Life is sweet with new sweet potato varieties

RIU

Validated RNRRS Output.

Hundreds of thousands of farmers in central Uganda and Tanzania are counting on improved sweet potato varieties to boost their nutrition and incomes. These sweet potatoes were chosen through a process involving farmers at all stages. Some varieties were selected from available materials, under local smallholder farming conditions: taste, market characteristics and resistance to pests and diseases were some of the things farmers were looking for. Farmers and scientists also worked side by side to develop new varieties through client-orientated breeding at decentralised, on-farm communal sites. This process has provided—in addition to the new sweet potatoes—knowledge among farmers about the potential of variety development, as well as scientists' insights into farmers' needs.

Project Ref: **CPP20:**
Topic: **1. Improving Farmers Livelihoods: Better Crops, Systems & Pest Management**
Lead Organisation: **Natural Resources Institute (NRI), UK**
Source: **Crop Protection Programme**

Document Contents:

Description

CPP20

Research into Use
NR International
Park House
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Geographical regions included:

Tanzania, Uganda,

Target Audiences for this content:

Crop farmers,

A. Description of the research output(s)

1. Working title of output or cluster of outputs.
In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.

Original title: Sweet potato virus disease management and promotion

Suggested title: Sweet potato virus disease-resistant cultivars identified through a decentralised farmer-participatory approach and promoted

2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.

Crop Protection Programme

The activity also receives funds (1997 onwards) from a multi-donor consortium including DFID (e.g., R8041) and then DFID through the Tropical Whitefly IPM Project

The project builds on more fundamental work during 2000 – 2003 funded through the EU INCO-DEV Programme project ICA4-CT-2000-30007 on sweet potato virus identification and characterisation – though this also built in its turn on earlier DFID funds including Holdback

3. Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.

R8457 (2005 - 2006) Extending the control of sweet potato virus disease
R8243 (2002 – 2005) Working with farmers to control sweet potato virus disease
R8167 (2002 - 2005) Sustainable sweet potato production
R8041 (2001 – 2004) Tropical Whitefly IPM Project
R8040 (2001 - 2003) Multiplication & distribution of sweet potato varieties
R7492 (1999 - 2002) Control of sweet potato viruses
R6617 (1994 - 7 extended to 1998) Whitefly borne viruses of sweet potato and cassava
ODA Holdback project R5878 (1994-7)

Associated projects:
R6769 (1997 – 1999) Investigating the potential of cultivar differences in susceptibility to sweet potato weevil as a means of control
R8302 (2003 – 2005) Participatory breeding of superior mosaic disease-resistant cassava: validation, promotion and dissemination
R7565 (2000 – 2003) Participatory breeding of superior, mosaic disease-resistant cassava

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*4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? **(max. 400 words)**. This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.*

The outputs, developed through a series of projects starting in 1994 with problem identification [R5878; R6617], can be divided into two main processes and one main product [cultivars]:

- **Participatory varietal selection** (**PVS**): This process, using **sweet potato varieties** recently released in **Uganda**, involves farmer groups working together on communal plots to select varieties with **high yield**, **pest** and **disease resistance**, particularly to **sweet potato virus disease** (**SPVD**), and other attributes identified by a variety ranking process as important to the farmers.
- **Participatory**, **client-orientated breeding** (**COB; PPB**): This process, validated in Uganda and **Tanzania,** enabled **superior cultivars** of **sweet potato** and potentially other **vegetatively-propagated crops** to be selected from amongst large seedling populations by farmers and scientists working in a close **collaboration** at on-farm communal trial sites using a **decentralised** approach. Scientists identify

and provide seeds from crosses amongst local and exotic **germplasm** and incorporating resistance to SPVD and high yield. At harvest, farmers select superior phenotypes to retain by vegetative propagation to the next cropping cycle. The process is iterated over cropping cycles until most selected clones appear superior to local and released variety checks; during this process, farmers take cuttings to their own farms, providing additional **decentralised selection**. The process also provides **experiential learning** for both farmers and scientists, farmers particularly learning the potential of variety development and scientists learning more about farmers' needs.

Ø Sweet potato **cultivars** appropriate to farmers' requirements in Uganda and Tanzania selected by one of the above two processes and, in particular, incorporating: high yield [often double that of local checks] under local **smallholder** farming conditions [rainfed, low input, hand-planting and –harvesting]; suitable for local palates and **market** requirements, and resistant to pests, particularly SPVD.

In addition, lessons were learnt about the effectiveness of linking with other organisations including donors and NGOs as part of the **promotion** of the cultivars selected by PVS in Central Uganda and the **Lake Zone** of Tanzania.

5. What is the type of output(s) being described here?
Please tick one or more of the following options.

Product	***Technology***	***Service***	***Process or Methodology***	***Policy***	***Other Please specify***
X	*X*		*X*		

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment

Main commodity: **Sweet potato.**

Both the processes [varietal selection and participatory plant breeding] and the broad product of these processes [superior cultivars resistant to pests and diseases and appropriate to farmers' needs] are highly appropriate to varietal development of other vegetatively-propagated crops, especially those affected by virus diseases such as cassava affected by cassava mosaic and cassava brown streak viruses, round potato and yams.

7. What production system(s) does/could the output(s) focus upon?
Please tick one or more of the following options. Leave blank if not applicable

Semi-Arid	***High potential***	***Hillsides***	***Forest-Agriculture***	***Peri-urban***	***Land water***	***Tropical moist forest***	***Cross-cutting***
	X		*X*				*X*

8. What farming system(s) does the output(s) focus upon?
Please tick one or more of the following options (see Annex B for definitions).
Leave blank if not applicable

Smallholder rainfed humid	***Irrigated***	***Wetland rice based***	***Smallholder rainfed highland***	***Smallholder rainfed dry/cold***	***Dualistic***	***Coastal artisanal fishing***
X						

*9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**).*

Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.

Effective selection of superior cultivars underlies most aspects of agricultural development. Achieving greater client orientation by farmer participatory approaches therefore contributes to a wide range of outcomes as well as incorporating pest resistance as in these outputs. Value could be added to this output by:

1. Incorporating general lessons learnt on increasing effectiveness of farmers and scientists working together in breeding activities with those learnt in other breeding activities, particularly those of other client-orientated breeding/ participatory varietal selection projects funded by PSRP, e.g., R6748, R6826, R7122, R7281, R7324, R7409, R7434, R7657, R8071, R8099, R8221, R8269, and PSRP programme development work.
2. Incorporating specific lessons learnt on breeding disease resistance into superior, farmer-appropriate varieties with those outputs from the Crop Protection Programme and other research activities in which pest, particularly disease resistance is identified [R6519, R6811, R7445, R7452, R7565, R7566, R8030, R8205, R8220, R8227, R8247, R8302, R8303, R8404, R8406, R8414, R8422, R8425, R8445, R8453, R8456, R8476 and R8481].
3. Clustering with outputs/projects focused on vulnerable people who need to obtain the maximum food from limited land; sweet potato's high yield of nutritious food makes it an ideal crop, disease-free crops are essential for maximum yield yet large numbers of small fields of differing crop ages packed together create circumstances in which pests and diseases become rampant unless resistant varieties are used [R8243 did link in this manner with Norwegian People's Aid to aid refugees in Kagera as well as with smaller NGOs to aid HIV AIDS affected families; there are a large number of similar opportunities with different aid organisations]. The orange-fleshed varieties being disseminated for their high pro-vitamin A content [http://www.cipotato.org/vitaa/] are, by contrast, mostly proving to be quite susceptible to SPVD, making outputs on SPVD control a natural partner.
4. Clustering with projects involving postharvest processing. Higher yields of new varieties achieved at least partly through disease resistance may be of limited benefit to farmers unless improved postharvest processing provides additional market. Specific outputs include those of R6769. R7520, R6507, R7498, R8273 and more general ones such as marketing and credit schemes include R8114, R8205 etc.
5. Linking with large-scale projects on sweet potato in Africa such as the VITAA project and McKnight Foundation projects on sweet potato including in Uganda on 'Multiple resistance and high-yielding sweetpotato'

Validation

B. Validation of the research output(s)

*10**. How** were the output(s) validated and **who** validated them?*

*Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the "who" component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation **(max. 500 words)**.*

The outputs have been validated in three main ways:

1. Locally, by smallholder farmers in groups in Luwero and Mpigi [Uganda] involved in participatory plant breeding already growing the new clones in their gardens, both for home consumption and for multiplication and sale of planting material. Farmers in Luwero and Masaka districts in Uganda involved in participatory varietal selection identified one variety, NASPOT 1, as outstanding; as an example, farmers in the Masaka group both sold material and organized a field day in which they gave planting material of this variety to hundreds of fellow farmers. Surveys done 1, 3 and 4yrs after trials were completed identified this as the main variety being maintained by farmers. Surveys in 2006 done by Ugandan National Sweet Potato Programme have shown that the new clones developed by participatory plant breeding are being passed from neighbour to neighbour, traveling >10 km by this informal means.

2. Nationally, by Ugandan and Tanzanian national programme scientists committing their programme resources to further work on decentralised participatory methods of selecting sweet potato clones [e.g., New crossing block at ARI-Maruku; MSc student recruited at NAARI to work on PPB]. Both programmes have also committed funds to on-station and on-farm trials of the new clones. The Buganda Cultural and Development Foundation (BUCADEF), a Ugandan NGO, has also committed its own funds and obtained external funds to distribute sweet potato varieties identified by participatory varietal selection after involvement of some of its farmer groups in this project activity.

3. Internationally by scientific peers by acceptance of the research findings on varietal selection and participatory plant breeding in international peer review prior to publication in internationally renown journals. These include Euphytica [MANU-ADUENING, J.A., Lamboll, R.I., Ampong Mensah, G., Lamptey, J.N., Moses, E., Dankyi, A.A. & Gibson, R.W. 2006. Development of superior cassava cultivars in Ghana by farmers and scientists: the process adopted, outcomes and contributions and changed roles of different stakeholders. *Euphytica* (Accepted)] and the African Crop Science Journal [Byamukama E., Adipala E., Gibson R.W. and Aritua V. 2002. Reaction of sweet potato clones to virus disease and their yield performance in Uganda. African Crop Science Journal, Vol. 10: 317 - 325]. A further manuscript detailing specifically the sweet potato breeding work has also been submitted to Euphytica.

*11. **Where and when** have the output(s) been validated?*

Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above ***(max 300 words)****.*

Where: The superior performance of the SPVD-resistant varieties has been validated by project activities on-station (replicated randomised block design) at NAARI in Uganda and on-farm (multiple sites; one replicate/site generally) in Uganda (Masaka, Rakai and Kunungu districts) and Tanzania (Kagera Region), generally over at least 3 growing seasons for each combination and by further complementary on-station and multilocational on-farm trials by national programmes.

Who x where: The project on-farm activities in Uganda were mainly with farmers belonging to groups organised by Buganda Cultural and Development Foundation [BUCADEF]. These were all smallholder farmers but those choosing to join BUCADEF may be slightly more innovative than others. BUCADEF facilitators are trained to be gender-sensitive in group formation. Consequently, on-farm trials for participatory varietal selection activities were gender balanced: e.g., in Masaka and Rakai, there were 9 on-farm trials led by men and 8 led by women. Participatory breeding group activities similarly had a man or woman leader. Participatory varietal selection trials have also been conducted in refugee camps in Uganda [Nakivale and Omurukinga in Mbarara District] and, in Tanzania, with farmers in Ngara and Biharimulo districts affected by refugees from Burundi and with HIV AIDS-affected families being supported by the NGO Partage-Tz. No trials have been conducted with large-scale farmers but outputs are probably still valid. National programme trials were also conducted with smallholder farmers.

System: Activities were done in rain-fed farming systems in agro-ecological environments in which forest or tall grass with scattered trees would be the natural climax vegetation. This was largely because this is an ecosystem in which sweet potato virus disease is common. However, sweet potato is widely grown in semi-arid areas where rainfall is only seasonal and outputs are likely also to be relevant to these.

When: Activities were done mainly between 2000 and 2004. Uptake of new varieties and clones refer to more recent observations/surveys.

Current Situation

C. Current situation

12. ***How and by whom*** *are the outputs currently being used? Please give a brief description* ***(max. 250 words****).*

Sweet potato clones selected by the farmer participatory breeding process are currently being used:

- By scientists in the Ugandan Sweet Potato Programme testing them as part of the process leading to variety release.
- By the smallholder farmers in Mpigi and Luwero districts in Uganda associated directly or indirectly with the breeding programmes using selected sweet potato clones in their farms in personal trials, for home

consumption and fresh sales and to give planting material to neighbours etc.

– They are also being transferred by the International Potato Center through quarantine to Tanzania for future trials in Kagera region, Tanzania.

Sweet potato cultivars, particularly NASPOT 1, selected by farmer varietal selection, are currently being grown by hundreds of thousands of farmers in central Uganda for home consumption and for sale following a major distribution in 2001 – 3 by the Buganda Cultural and Development Foundation. These Ugandan cultivars have recently been transferred to Tanzania and are currently being used by various NGOs funded through Norwegian Peoples' Aid (NPA) to supply client farmers [Table]; perhaps some thousands of farmers in Kagera Region of Tanzania are growing them for home consumption and sale.

*13. **Where** are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used **(max. 250 words).***

Sweet potato clones selected by the farmer participatory breeding process are currently being used:

– By the Ugandan Sweet Potato Programme in on-station trials at Namulonge and Serere Agricultural and Animal Production Research Institutes and Kalengyere Agricultural Research Development Center and on-farm in Mpigi and Luwero districts.

– By farmers in Mpigi and Luwero districts in Uganda associated directly or indirectly with the breeding programmes.

Sweet potato cultivars, particularly NASPOT 1, selected by farmer varietal selection are being extensively used in central Uganda. These Ugandan cultivars have recently been transferred to Tanzania. There, they are currently being used by various NGOs funded through Norwegian Peoples' Aid (NPA) to supply client farmers [Table 1] in Kagera Region of Tanzania.

Table 1. Number of sweet potato vines distributed by NPA to various groups

Group / **Variety**	Mabare chini	Nyamizi	Gwesero	Kumubuga & Ntanga	Murusagamba	Magamba
Naspot 1	700	3,400	2,000	200	-	-
Naspot 2	3,400	3,400	2,000	1,400	1,500	1,000
Naspot 3	2,800	3,400	2,000	1,400	2,500	2,022

*14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading **(max 250 words).***

The Uganda Sweet Potato Programme has already obtained additional funds from McKnight Foundation to support participatory plant breeding activities but the main output for which sufficient time has elapsed for scale of use to be indicated in any way is the use of resistant varieties, particularly NASPOT 1. This variety was identified by the project as a very high-yielding farmer-preferred and SPVD-resistant variety in on-station and on-farm project trials in areas where SPVD had been shown to be prevalent. This variety has been widely adopted now; many fields of it can be seen whilst driving from Masaka to Kampala and hundreds of thousands of farmers are

estimated to be growing it as their main variety. In the main produce market in Kampala, Kalerwe, NASPOT 1 is now the predominant variety sold. This level of adoption has occurred since around 2000. Similarly, the project facilitated the transfer of this and several other Ugandan varieties to Tanzania around 2000. I have been to villages around the research station where this variety is grown by almost every farmer and the farmers report this is the main variety they wish to grow. Based on these observations, usage of at least NASPOT 1 is still spreading.

It appears likely that a similar rate of spread will also occur for some of the clones developed by the projects by participatory breeding, judging by adoption in the communities involved in the breeding work. Surveys by the Ugandan National Sweet Potato Programme indicate planting material is being transferred informally to neighbours etc, spreading >10km already, even though planting material was only identified by farmers 2 yrs previously.

15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key facts of success? ***(max 350 words).***

Participatory varietal selection and breeding.
A key aspect of our activities is that they were initiated at national agricultural research institutes [Namulonge Agricultural and Animal Production Research Institute (NAARI), Uganda and Maruku Agricultural Research Institute ARI-Maruku), Tanzania] and fully involved scientists in the relevant national programmes at these NARIs. This ensured easy access to national germplasm collections and to appropriate seed families. It has led to the 'automatic' takeover of advanced lines for national multilocational trials at the end of the project and is also expected to ensure acceptability by official varietal release committees in each country. Variety release is a key step to achieving national dissemination of new cultivars using official funds.

As regards capacity strengthening, this has involved a changed approach to breeding and development of successful proposals rather than a change in any physical infrastructure. This close collaboration enjoyed between project partners has enabled the Sweet Potato Programme to include participatory breeding in a successful approach for further funds to the McKnight Foundation, employment of an MSc student to extend the work and funding for national multilocational trials at the end of the project

Dissemination of superior SPVD-resistant varieties requires both a technical knowledge of sweet potato diseases etc, knowledge of how to disseminate to farmers, a 'grass-root' infrastructure and the resources to fund multiplication and distribution of planting material. Project and national sweet potato programme staff possess the first two capacities but lacked the 'grass-root' infrastructure and the resources. Furthermore, they also lack the time to engage in multiplying and distributing materials on any large scale. In both Uganda and Tanzania, a system was developed in order to accommodate these requirements. In Uganda, the NGO BUCADEF was facilitated through the regional sweet potato network, PRAPACE, to successfully apply to CPP DFID for funds to multiply and disseminate SPVD-resistant varieties under the advice of project and national programme technical staff. In Tanzania, Norwegian People's Aid (NPA) was approached by project staff to support regional distribution of SPVD-resistant varieties. NPA, as well as acting directly, funded local NGOs that multiplied and disseminated SPVD-resistant varieties, again under the advice of project and national programme technical staff. District extension, training institutes and prison farms were also involved in dissemination but were poorly funded.

As regards capacity strengthening, a key factor in the success of the distribution schemes in both Uganda and Tanzania was that project and national sweet potato programme staff provided NGO and government extension officers with up-to-date knowledge of new varieties and how to control SPVD [none of the varieties is immune] and also provided them with disease-free planting material. This approach also improved the research capacity of national programmes by ensuring researchers were not diverted from their main work into multiplying and distributing planting material to farmers.

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? ***(max 300 words)***

This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

The technologies developed are largely neutral in their effects on the environment. No pesticides or genetically manipulated crops are involved in the outputs. No major changes in cropping practice are involved. Land cover may be increased by the more rapid growth of healthier crops, reducing erosion. Adoption of the outputs may lead to increased land area cropped by sweet potato but this may indirectly be beneficial because sweet potato has a greater food output/unit land than most crops so this will lead to less land having to be cropped, allowing longer fallows.

Formal plant breeding has been successful for high potential farming systems, particularly for irrigated lands but has often failed to generate varieties which are adopted by farmers in rainfed marginal agricultural ecologies. Such systems are particularly susceptible to degradation resulting from farmers and their families having to misuse their natural environment because crop failure, to which farmers are more vulnerable if they have access only to poorly-adapted high-yielding varieties, has provided no alternative. Participatory and decentralised on-farm plant breeding is, by contrast, more appropriate for the development of varieties for rainfed marginal agricultural ecologies, leading to less frequent crop failures. In addition, farmer involvement in crop improvement is likely to generate superior cultivars appropriate to a diversity of needs including alternative uses for crop 'residues' as livestock feed, fuel, thatching etc. By satisfying these needs through cultivated crops, cultivars developed through participatory breeding provide alternatives to the destructive harvesting of natural vegetation.

25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? ***(max 100 words)***

No. None have been identified to date and no adverse environment impacts are to be expected from a shift from formal to participatory plant breeding processes.

26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? ***(max 200 words)***

YES. Poor people turn to sweet potato when climate change or natural disasters occur because it is has the capacity to yield large amounts of food from a small amount of land and within a short time (3 mths; faster than most other staple food crops). Sweet potato is also very resilient in the face of erratic rainfall because of its indeterminate growth, unlike, e.g., maize. NGOs have begun to provide sweet potato planting material for refugees. Under such circumstances, it is vital that high-yielding, disease-resistant varieties are provided, the plant material is selected from disease-free parents and farmers are trained to rogue diseased cuttings.