The survey indicated that the following factors have influence on their activities: lack of support for risk-taking (94%), product quality (92%), lack of standard process and adapted equipment (75%), marketing (70%), consumers needs (40%), local taxes (40%), and competition (50%).

Elements of the work were summarized in Annex (file 1)

Activity 1.2. Comparative analysis of sweet potato with other crops, and other small enterprise activities.

A representative group of farmers from the project areas, growing sweet potato or one of the other staple food crops (maize, cassava, sorghum, and millet) was selected. They were grouped as follows:

**Grouping farmers into wealth categories**

With the help of local council chairmen and persons knowledgeable about the well being of each individual in a selected village, a list of all the village members was made.

Then 3 people from the villagers were selected and went ahead to do the selections and classify all villagers into the 3 categories namely Wealthy, Medium wealthy and Poor.

That classification by each of the three was then compared and adjustments made where there were big difference in classification.

Wealthy category – had the following characteristics:

- 1) Should have oxen for cultivation with some cows or goats
- 2) Should have enough food throughout the year
- 3) Have some household items such as a bicycle, ox-plough, radio
- 4) Has an extra source of income: may be employed with a regular salary, or has educated children who may be sending money
- 5) Can hire labour regularly

Medium wealthy category:

- 1) Can afford to hire oxen or share with a neighbour
- 2) Has food throughout the year
- 3) Has a few livestock like goats, but not cows
- 4) Has some household items such as a plough which he shares with the neighbour who may have oxen but lacks a plough
- 5) Has an extra source of income and may be employed with a regular salary and has children going to school

Poor Category:

- 1) Normally widower orphans or widowed
- 2) Does not have food throughout the year
- 3) Are mostly casual labourers and does not have access to cash
- 4) Do not have cattle but may have a few goats or pigs
- 5) Work in neighbours' fields in exchange of the opportunity to use the plough in the own fields
- 6) Use hand hoes for most of the field operations

The comparison of the annual profit margins for producing major crops in Soroti, Uganda, were determined. The analysis demonstrated that the investment in sweetpotato, cassava and groundnuts were good ways of combating poverty in the poorest households from the remote area.

Table 2. Retail prices of various flours in Uganda, 1998-99.

Item	Price per Kg (Ushs)	US\$/tonne
Sweetpotato flour	140-200	100-130
Cassava flour	150-300	110-200
Maize flour	500-900	270-500
Wheat flour	800-1500	500-1000
Maize starch	2000-2500	1300-1600
Cassava starch	1500-2200	1000-1500

Table 3. Annual profit margins ('000Ushs) for producing majors crops in Soroti, Uganda, 1998-1999.



Category	Cassava	Sweetpotato	Groundnuts	Millet	Sorghum	Rice	Other crops (vegetables)
Well to do	2,887	3,082	1,474	156	57	682	3,415
Medium	2,724	3,668	654	40	61	847	394
Poor	2,621	3,363	1,577	56	103	255	118
Total	8,222	10,114	3,705	253	221	1,784	3,927

Poor households were characterized by inadequate food supply throughout the year, were casual labourers in neighbours fields for food or money, had limited purchasing power (did not have cattle but could have a few goats or pigs, did not have oxen nor utilities like a plough for cultivation), had very poor health conditions and incomplete knowledge about nutrition. The table demonstrated that the investment in sweetpotato, cassava and groundnuts was a good way of combating poverty in the poorest households from the remote areas.

More results on the same issue has been reported by Mudiope et al. (2000) in the paper presented at the *Fifth Triennial Congress of the African Potato Association*, Kampala, Uganda. May 29–June 2 2000.. Details are available in the annex file (2 and 3).

### Activity 1.3. Planning Workshop

A planning and more inclusive workshop was held in April 1998 at Serere Research Center and involved scientists from Namulonge and Kawanda, extensionists from Soroti, Kumi and Lira Districts, NGO SOCADIDO, and Soroti Development Project, and , discussed the potential of sweet potato processing to contribute to income generation and drew the strategy for the development of sweet potato based enterprises in Soroti.

A hint of the strategy had been drafted to the agricultural extension workers and food scientists from Kenya, Uganda, Rwanda, Madagascar, Malawi, Tanzania, R.D. Congo who attended in August 1997 a one-month course on postharvest and product development of root and tuber crops at Kabete Campus, University of Nairobi, Kenya.

### Activity 1.4. Social and economic impact assessment of the potential uptake of technologies and methods within the region (and beyond).

In the household economy of the northeast Uganda (Kumi, Soroti, and Katakwi Districts) 80% of sweet potato was found being traded in the fresh form and sweet potato flour was identified as a most promising product for urban markets (sweet potato flour of acceptable quality was produced at the farm-level in Soroti at a commercially attractive cost: Ushs140 about US\$0.14/kg). Soroti area was identified as a favorable site for the development and evaluation of the sweet potato flour production technology based on the current importance of the crop in the area; the potential for increased production; the favorable climatic conditions for seasonal drying; and the existence of indigenous processing technology which served as a base for production of commercially acceptable flour.

The results of the survey were reported in BASHAASHA, et al. (2000), the paper presented at the *Fifth Triennial Congress of the African Potato Association*, Kampala, Uganda. May 29–June 2 2000., and the report is in Annex (file 4).



## **Output 2: Technologies developed, evaluated and promoted for improving sweet potato based products to meet enterprise, market and consumer needs.**

### Activity 2.1. Selection of enterprises for process/product development research

Enterprises were selected for case study research. Criteria for their selection was based on the type of enterprise (farm level or not), location of the enterprise, products made, interest in collaborating (time, labour inputs), enterprise size/output, access to market etc. This selection was assisted by the work carried out for activities 1.1 and 1.2.

### Activity 2.2. improvement of sweet potato flour quality produced by or for small food enterprises, based on consumer/market needs.

Experiments were conducted in a small enterprises setting with the objective of improving the quality of the sweet potato flour produced whilst maintaining the cost advantage of the product. Experiments focused on sweet potato variety (flesh colour, browning reaction development during drying), size reduction, drying time, milling/sifting. Flour quality of samples were determined (chemical/nutritional, microbiological and organoleptic). Attention was paid to the nutritional quality of flour from orange-fleshed varieties, with high beta-carotene content.

Elements of the work were summarised in the following papers: Carey et al. (1999) published in *Food Security and Crop Diversification in SADC Countries: The Role of Cassava and Sweetpotato*. Edited by M.O. Akoroda and J.M. Teri. SARRNET, Malawi.; Ewell and Hagenimana (2000), the paper presented at the conference on *Alleviating malnutrition through food-based approach*, Cape Town, South Africa. 22-25 November 2000.; Hagenimana and Low (2000) published in *Food and Nutrition Bulletin* 21: 414-418, Hagenimana et al. (1999), paper presented at the Annual and Regional Conference of Kenya Institute of Food Science and Technology and Jomo Kenyatta University of Agriculture and Post-harvest on *Progress and Challenges in Food Science and Post-harvest Technology in Africa: 2000 and Beyond*, Nairobi, Kenya. 15-16 March 1999, Hagenimana et al. (1999) published as an International Center for Research on Women (ICRW) research serie, Washington, DC, 24p., K'osambo et al. (1998) published in *Journal of Food Composition and Analysis* 11: 305-321., Nandutu et al. (2000) published in *Journal of Food Technology in Africa* 5: 66-69., Oyunga et al. (1999) in *Institutionalising Gender in Agricultural Research: Experiences from Kenya*. Edited by Curry, J., Kooijman, M., and Recke, H. Nairobi, Kenya, Signal Press Ltd., 257p. , and Wanjekeche et al. (2000), paper presented at the *Fifth Triennial Congress of the African Potato Association*, Kampala, Uganda. May 29–June 2, 2000. (file 5-13)

### Activity 2.3. Flour storage: effects on flour quality.

Storage trials of flour produced from Activity 2.2. Flour was stored by the enterprises in ambient conditions and in a range of appropriate materials, for periods representing the length of time desired by the enterprises. The acceptability of stored flour was evaluated

Elements of the work were summarised in the paper authored by Hagenimana et al (1999) and published in the *Ecology of Food and Nutrition* 37: 455-473 (file 14).

### Activity 2.4 Assessment of product quality using sweet potato flour.

Sweet potato flour produced from the best treatments resulting from Activities 2.2 and 2.3. was used to produce a range of food products by the different enterprises involved, or by interested retail outlets (market stalls, restaurants etc.), and the quality and market acceptability of the products, compared to others made from fresh sweet potato roots (cooked and mashed or grated), as appropriate. The products evaluated with sweet potato flour from both traditional and novel (and based on market potential). Consumer and market acceptability of flour based products was determined as part of Activity 2.3.

Elements of the work were summarised in the papers authored by FAWZIA et al. (1999) in the *African Crop Science Journal* 7: 81-89; HAGENIMANA (1999) Micro-scale enterprise approach to sweet potato and potato improvement systems, pp. 20-26. In Kwarteng, J. (ed.), *Enhancing post-harvest technology generation and dissemination in Africa*. Mexico City: Sasakawa Africa Association, viii + 79p; HAGENIMANA et al. (1998) in the *Journal of Food Processing and Preservation* 22: 123-137;. NUNGO et al. (2000) in the paper presented at the *Fifth Triennial Congress of the African Potato Association*, Kampala, Uganda. May 29–June 2, 2000; OWORI and HAGENIMANA (1998) in the paper presented at the *Seventh Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch (ISTRAC-AB)*, Cotonou, Bénin. 11-17 October 1998; and OWORI and HAGENIMANA (2000) in the paper presented at the *Fifth Triennial Congress of the African Potato Association*, Kampala, Uganda. May 29–June 2, 2000 (file 15-20).

#### Activity 2.5. Workshop to discuss technical and socio-economic results

December 1998, key extensionists from Uganda, Kenya, and Tanzania met in Soroti, Uganda, to discuss technical and socio-economic results on the improvement of sweetpotato solar drying and sanitation and were informed on the storage. The handouts for discussion are in the Annex (file 21).

### **5.0 CONTRIBUTION OF OUTPUTS**

The feasibility of producing a rural-based sweetpotato flour was assessed in Soroti, Uganda. This was done by working

- a) with smallholder farmers/processors to efficiently produce sweetpotato flour of acceptable quality;
- b) to establish flour quality standards and perfect practical recipes for products (buns, chapatis; and mandazis) out of flour to be traded;
- c) with consumers to test the quality and market in the interaction micro-enterprise--customers.

The low level of production by each household does not facilitate profitable processing unless they work collaboratively by combining output.. Current indigenous sweetpotato processing technology was found not profitable at the household level due to high cost of labour. However, this problem was overcome by the introduction of a sweetpotato slicer into the farming system, which increased the profitability of processing sweetpotatoes into dried chips.

Dried sweetpotato was found to have a local and immediate market particularly in the area of the nomadic Karamojongs and Katakwi District. Because of their pro-vitamin A contents, dried orange-fleshed sweetpotato from the variety Naspot 5, were of exceptional interest for existing NGO programs, particularly those working in disaster relief in the far North of Uganda and Southern Sudan. Bakers in Kampala were interested and willing to use sweet potato flour to process their products provided:- the price of sweet potato flour was motivating, a regular supply of quality sweet potato flour was assured and the quality of products was not lowered.

Consumers from Soroti, Kumi and Lira, Uganda, and Teso, Busia, Kenya found the dried chips excellent for making their local product. *atapa*. Kampala and Nairobi consumers identified the major quality problems that sweetpotato flour imparted onto the products: off - odour, reduced volume of product during the processing, and short shelf life (disintegration of products). The project established the potential of sweet potato flour as an important component in urban baked products, but much developmental work involving the link between producers/processors and users needs to be done in regards to the improvement of quality of the product required by the urban consumers. Changes in packaging practice are needed to improve the quality of dried product and hence its value and wider distribution.

Students, technicians, extensionists, and farmers/processors have been trained in sweetpotato processing and micro-enterprise development, young scientists supported in the initial research on sweetpotato post-harvest issues; a working group on post-harvest sweetpotato research has emerged in both Uganda and Kenya;

Considerable interest and support have been stimulated among national research directors, NGOs, rural development projects, church leaders, institutional linkages on sweetpotato post-harvest and processing issues within and between Uganda and Kenya have been fortified, and made more inclusive and effective in the process;

A body of locally generated scientific literature has begun to be developed to provide the foundation for longer term efforts aimed at addressing sweetpotato post-harvest problems and opportunities;

***Overall, the project has contributed to the purpose by developing, testing and promoting processing systems to add value to sweetpotato production by poor households.***

#### **Further activities to be conducted**

Financial support is sought by CIP to build upon this basis and promote and market key technologies previously developed, and, which will be implemented in collaboration with local, national institutions, CBOs and NGOs:

- To increase the availability of key technologies developed: early, high yielding, high dry matter content, high levels of beta-carotene varieties, pieces of equipment for processing sweetpotato products, expertise and tools in the development of microenterprises trading foods and feeds in East Africa;
- To facilitate a wide and on-farm processing of sweetpotato dried products, use, and catalyse trading of end products from new varieties including orange-fleshed sweetpotato varieties in Uganda, Tanzania and Kenya. CIP is building up an expanded program on orange-fleshed sweetpotato varieties as a dietary source of vitamin A, and the activities proposed are a key to diversified forms of consumption and to increase income of poor farmers growing sweetpotato;
- To continue on-going monitoring and technical support for quality control of products and processes made by new and old microenterprises trading food products;
- To enhance local, regional, and international cooperation in solving problems related to rural food-based micro-enterprises development in East Africa.

#### **Pulications, plans for further dissemination**

The majority of datasets generated by the project are available in the reports mentioned above. The raw data is available from CIP-Nairobi, Kenya. An exhaustive list of the document has been gathered on CD-ROM, which will be mailed shortly after this report.

#### **Publications**

BASHAASHA, B., SCOTT, G., HAGENIMANA, V. and EWELL, P.T. (2000) Processed sweet potato in the household economy of the northeastern Uganda. Paper presented at the *Fifth Triennial Congress of the African Potato Association*, Kampala, Uganda. May 29–June 2 2000.

CAREY, E.E., HAGENIMANA, V., K'OSAMBO, L., OYUNGA, M.A., BENESI, I., SMIT, N., OCITTI P'OBWOYA, C., TURYAMUREEBA, G., NDOLO, P.J., and LOW, J. (1999) Using orange-fleshed sweetpotato varieties to combat vitamin A deficiency and enhance market opportunities for smallholder farmers in sub-Saharan Africa, pp.157-168. In: *Food Security and Crop Diversification in SADC Countries: The Role of Cassava and Sweetpotato*. Edited by M.O. Akoroda and J.M. Teri. SARRNET, Malawi.

- EWELL, T.P. and HAGENIMANA, V. (2000) Orange-fleshed sweet potato as a dietary source of pro-vitamin A: Lessons from preliminary experiences in Africa. Paper presented at the conference on *Alleviating malnutrition through food-based approach*, Cape Town, South Africa. 22-25 November 2000.
- FAWZIA, A., KARURI, E.G., and HAGENIMANA, V. (1999) Sweet potato ketchup: Feasibility, acceptability, and production costs in Nairobi, Kenya. *African Crop Science Journal* **7**: 81-89.
- HAGENIMANA, V. (1999) Micro-scale enterprise approach to sweet potato and potato improvement systems, pp. 20-26. In Kwarteng, J. (ed.), *Enhancing post-harvest technology generation and dissemination in Africa*. Mexico City: Sasakawa Africa Association, viii + 79p.
- HAGENIMANA, V. and LOW, J. (2000) Potential of orange-fleshed sweet potatoes for raising vitamin A intake in Africa. *Food and Nutrition Bulletin* **21**: 414-418.
- HAGENIMANA, V., CAREY, E.E., GICHUKI, S.T., OYUNGA, M.A., and IMUNGI, J.K. (1999) Carotenoid contents in fresh, dried and processed sweet potato products. *Ecology of Food and Nutrition* **37**: 455-473.
- HAGENIMANA, V., K'OSAMBO, L.M., and CAREY, E.E. (1999) Potential of sweet potato in reducing vitamin A deficiency in Africa. Paper presented at the Annual and Regional Conference of Kenya Institute of Food Science and Technology and Jomo Kenyatta University of Agriculture and Post-harvest on *Progress and Challenges in Food Science and Post-harvest Technology in Africa: 2000 and Beyond*, Nairobi, Kenya. 15-16 March 1999.
- HAGENIMANA, V., K'OSAMBO, L.M., and CAREY, E.E. (1999) Potential of sweet potato in reducing vitamin A deficiency in Africa, pp.287-294. In *Impact on a Changing World. Program Report 1997-98*. International Potato Center, Lima, Peru. 458p.
- HAGENIMANA, V., KARURI, E.G., and OYUNGA, M.A. (1998) Oil content in fried sweet potato processed products. *Journal of Food Processing and Preservation* **22**: 123-137.
- HAGENIMANA, V., OYUNGA, M.A., LOW, J., NJOROGE, S.M., GICHUKI, S., and KABIRA, J. (1999) *The effects of women farmers' adoption of orange-fleshed sweetpotatoes: Raising vitamin A intake in Kenya*. ICRW/OMNI Research Program, Research Report Series 3. International Center for Research on Women, Washington, DC, 24p.
- K'OSAMBO, L.M., CAREY, E., MISRA, A.K., WILKES, J., and HAGENIMANA, V. (1998) Influence of age, farming site, and boiling on pro-vitamin A content in sweet potato (*Ipomoea batatas* (L.) Lam.) storage roots. *Journal of Food Composition and Analysis* **11**: 305-321.
- MUDIOPE, J., KINDNESS, H., and HAGENIMANA, V. (2000) Socio-economic constraints to the production, processing, and marketing of sweet potato in Kumi District, Uganda. Paper presented at the *Fifth Triennial Congress of the African Potato Association*, Kampala, Uganda. May 29–June 2 2000.
- NANDUTU, A., CARASCO, J, and HAGENIMANA, V. (2000) Using sweet potato amylase extracts for the determination of starch in foodstuffs. *Journal of Food Technology in Africa* **5**: 66-69.
- NUNGO, R.A., P.J. NDOLO and HAGENIMANA, V. (2000) Promoting sweet potato post-harvest and utilization: Experience of Western Kenya. Paper presented at the *Fifth Triennial Congress of the African Potato Association*, Kampala, Uganda. May 29–June 2 2000.
- OWORI, C. and HAGENIMANA, V. (1998) Development of sweet potato snack products in rural areas: Case study of Lira District, Uganda. Paper presented at the *Seventh Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch (ISTRAC-AB)*, Cotonou, Bénin. 11-17 October 1998.
- OWORI, C. and HAGENIMANA, V. (2000) Quality evaluation of sweet potato flour processed from different rural sites using small scale processing technologies. Paper presented at the *Fifth Triennial Congress of the African Potato Association*, Kampala, Uganda. May 29–June 2 2000.
- OYUNGA, M.A., HAGENIMANA, V., KURZ, K., AND LOW, J. (1999) Increasing vitamin A intake through promotion of orange-fleshed sweetpotatoes in western Kenya: A women centered approach, pp. 175-190. In *Institutionalising Gender in Agricultural Research: Experiences from Kenya*. Edited by Curry, J., Kooijman, M., and Recke, H. Nairobi, Kenya, Signal Press Ltd., 257p. (Peer reviewed conference proceedings)

WANJEKECHE, E., MISTO, E., WAKASA, V., LOPELO, I. and HAGENIMANA, V. (2000) Performance and post-harvest acceptability of orange-fleshed sweet potato in the marginal areas of West Pokot District, Kenya. Paper presented at the *Fifth Triennial Congress of the African Potato Association*, Kampala, Uganda. May 29–June 2 2000.

#### Internal Reports:

The following are Journal publications that have been submitted or will shortly be submitted, but are not yet published.

EDEBE, D.K., KARURI, E.G., and HAGENIMANA, V. (2001) Use of high beta-carotene sweetpotato in the formulation of baby food in Kenya. *African Crop Science Journal*. (submitted).

FERUZI, M., NGONGO, M., BITIJULA, M.M., MADIKA, M., and HAGENIMANA, V. (2000) Caractérisation des cultivars de patate douce (*Ipomoea batatas*) dont les feuilles sont consommées en République Démocratique du Congo. *African Crop Science Journal*. (submitted)

KINGORI, W.J., KARURI, E.G. and HAGENIMANA, V. (2001) Assessment of sweet potato consumption in Nairobi, Kenya. To be submitted to *Ecology of Food and Nutrition*- 18 pp. in manuscript

MWAURA, S, KARURI, E.G. and HAGENIMANA, V. (2001) Urban agriculture and the assessment of heavy metals contamination of sweet potato roots (*Ipomoea batatas*) grown in Nairobi, Kenya. To be submitted to *African Crop Science Journal*- 15pp. in manuscript

ODORA, C., AMENY, M.A., KIRSCH, N.H., and HAGENIMANA, V. (2001) Quality control of dried processed sweetpotato products. To be submitted to *African Crop Science Journal*- 16pp. in manuscript

OWORI, C., OYUNGA, M.A., and HAGENIMANA, V. (2000) *Sweetpotato recipes for Uganda and Kenya, a field booklet*.30p.in manuscript

SHIKUKU, C. and HAGENIMANA, V. (2001) Effect of recharging on the quality and shelf life of fresh sweetpotato roots. To be submitted to *African Crop Science Journal*- 16pp. in manuscript

The following are internal reports

BASHAASHA, B (1999) Processed sweetpotato in the household economy of the northeastern Uganda. Survey report. NARO, Kampala, Uganda. 55p

FERRIS, S., MUGANGA, A., MATOVU, R., KOLIJN, S., HAGENIMANA, V., and E.G. KARURI (1999) Marketing opportunities for starch and high quality flour production from cassava and sweetpotato in Uganda. A project report. Kampala, Uganda. 60p.

HAGENIMANA, V. (1999) Solar drying of sweetpotato storage roots. Handouts of a training course. International Potato Center (CIP), Sub-Saharan Africa Region, Nairobi, Kenya. 27p.

HAGENIMANA, V., KINDNESS, H., MUDIOPE, J., AND SMIT, N. (2000). Household production costs of sweetpotato in comparison with other major crops at Soroti, Uganda. 30p.-in manuscript

HAGENIMANA, V., OWORI, C. and NUNGO, R. (1998). Factors contributing to success or failure of existing micro-enterprises processing sweetpotato in Lira, Uganda and W. Kenya. Survey Report. 23p.-in manuscript

LOW, J., KINYAE, P., GICHUKI, S., OYUNGA, M.A, HAGENIMANA, V., and KABIRA, J. (1997). Combating vitamin A deficiency through the use of sweetpotato. Results from Phase 1 of an action research project in South Nyanza, Kenya. Lima, Peru. 110p.

OWORI, C. (2000). Assessment of product quality using sweetpotato flour. Survey report. 25p in manuscript

The following are popular dissemination of results

CIP and KARI. Orange-fleshed sweetpotato varieties. Field extension pamphlet, Nairobi. 8p.

CIP and KARI. Sweetpotato Recipes. Field extension pamphlet, Nairobi. 8p

HAGENIMANA, V. (1998) An extension field pamphlet guide for the village level handling and production of flour from sweetpotato roots. 4p



HAGENIMANA, V., CAREY, E., GICHUKI, S.T., OYUNGA, M.A., and IMUNGI, J.K. (1998) Replacing pills with sweetpotatoes to combat vitamin A deficiency. *PostHarvest Systems Newsletter* 3: 2-3

NARO, PRAPACE and CIP. *New sweetpotato varieties*. Field extension pamphlet, Nairobi. 8p

NARO, SOCADIDO and CIP. INYAMEN LU ACOK. Field extension pamphlet (In Ateso), Nairobi. 8p.

#### **Other Dissemination of Results:**

EDEBE, D.K. (1999) Use of high beta-carotene sweetpotato in the formulation of baby food. University of Nairobi. 80p.(MSc Thesis)

K'OSAMBO, L. (1998) Carotenoid content and vitamin A value of sweetpotato (*Ipomoea batatas* (L.) Lam) cultivars as influenced by root age, farming site and cooking. University de Nairobi. 110p. (MSc Thesis).

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#### **Follow-up dissemination planed**

A number of scientific papers have been submitted, hopefully will be published in a near future. The project collaborators will promote the outputs of the project where possible through their normal activities.



## Annex 1. Project logframe:

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
<b>Goal</b>			
Storage and processing losses reduced			
<b>Purpose</b>			
More efficient and cost effective methods of processing developed and facilitated			
<b>Outputs</b>			
<p>1. Strategies developed and promoted for the successful development of the small enterprise sector, based on sweet potato products</p> <p>2. Technologies for improving products to meet market needs developed, evaluated and promoted</p>	<p>Workshop held in month 13 of the project to serve to:</p> <ol style="list-style-type: none"> <li>determine the potential of sweet potato processing to contribute to income generation (in comparison with other activities);</li> <li>develop a strategy for the further development of sweet potato based enterprises in the case study areas;</li> <li>develop the detail and collaborative arrangements for activities for output 2,.</li> </ol> <p>1. Sweetpotato quality characteristics improved, standardised, and its adoption and processing promoted to all target institutions and agencies;</p> <p>2. Increased emphasis on support and development of food enterprises.</p>	<p>Quarterly reports, Publications, Workshop report. Actions of local agencies.</p> <p>ex-post enterprise analyses; feedback from user groups and local agencies (study); Publications. Meeting report.</p> <p>Ex-post enterprise analyses; feedback from user groups and local agencies (study). Publications, meeting report.</p>	<p>There is enabling environment beyond the immediate control of the project.</p> <p>Issues of credit availability and the necessary training in business skills is provided within the wider CIP project from other sources.</p> <p>Security situation permits fieldwork.</p> <p>Crop and market situation similar to medium term expectations.</p> <p>Output 1 completed on time</p> <p>sweet potato production/prices in usual range (no shortage).</p> <p>General economic climate and business situation remains stable.</p> <p>Output 1 completed</p> <p>sweet potato production/prices in usual range (no shortage)</p> <p>Research Innovations to other crops/raw materials (e.g. cassava) do not affect medium term prospects for sweet potatoes</p>
<b>Activities</b>	<b>Inputs</b>	<b>Means of Verification</b>	<b>Important Assumptions</b>
1.1 Small enterprise studies (2): identification of factors determining success/failure.	<p>ODA contribution (£'000):</p> <p>Staff 69.9 k</p> <p>Overheads 29.4</p> <p>T&amp;S 8.9</p> <p>Other 7.0</p>	Financial reports	Enterprises willing and able to collaborate.

Total	129.4
£175.0 contribution from CIP	

1.2 Comparative analysis of sweet potato vs other crops, food products; and of processing vs other types of utilization.			Situation of individual crops/products not affected by short term events (e.g. drought, pests) which alter relative prices/availability.
1.3 Workshops (2) to present/analyse results of 1.1 and 1.2; develop strategy for sweet potato based enterprises in the two regions; adjust details of activities for output 2 accordingly.			Activities 1.1 and 1.2 completed on time.
1.4 Socio- economic assessment of potential regional impact			Activities 1.1-1.3 completed.
2.1 Selection of enterprises for process/product research			Enterprise interest sufficient.
2.2 Cost effective improvement of flour quality			Flour price still attractive for enterprises when quality improved.
2.3 Improved flour storage methods			Costs of storage acceptable to users.
2.4 Assessment of product quality using sweet potato flour.			Better quality flour makes better quality/more marketable products.
2.5 Workshop (2) to present and disseminate results of activities 2.1-2.4.			Activities 2.1-2.4 completed.