FOREST/AGRICULTURE INTERFACE PURPOSE 1

Benefits for poor people generated by application of new knowledge on crop protection to annual and herbaceous crops in Forest/Agriculture production systems

Annual Report format unless otherwise stated

R8040 **Rapid multiplication and distribution of sweet potato varieties with high yielding and 8-carotene content. *PCSS***
(PRAPACE, Uganda)

R8167 **Promotion of sustainable sweet potato production and post-harvest management through farmer field schools in East Africa. *PCSS***
(International Potato Centre, Peru)

R8222 **Adaptive evolution within *Bemisia tabaci* & associated Begomoviruses: A strategic modeling approach to minimising threats to sustainable production systems in developing countries. *PCSS***
(Rothamsted Research, UK)

R8227 **Promotion of control measures for cassava brown streak disease. *PCSS***
(Natural Resources Institute, University of Greenwich, UK)

R8243 **Working with farmers to control sweet potato virus disease in East Africa. *PCSS***
(Natural Resources Institute, University of Greenwich, UK)

R8278 **Evaluation and promotion of crop protection practices for 'clean' seed yam production systems in Central Nigeria. *PCSS***
(Natural Resources Institute, University of Greenwich, UK)

R8301 **Archiving data from integrated pest and disease management projects within the Uganda National Banana Research Programme. *PCSS***
(University of Reading)

R8302 **Participatory breeding of superior mosaic disease-resistant cassava: validation, promotion and dissemination. *PCSS***
(Natural Resources Institute, University of Greenwich, UK)

R8303 **Maximising, disseminating and promoting the benefits to farmers of cassava varieties resistant to cassava mosaic disease. *PCSS***
(Natural Resources Institute, University of Greenwich, UK)

R8342 **Promotion of improved IPM practices for banana diseases and pests in Uganda. *PCSS***
(CABI Bioscience, UK)

R8437 **Assessing the impact of the Banana Bacterial wilt *Xanthomonas campestris pv. Musacearum* on household livelihoods in East Africa.**
(International Network for the Improvement of Bananas and Plantains, France)

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2004

Project Title:	Rapid multiplication and distribution of sweet potato varieties with high yielding and ß-carotene content	
DFID Project Reference No:	R8040	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor:	The Eastern and Central African Regional Network for the Improvement of Potato and sweet potato' and 'Programme Regional d'amelioration de la pomme de terre et de la patate douce en Afrique Centrale et de l'est' (PRAPACE)	
Production System:	Forest/Agriculture Interface	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to annual and herbaceous crops in Forest/Agriculture production systems	
Commodity Base:	Sweet potato	
Beneficiaries:	Farming households (consumers), traders, researchers, heath workers, local community leaders and politicians.	
Target Institutions:	Households, farmer groups, women groups, traders, transporters, local millers	
Geographic Focus:	Uganda	
Total Cost:	£11,367	
	Planned	**Actual**
Start Date:	01 July 2001	1 July 2001
Finish Date:	30 June 2003	30 June 2003

1. Project Purpose:

The purpose of the project was to develop a cost effective and sustainable system for continuous multiplication and timely distribution of quality sweet potato planting material in target areas. It was conceived that this would contribute to alleviating food insecurity, poverty and malnutrition among small-scale farmers in central Uganda through increased production of sweet potato varieties that are high yielding and rich in vitamin A.

In a country devoid of a formal system to take charge of the proper multiplication and dissemination of vegetatively propagated crops like sweet potato, setting up informal farmer-based seed systems to produce quality planting material on a commercial basis contributes to improving incomes.

2. Outputs:

The following 5 were the project outputs as initially anticipated

i. More land planted to quality cuttings of improved varieties and higher productivity achieved. Current productivity of local cultivars is on average 6 t/ha while the new varieties can produce 15–35 t/ha depending on management
ii. A cost effective and sustainable system for continuous multiplication and timely availing of planting material developed
iii. More orange-fleshed sweet potato produced, consumed by households and VAD related health problems reduced

iv. Households' food security and nutrition improved and income increased
v. Linkages strengthened between partners such as networks (for example, PRAPACE), national and international research institutions (NARO and CIP), donors, extension services, farmers, health workers and nutritionists.

Actual achievements include the following:

- Informal farmer-based systems now exist in all project target areas for the multiplication and distribution of quality planting material in a timely manner all the year round.
- Multiplication and distribution of improved sweet potato planting material is increasingly becoming commercial in the project areas, where sale of sweet potato vines was supposed to be a taboo. In fact, apart from being seasonal, the business of producing sweet potato planting material is far more profitable than that of producing fresh roots. This has significantly improved income and livelihoods of many.
- Improved varieties increased on-farm yields by around three-fold, provided better culinary characteristics and associated production returns, consequently resulting in high adoption (about 90%) for two varieties, one white-fleshed (Naspot 1) and the other orange-fleshed (SPK004).
- It is estimated that over 34,000 tonnes of improved sweet potato worth over UK £1,200,000 was produced in the project area during the lifetime of the project
- Orange-Fleshed Sweet Potato (OFSP) varieties that are rich in Vitamin A were identified for particular districts with SPK004 performing well in all the districts. The varieties are now widely distributed in the districts of central Uganda, where Vit. A deficiency is most pronounced. These districts are dedicated to multiplying the varieties more aggressively.
- The wide distribution/adoption of the orange-fleshed sweet potato, coupled with the spread of awareness on findings of a collaborative study in Kenya that a regular intake of at least 100 grams per day of orange-fleshed sweet potato roots provides the required daily allowances of vitamin A for children under five years of age, contributed to increased consumption of such varieties and reduced VAD-related problems.
- OFSP is increasingly helping the poor living with HIV/AIDS manifested through its increased utilisation.
- The project brought together multiple partners in agriculture, health & nutrition promoting the adoption of orange-fleshed SP varieties as a dietary source of Vitamin A. Moreover, links were made with the Vitamin A Initiative for Africa (VITAA) project implemented by the International Potato Centre in several countries in Eastern and Central Africa.
- The project also successfully introduced farmers to post-harvest processing to add value to their produce. It contributed to the successful production of Nutria-porridge by Maganjo Millers. This was beyond the target and the project was funded by PRAPACE as a contribution to the project.

3. Contribution of Outputs to Project Goal:

Project outputs (extremely ambitious for US$16,000 grant) were achieved to about 85%. However, the output of reducing Vitamin A deficiency-related health problems through increased production and utilisation of OFSP was not thoroughly addressed. Planned in its support, was a survey aimed at documenting the vitamin A deficiency status before and after project interventions in the project area. This was not done because of budgetary problems. We actually under-budgeted this item not because we lacked the foresight, but because the specialist was not straightforward from the start. This indeed caused a setback to the project and is the major reason behind the delay in this project report because the same specialist was also to carry out adoption and impact studies.

On the other hand, more was achieved than targeted in the area of post-harvest that focused on producing dried chips. Dried chips were processed to flour to produce very successful and nutritious products such as Nutri-porridge.

The achieved project outputs as reported in 2 above contributed to the project goal of reducing food insecurity, poverty and malnutrition among small-scale farmers in central Uganda. The contributions were realised through increased productivity, availability and utilisation as well as increased market opportunities for both improved white and orange-fleshed sweet potato varieties. Moreover, the multi-disciplinary/institutional approach adopted in the project contributed to a strong regional partnership for development, laying a good foundation for sustainability.

4. Publications:

None

5. Internal Reports:

1. Project Progress Report (PPR1) submitted on 14 September 2001
2. Project Progress Report (PPR2) submitted on 15 January 2002
3. Annual Report 19 March 2002
4. Annual Report 15 March 2003

6. Other Dissemination of Results:

MUSOKE, A. (2004) An overview of sweet potato and potato production, processing and marketing from smallholder systems: The BUCADEF experience. Paper presented at the PRAPACE SC meeting, 16–17 February 2004, Kampala, Uganda (Presented after the project period)

THORP, S. (2003) Eat up – it's good for you. *New Agriculturist* on-line. Reporting Agriculture for the 21st century.

THORP, S. (2003) Sweet success. *New Agriculturist* on-line: Picture feature. Reporting Agriculture for the 21st century. Issue 32:03-2.

THORP, S. (2003) Processing sweet potato for poultry AGFAX: Communicating science for sustainable development World radio for the environment (WRENmedia) 3.27' [Radio]. http://www.wrenmedia.co.uk/ post@wrenmedia.co.uk

THORP, S. (2003) Chipping in on sweet potatoes. AGFAX: Communicating science for sustainable development. World radio for the environment (WRENmedia). 7 34 [Radio].

The following were reported earlier

KYEWALABYE, M. (2002) Sweet potato multiplication and distribution in the Buganda Kingdom: The BUCADEF/PRAPACE experience. Paper presented at the PRAPACE Steering Committee meeting, 19–22 June 2002, Nairobi, Kenya.

Soft copies of major presentations made by key resource personnel during mobilisation and stakeholder workshops/meetings. These were sent on 4 October, 2001

A 14-minute Video entitled 'The CPP Funded Sweet potato Project with BUCADEF' sent in April 2002

Pamphlets the project is using to disseminate the latest sweet potato varieties sent on 16 January 2002

A presentation about the project (by the project leader) during PRAPACE's Steering Committee Meeting in Nairobi. This dissemination output was sent 17 December 2002

A 29-minute Video, an update of the version named in 2 above was sent in on 16 February, 2003

A number of dissemination outputs in local newspapers at different times.

A number of dissemination outputs on local and national radios and TV6.

7. Listing and reference to key datasets generated:

8. Follow-up indicated/planned:
The project identified poor linkages to market outlets, inadequate storage and processing techniques, market information, capital, control of unlicensed traders and, high transportation costs as the current major limitations to the sweet ppotato sub-sector.

These constraints together with much of what was learnt in ZA0483 were the basis for an on-going DFID/CPHP project (ZB0342 or R8273). The on-going project is using development of marketing systems, value addition and reduction of storage losses for SP as entry points for improving market access for poor farmers in Central Uganda. It also has as an important component of the development of institutional arrangements that can enable farmers to sustainably access knowledge and technologies they need to innovate for improving their livelihoods.

9. Name of author of this report:
K. Male

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Promotion of sustainable sweet potato production and post-harvest management through farmer field schools in East Africa	
DFID Project Reference No:	R8167	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	Natural Resources Institute (NRI) for the International Potato Centre (CIP)	
Production System:	Forest/Agriculture Interface	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to annual and herbaceous crops in Forest/Agriculture production systems	
Commodity Base:	Root and tuber crops	
Beneficiaries:		
Target Institutions:	CIP Uganda FAO Global IPPM Facility NAARI (NARO)	
Geographic Focus:	NE Uganda and W Kenya	
Total Cost:	£101,468 (original £74,883 plus add on of £26,585)	
	Planned	**Actual**
Start Date:	01 April 2002	01 April 2002
Finish Date:	31 March 2005	31 March 2005

1. Project Purpose:

The project purpose was specifically to increase the returns from sweet potato enterprise through improved production and post-harvest management by East African smallholders. This feeds into the more general purpose given by the Crop Protection Programme of promoting strategies to reduce the impact of pests in herbaceous crops in Forest/Agriculture systems in order to improve the livelihoods of poor people.

2. Outputs:

Output 1. Location-specific protocols, manuals and materials for sweet potato integrated crop management (ICM) farmer field school (FFS) developed and field-tested.
Three drafts of the sweet potato IPPM FFS manual were developed, copies of each draft were given to at least thirty different stakeholders (farmer and extension facilitators, researchers, local government officials, extension staff, FAO staff, FFS coordinators and all project partners) and were field tested during the two pilot seasons of sweet potato FFS. Comments from all the different stakeholders following their experience using each draft were collected at the annual planning/ evaluation workshops and were then incorporated or acted upon in order to improve the next draft. The final version is now ready for printing in Kampala, followed by distribution to more than 300 stakeholders. The manual is intended for use by field school facilitators be they extension staff, farmer facilitators or NGO/CBO staff facilitators. The final version includes sections on: background to FFS and facilitation skills; eight chapters on technical sweet potato IPPM information from planting material selection and land preparation through to post-harvest processing, storage, alternative products, marketing, including information on experimentation; an example of a SP FFS learning curriculum; ideas for learning activities; examples of meaningful group dynamic exercises; examples of monitoring and evaluation forms and methods used by the project. A general sweet potato farmer field school curriculum was developed at the beginning of the project, the facilitators have then adapted this to fit their specific schools circumstances and

interests, amended versions of the general curriculum have been developed as the project team has learnt.

Output 2. Farmers trained in pilot sweet potato ICM FFSs to manage their sweet potato enterprise and produce profitably and sustainably by January 2004.
In the first two seasons of the project (June – January 2002/03, 2003/04) a total of 18 sweet potato farmer field schools were run in NE Uganda and W Kenya, six of which were farmer facilitated, there were 492 participants, 322 of whom were women. Additional spin-off activities in NW Tanzania led to four extension facilitated sweet potato FFS with 92 participants using the curriculum, manual and training developed by the project but with funding for the FFS running costs from FAO.

Output 3. National cadres of trainers are trained by January 2004
Seven extension staff were trained as master trainers for sweet potato IPPM FFS (3 from Kenya, 2 from Uganda and 2 from Tanzania) through attending two technical courses at Namulonge Agricultural Research Institute in Uganda. Twelve farmer facilitators who had graduated from the first season's field schools were trained at Namulonge, and successfully facilitated sweet potato field schools during the second season. A further 15 graduates from the second season's field schools who would make skilled facilitators have been identified but due to the project only being funded to run two seasons of FFS, they have yet to actually run field schools themselves.

Output 4. Sweet potato ICM FFS modules institutionalised into large-scale FFS implementation programs by national extension systems, CBOs, NGOs, and follow-up plans for scaling-up developed by March 2005.
A wide range of diverse stakeholders have been involved in the project since its start, and many of them have been brought together annually at the projects planning and evaluation workshops. A stakeholder workshop was held in March 2005, to which individuals from organisations with an interest in sweet potato and food security in Uganda and Kenya were invited. The participants came with presentations on their plans for integrating sweet potato farmer field school approach and activities into their own programmes, and these plans were then further developed by groups of participants during the workshop. A feedback system to enable progress in achieving the plans was also developed.

3. Contribution of Outputs to Project Goal:

The project's outputs have already contributed to the chain of realisation of the project's goal which is stated as livelihoods of poor peoples improved through sustainably enhanced production and productivity of RNR systems by:

- demonstrating that farmers are keen to be involved in sweet potato IPPM FFS and can use what they learn through the FFS to improve their livelihoods in numerous ways including: improved household nutrition as a result of growing sweet potato varieties with high vitamin A content; producing more sweet potato using the techniques they have learnt in the FFS; trialling different practices using the skills they have learnt for experimenting with different methods; improved decision making as a result of understanding how to base economic decisions on evidence they collect about their own activities; selling products they have made from sweet potato; linking to factories and setting up village level quality processing units that function as profit making businesses; planting material; different recipes (mandazis, chapatis, juice, soap etc) made from sweet potato to help increase income opportunities and to encourage children to eat more sweet potato
- producing a learning curriculum that has been field tested over two crop seasons;
- producing a sweet potato farmer field school manual for sub-Saharan Africa for which there is already huge demand;
- developing a regional sweet potato technical training of trainers course which practically covers subjects from land preparation and planting material selection and conservation through to marketing, product diversification and storage issues;
- training of 37 sweet potato IPPM FFS facilitators ;

- scaling up plans which will ensure wider scale continuation of the SP IPPM FFS and use of the manual;
- other organisations are utilising their funding to implement linked activities elsewhere using skills initially acquired through this project and adding value to this project. For example involvement of local governments, other projects (e.g. DFID-COARD_in Soroti, NAADS programs (Busia and Soroti), Kenya- NALEP (Vihiga, Kisumu, Kakamega and Busia), TSAEE, DRD, and Ministry of Agriculture-Zanzibar in Tanzania);
- capacity building of participating FFS members in attracting and accessing additional resources e.g. Abuket FFS sweet potato processors group in Soroti, Uganda successfully applied for funds from the DFID-COARD project to participate in a tailor made sweet potato quality processing course, use of FFS participants by district councils to help raise awareness about other topics such as HIV;
- involvement of local government players in promoting sweet potato IPPM FFS approach amongst their constituencies and in lobbying for funds to support further activities, and in linking the work to national level policy makers and local level programmes such as school feeding programmes;

4. Publications:

*EKINYU, E. (2004) Steps in high quality production of orange-fleshed (Vitamin A) sweet potato chips. Poster submitted to the NARO Conference on Integrated Agricultural Research for Development – Achievements, Lessons Learnt and Best Practice, Kampala, Uganda, 1–4 September 2004. [Presentation]

NAMANDA, S., KAPINGA, R., TUMWEGAMIRE, S., STATHERS, T.E. and VAN DE FLIERT, E. (in prep) Dissemination and promotion of orange fleshed sweet potato varieties through FFS and VITAA partnerships: Experiences in Eastern Uganda. Draft paper for inclusion in proceedings of 13th Triennial Symposium of the International Society for Tropical Root Crops, 9–15 November 2003, Arusha, Tanzania. [Abstract, Presentation and Draft Conference Paper]

*NAMANDA, S., STATHERS, T., KAPINGA, R., MWANGA, R., TUMWEGAMIRE, S., ORUKO, L. and OWORI, C. (2005) Promotion of sweet potato marketing and utilisation through improved chipping techniques: Evidence from Abuket Sweet potato Processors Association. ISTRC-AB Symposium, Mombasa, Kenya. 1–5 November 2004. 9 pp. [Presentation (7 slides) and Conference paper]

STATHERS, T.E., NAMANDA, S., KAPINGA, R., KHISA, G., THOMAS, J. and VAN DE FLIERT, E. (in prep) Promotion of sustainable sweet potato production and post-harvest management through farmer field schools in East Africa. Abstract submitted to 13th Triennial Symposium of the International Society for Tropical Root Crops, 9–15 November 2003, Arusha, Tanzania. [Abstract, oral presentation, draft conference paper]

5. Internal Reports:

*AKELLO EKINYU, C. (2005) Abuket sweet potato growers and vine multipliers (ASPOGAVM): Report on Sweet potato ICM training and challenges encountered, achievements gained and gaps to address. International Potato Centre (CIP), Kampala, Uganda. 11 pp.

*EKINYU, E. (2004) One week in the brotherhood of ‘the colours of mother earth food communities’. Report on the Terra Madre World Food Community Meeting, Turin, Italy, 20–23 October 2004. 7 pp.

MWANGA, R.O.M. (2002) Report of the training of trainers and curriculum development on integrated pest and production management (IPPM) for sweet potato farmer field schools (FFS) in East Africa, Namulonge Agricultural and Animal Production Research Institute (NAARI), Kampala, Uganda 9–15 June 2002. International Potato Center, Kampala, 19 pp.

MWANGA, R.O.M. and NAMANDA, S. (2003) Report of the Second SP IPPM FFS Training of Trainers course at NAARI, Kampala from 28 April to 2 May2003. Namulonge Agricultural and Animal Production Research Institute (NAARI), Kampala, Uganda. 59 pp. [12 farmer facilitators and 5 master trainers from Uganda and Kenya]

NABASIRYE, M. (2003a) Report on Biometric Support to the Promotion of sustainable sweet potato production and post-harvest management through farmer field schools in East Africa project for the period of November 2002 to June 2003. Makerere University, Uganda, 5 pp.

NABASIRYE, M. (2003b) Summary Report on Training Session on Experimental Design, Data Collection and Analysis, held at Namulonge, 1 May 2003. Makerere University, Uganda, 3pp.

NABASIRYE, M. (2003c) Experimental Design, Data Collection and Analysis training for farmer facilitators and master trainers of sweet potato integrated pest and production management farmer field schools in East Africa. May 2003, Makerere University, Uganda, 12 pp.

NAMANDA, S. (2002) Review of SP IPPM FFS activities in Soroti and the sustainability of FFS activities in the district, Soroti flying school, Uganda, 4 October 2002. [Workshop] [English]

NAMANDA, S. (2003) Brief notes on preliminary meetings of new SP IPPM FFS in Soroti district, NE Uganda and initial needs assessment discussions from 17-21/5/03. 9 pp.

NAMANDA, S. and TUMWEGAMIRE, S. (2003) Trip report to Tanzania SP ICM FFS. CIP, Kampala, 5 pp.

OKOTH, J. (2002) Briefs on the Sweet potato ICM FFS Implementation/Consultative Meeting 1. Soroti Civil Aviation Academy, Uganda, 14 July 2002. International Potato Center, Kampala, 2 pp.

STATHERS, T., NAMANDA, S., MWANGA, R., KHISA, G. and KAPINGA, R. (2002–05) R8167 Project Progress Reports. Natural Resources Institute (NRI), Chatham, UK. [A series of project progress reports for submission to the Crop Protection Programme written in September and January of each project year.]

STATHERS, T., NAMANDA, S., MWANGA, R., KHISA, G., KAPINGA, R. and NABASIRYE, M. (2003) R8167 2002/03 Annual Report. Natural Resources Institute (NRI), Chatham, UK. 1 pp. [Annual report for submission to the Crop Protection Programme]

STATHERS, T., NAMANDA, S., MWANGA, R., KHISA, G. and KAPINGA, R. and NABASIRYE, M. (2004) R8167 2003/04 Annual Report. Natural Resources Institute (NRI), Chatham, UK. 1 pp. [Annual report for submission to the Crop Protection Programme]

6. Other Dissemination of Results:

AGRICULTURAL CORRESPONDENT (2003) Two radio talk shows were held by the Soroti district local councillors on the Voice of Teso radio station on 19/8/02 and 20/8/03. [Radio talk show] [National, Uganda]

*AGRICULTURAL CORRESPONDENT (2004) The novelty of the sweet potato farmer field schools. Community Support Book – Consolidating the efforts of NGOs, Government Agencies & the Private Sector in Uganda, Volume 2 with Television Series: p 32. [Magazine article and Television Programme, VCDs and Video tapes]

*AKELLO EKINYU, C. (2005) Farmers, farmers, farmers. Poem performed at the SP IPPM FFS Stakeholders workshop IV in Soroti, Uganda, 9–10 March 2005. International Potato Centre (CIP), Kampala, Uganda. 1 pp. [Poem]

ANON (2002) Sweet missing vitamin. [Play presented during Soroti field day on promotion of orange fleshed sweet potato]

ANON. (2002) First Draft Technical Guidelines for Farmer Field School for Integrated Pest and Production Management of Sweet potato in East Africa. December 2002. 76 pp.

ANON. (2003) Third Draft Technical Manual for Sweet potato Integrated Pest and Production Management Farmer Field Schools in East Africa, June 2003. Natural Resources Institute (NRI), Chatham, UK, 91 pp.

ECHERU, A. (2002) Food for life. [Poem presented by pupil of Anjopet primary school during Soroti field day on promotion of orange fleshed sweet potato] [English]

KAPINGA, R., NAMANDA, S. (2003) Sweet potato farmer field schools subproject- SSA. CIP Annual progress report 2003. International Potato Centre (CIP), Kampala, Uganda. 5 pp.

KYERE FARMER FACILITATORS, HEALTH AND WORKS SERVICE PROVIDERS ASSOCIATION (2003) Minutes of the formation meeting of the Kyere Farmer Facilitators, Health and Works Service Providers Association (KEFFAH-WOSPA). 5 pp.

NAMANDA, S. (2002) Field day on promotion of orange fleshed sweet potato, Gweri subcounty, Uganda, 27 September 2002. [Field day] [English] [2 Soroti SP IPPM FFS plus > thousand other farmers]

SOROTI DISTRICT COUNCIL (2003) Report of planned speeches on promotion of sweet potato use in 22 educational establishments in Soroti district, NE Uganda. 7 pp.

STATHERS, T. (2003) Evaluation/ Planning Workshop – II Report, Blue York Hotel, Busia, 1-3 April 2003. Natural Resources Institute, 100 pp.

STATHERS, T. (2004) Evaluation/ Planning Workshop – III Report, Blue York Hotel, Busia, 22–28 August 2004. Natural Resources Institute (NRI), Chatham, UK. 82 pp.

*STATHERS, T. (2005) Detailed planning for integration of sweet potato farmer field schools approach and activities into other programmes as developed in Stakeholders workshop. Natural Resources Institute (NRI), Chatham, UK. 11 pp.

*STATHERS, T. (2005) Stakeholder Workshop – IV Report, Soroti Hotel, Soroti, Uganda, 9-10 March 2005. Natural Resources Institute (NRI), Chatham, UK. pp.

UMOJA FFS (2002) FFS field day, Kakamega, Kenya, 10 December 2002. [Farmer field day]

UNDUGU FFS (2002) FFS field day, Busia, Kenya, 13th Dec 2002. [Farmer field day]
VAN DE FLIERT, E. and T. STATHERS (2002) Initial Project Planning Workshop – I Report, Starlight Guesthouse, Soroti, Uganda, 8–10 May 2002. International Potato Center, Kampala, 41 pp.

In addition to the above disseminations

- Eighteen pilot sweet potato IPPM FFS run (eight in Soroti, Uganda, and ten in Western Kenya) involving 492 farmers.
- Four additional pilot sweet potato IPPM FFS were initiated as a self-financed spin-off activity in Kagera, Tanzania.
- Training of facilitators, to date seven extension and one NGO staff were trained as master trainers for SP IPPM FFS and 12 farmers as farmer facilitators and a further 15 identified following the 2nd pilot season.

- The Secretary for production Local Council V, Soroti District spearheaded dissemination of orange-fleshed varieties to Bugondo and Olio sub-counties which are outside the project area.
- The project assistant (Sam Namanda) participated in sweet potato planning meetings with SOCADIDO, with the objective of promoting sweet potato productions within Kumi, Katakwi, Kaberamaido and Soroti districts. Unfortunately these activities were adversely affected by the insurgency.
- The project assistant attended the NAADS, Soroti district review meeting on 12.08.03 at Soroti flying School during which promotion of orange fleshed sweet potato was adopted for next season in the sub-counties of Kyere and Gweri in NE Uganda.
- Samples of farmer – formulated composite flour for porridge and local bread (Atap) prepared by farmers of Abuket FFS were presented to different consumers in Soroti including district stakeholders such the DAO and two samples (one for porridge and one for Atap) have been accepted and will be produced for mitigating Vitamin A deficiency and hanger in the internally displaced camps. Distribution was launched on 26 January 2004
- Radio and TV coverage were made of the sweet potato field day held in Soroti on 06 November 2003. Since then media coverage has been ongoing with different messages mainly on the promotion and utilisation of orange-fleshed sweet potato for increased food security, rural incomes targeting women and improved nutrition mainly increased Vitamin A intake.
- Two Ugandan SP IPPM FFS Master Facilitators attended TOT training in specialised sweet potato processing at Kawanda ARI, Uganda in May 2004 and have trained 35 farmer specialised sweet potato processors trainer (SP IPPM FFS graduates) in Soroti using funds they won competitively through a proposal to the NARO/DFID funded COARD project.
- Printing of T-shirts for Abuket sweet potato farmer field school processors group members in Soroti, funded by the sweet potato processing and commercialisation project managed by the FFS farmer groups and funded by the DFID NARO COARD program.
- Mr Ekinyu, one of the Soroti FFS graduates carried several photos of the FFS activities to the Slow Food Tour in Italy, which the other participants enjoyed. He was then asked to make a short presentation at the meeting.

7. Listing and reference to key datasets generated:

Data set	**Location**
R8167 – SP FFS Monitoring and evaluation data for Uganda and Kenya	Originals with Sam Namanda at CIP Kampala office namandasam@yahoo.co.uk Electronic copies with Tanya Stathers, NRI, UK T.E.Stathers@gre.ac.uk
R8167 – Photographic collections from Uganda and Kenya	Originals and electronic copies (if existing) with Tanya Stathers and Sam Namanda
R8167 – All the presentations and reports and activities comprising the 4 project workshops	Hard copies with all workshop participants and CPP. Electronic copies with Tanya Stathers, Sam Namanda, Robert MWANGA rmwanga@naro-ug.org , Godrick Khisa ffsproj@africaonline.co.ke , Regina KAPINGA r.KAPINGA@cgiar.org and CPP i.carballal@nrint.co.uk
R8167 – Electronic project communications	Electronic versions with Tanya Stathers, Sam Namanda, Godrick Khisa, Robert MWANGA and Regina KAPINGA

8. Follow-up indicated/planned:

The current project 'Promotion of sustainable sweet potato production and post-harvest management through farmer field schools in East Africa' (R8167), has stimulated huge demand for further support for sweet potato farmer field schools from a wide range of

stakeholders, including farmer groups, local government officials, extension staff, NGOs, CBOs and other projects.

Project R8167, started by looking at the numerous but isolated bits of research on sweet potato that have been supported over the years but which ignored the fact that farmers rarely face only one constraint, and that the various constraints[1] are often interrelated. It attempted to bring together as wide a range of research findings as possible and promote sustainable sweet potato production and post-harvest management through farmer field schools (FFS) in W Kenya and NE Uganda. The experiential learning approach taken by the FFS provided farmers with a deeper understanding of crop ecology and observational, analytical and problem solving skills. This helped farmers evaluate the importance and applicability of their existing and innovative practices and their adaptation to suit their own specific farm conditions.

When project R8167 was formulated, it was hoped that NW Tanzania could be one of the target areas, however CPP budget limits at the time prevented this. Despite this, linkages developed within the project enabled the training of extension facilitators from N.W. Tanzania, and FAO funds were used to support four sweet potato IPPM FFS. There is huge demand from farmers and extension systems who participated in these FFS for further training opportunities to enable the facilitation of more SP IPPM FFS, and particularly more farmer run FFS as has already begun to happen in Kenya and Uganda through the pilot FFS. The future of FFS in the region lies in the hands of these skilled farmer facilitators who are not only trusted by their colleague farmers but are also highly experienced and committed and a proposal was developed and will be funded to provide further support to build the competence of these farmer facilitators. The FFS graduates have specifically requested the project develop field leaflets on sweet potato pests and diseases and processing and recipes based on the information in the manual but which are targeted to farmers and translated to Kiswahili, Ateso and Luganda for use in the field and at home.

As the project has evolved cohesive farmer groups have developed through the collective learning activities, their exposure to economic analysis and value adding processes has lead to an increased awareness of their rights and the development of small enterprise groups. In Soroti FFS graduate groups have divided themselves into sweet potato producer and processor groups and have not only linked to millers such as Maganjo and Kasawo processors in Kampala but on finding they had seriously overproduced for their potential market they entrepreneurially developed and tested different sweet potato flours for use in local products such as porridge and Atap (bread), which have become popular locally and are helping feed the numerous internally displaced persons in feeding camps around Soroti.

As with any process there were problems surrounding the sweet potato IPPM FFS, and the project has learnt from these lessons and devised solutions to reduce their impact or prevent them reoccurring in the future. The literature surrounding FFS is notable for its lack of criticism and failure to discuss common problems associated with FFS. The issues faced by project R8167 are not specific to sweet potato FFS and the sharing of this information will help others involved in funding/ facilitating/ participating in or monitoring FFS to avoid repeating these mistakes.

9. Name of author of this report:
Tanya Stathers

[1] lack of planting materials; shortage of varieties which are high yielding, early maturing, drought tolerant, and high in dry matter and beta-carotene content; sweet potato weevils; sweet potato viruses; low soil fertility; lack of markets and/or market information; short shelf life of fresh roots after harvest; and limited processing opportunities

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Evolution within *Bemisia tabaci* and associated Begomoviruses: A strategic modelling approach to minimise threats to sustainable production systems in developing countries.	
DFID Project Reference No:	R8222	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	Rothamsted Research	
Production System:	Forest/Agriculture Interface	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to annual and herbaceous crops in Forest/Agriculture production systems	
Commodity Base:	Various crops and vegetables including legumes, roots and tubers	
Beneficiaries:	Institutions collaborating in the Tropical Whitefly IPM Project, programme management of the CPP	
Target Institutions:	Institutions collaborating in the Tropical Whitefly IPM Project	
Geographic Focus:	Colombia, Africa, Latin America	
Total Cost:	£221,554	
	Planned	**Actual**
Start Date:	1 October 2002	1 October 2002
Finish Date:	31 March 2005	31 March 2005

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1. Project Purpose:

1. Develop an overview of existing knowledge and information on recent *Bemisia tabaci* and begomovirus evolutionary changes.
2. Develop and analyse models that elucidate the possible effects of *B. tabaci* management on evolutionary changes.
3. Develop and analyse models that elucidate the possible effects of begomovirus management on evolutionary changes.
4. Transfer the knowledge generated, and further research needed, to research teams and CPP management.

2. Outputs:

1. The review of the literature has identified that begomovirus genetic diversity is extremely complex and that there is still much to be answered regarding how the different genomic components and satellite molecules interact. The vector populations are also more diverse than previously realised, but more research is needed on how this diversity affects the evolution of more virulent begomovirus strains/species. The review has identified the most pressing research needs in this area (see section 8), together with studies on the control of host gene silencing of virus genes, and the effects of particular cropping mixtures on virus genetic diversity. A paper on this work is submitted to Critical Reviews in Plant Sciences.

2. A model was formulated and analysed to study the evolution of *B. tabaci* biotypes under the influence of (a) the introduction of a new crop or new crop variety, (b) the use of pesticides, and (c) the structure of the cropping system, comparing large scale monocultures with intercropping. Three life-history traits, that might undergo evolution, were studied. To wit (a) the

feeding rate of the whitefly on the crop species/varieties, (b) the efficiency of conversion of food into offspring, and (c) the death rate of the whitefly on each crop.

Using the adaptive dynamics methodology of evolutionary ecology we have shown that:

- It depends strongly on the trait under evolution whether new biotypes will evolve. This result is unexpected and attracted attention of the evolutionary ecology and the whitefly community. See also section 8.
- When feeding rate is the evolving trait, new biotypes can evolve when a new introduced crop reaches a critical acreage. When the conversion efficiency is the evolving trait and no whiteflies are brought in with the new crop, no new biotype will evolve.
- Although there are very good other reasons for intercropping, we have found no difference between large monocultures and intercropping systems in their evolutionary pressures to the evolution of whitefly biotypes.

A paper on the results of this work will be submitted soon to *Journal of Applied Ecology*.

3. For this project purpose we studied the evolutionary effects of virus transmission through cuttings, and the evolutionary consequences of the introduction of resistant and tolerant cultivars.

Evolution of viral plant diseases with two routes of infection: A model is developed for crops that are multiplied through the use of cutting material (as in cassava, sweet potato, plantain, etc.) The evolving virus trait used in this work is the within plant virus titre build up. The model has been analysed using analytical techniques from adaptive dynamics. Our main conclusions are:

- Not taking the evolutionary dynamics into account when developing disease management methods for viral plant diseases can lead to incorrect predictions.
- When cuttings are used as planting material for the next crop, disease management interfering with the cutting-transmission route of the virus bears the risk of increased virulence of the virus.
- When cuttings are used as planting material for the next crop, disease management interfering with the vector-transmission route of the virus does not increase the virulence of the virus.

A paper on the results of the work will be submitted soon to *Journal of Applied Ecology*.

Virus evolution under the influence of resistant crops: A model has been developed to analyse the effects of introducing a resistant cultivar on the evolution of the virus titre a virus builds up in a plant. We have distinguished four types of resistance/tolerance mechanisms. When the virus has had the time to adapt to the use of resistance two groups of effects of using resistance cultivars on the dynamics of the disease are found:

- The first group, including inoculation resistance and acquisition resistance, does not put a selection pressure on the virus. This implies that the virus titre in infected plants does not change. Furthermore the density of healthy plants in the system does not change. This means that yield loss due to the disease will not change in any way when inoculation resistant or acquisition resistant cultivars are used. These types of resistance thus are good candidate disease management methods in the development of sustainable agricultural systems.
- The second group, including tolerance and virus tire reducing resistance, do put a selection pressure on the virus to evolve towards larger virus multiplication rates. For tolerant cultivars this implies that the plant virus titre increases. Whether this has a negative effect on crop yield depends on the balance between the yield gain due to the tolerance of the plants, and the yield reduction due to the increased virus titre. For plants expressing virus titre reducing resistance the evolutionary response of the virus causes the within plant virus titre to evolve back to the titre of the non-resistant cultivar it has been derived from. Also the density of healthy plants will evolve back towards the density it would have for a non-resistant cultivar. The cultivars from this second group are thus not durable in the sense that they put an evolutionary pressure on the virus that might reduce the effectiveness of the tolerance/resistance.

Whether tolerant cultivars and virus titre reducing cultivars have a contribution to make is however not only dependent on the selection pressure put on the virus but also dependents

on additional factors. The tolerant cultivar might still have a positive effect on yield even when the virus has evolved the new ESS simply because the tolerance provides a sufficient amount of addition damage reduction. Furthermore it can be that the ESS virus multiplication rate is outside the attainable range for the virus under consideration. Finally the time at takes the virus to evolve towards the new ESS virus multiplication rate is of importance here.

We are thus not advocating that tolerance and virus titre reducing cultivars will never have a contribution to the management of virus diseases but we have shown that there are potential problems with the use of such cultivars that need to be considered to maximise the effectiveness of the use of resistant cultivars. The inoculation resistant and acquisition resistant cultivars do not have such problems.
A paper on this work has been submitted to *Ecological Applications*.

4. In several meetings with researchers of the Tropical Whitefly IPM Project we have discussed our findings and discussed the use of these findings in future research. During a visit of one of the team members to CIAT, Colombia, extensive discussions have taken place on the research findings. During the IX International Plant Virus Epidemiology Symposium to be held in Lima, Peru on 4–7 April 2005, a workshop will be held to discuss the work further and develop future research plans.

3. Contribution of Outputs to Project Goal:

As in the RD1-form, the project goal was 'to provide a strategic analysis to identify potential consequences for pest and disease management measures on evolution of *B. tabaci* and begomoviruses''. This goal has fully been met. The researchers involved in the project are presently developing further research that will take these strategic results towards application in pest and disease management.

4. Publications:

Because this project developed a novel area of research and the project duration was only two years, the papers written and submitted have not yet been accepted for publication.

SEAL, S., JEGER, M.J., and VAN den BOSCH, F. (2005) Begomovirus evolution – factors influencing the rate of evolution and global emergence of whitefly transmitted diseases and implications for sustainable control. Submitted to *Critical Reviews in Plant Sciences*.

DEMON, I., JEGER, M.J., and VAN Den BOS (2005) The effect of crop and pest management on the evolution of *Bemisia tabaci* biotypes. To be submitted to Journal of Applied Ecology.
Van den Bosch, F., Jeger, M.J., and Gilligan, C.A. Disease management and the virulence of viral plant diseases. To be submitted to *Journal of Applied Ecology*.

VAN den BOSCH, F, AKUDIBILAH, G, SEAL, S. and JEGER (2005) Resistant cultivars and the evolutionary response of plant viruses. Submitted to *Ecological Applications*.

We have been invited to contribute two papers, based on our *presentations in the virus epidemiology symposium in Lima, to an issue of Advances* in Virus Research edited by Mike THRESH, to be published end 2005/early 2006.

JEGER, M.J. and VAN den BOSCH, F. evolutionary epidemiology of plant viruses. To be submitted to *Advances in Virus Research*.

VAN den BOSCH, F. and JEGER, M.J. The effect of cropping practices on begomovirus evolution. To be submitted to *Advances in Virus Research*.

5. Internal Reports:

Because all the results are submitted to internationally refereed journals no internal reports were published.

6. Other Dissemination of Results:

Presenter: Frank van den Bosch. Evolution within *Bemisia tabaci* and associated Begomoviruses. Presented at: meeting at East Malling with people from the CPP. December 2003.

Presenter: Frank van den Bosch. Evolution within *Bemisia tabaci* and associated Begomoviruses. Presented at: meeting at NRI with people from the Tropical Whitefly IPM Project and the CPP. October 2003.

Presenter: Inez Demon. Effects of crop and pest management on the evolution of biotypes of *Bemisia tabaci*. Presented at: The 2003 National Meeting of the Royal Entomological Society, International Symposium on Insect Evolutionary Ecology. 28–31 July 2003, Reading.

Presenter: Inez Demon. The evolution of biotypes of *Bemisia tabaci*. Presented at: CIAT, International Centre for Tropical Agriculture. 12 December 2003, Colombia.

Presenter: Gordon Akudibillah. The effect of resistant cultivars on the evolution of whitefly transmitted diseases. Presented at: 1st International Symposium on Tomato Diseases. 21–24 June. Orlando, Florida, USA.

Presenter: Inez Demon. The evolution of biotypes of *Bemisia tabaci*. Presented at: The Ministry of Agriculture, Animal Husbandry And Fisheries, 6 January 2004, Suriname.

Presenter: F. van den Bosch. Disease management and plant pathogen evolution. Invitation to speak at the XVTH International Plant Protection Congress, 11–16 May 2004, Beijing.

Presenters: M. Jeger and F. van den Bosch. Evolutionary epidemiology of plant viruses Invited key-note presentation at the IX International Plant Virus Epidemiology Symposium to be held in Lima, Peru on 4–7 April 2005.

Presenters: F. van den Bosch and M. Jeger. The effect of cropping practices on begomovirus evolution. Invited talk in Special Topics Session at the IX International Plant Virus Epidemiology Symposium to be held in Lima, Peru, on 4–7 April 2005.

7. Listing and reference to key datasets generated:

No data were gathered in this project as it is a theoretical study.

8. Follow-up indicated/planned:

The review has shown that insight into the genetics and the possible evolutionary changes on the genome level of begomoviruses is rapidly accumulating. It is very likely that further and detailed insight will be available in the near future without special additional DFID commitment. There is however very little research developing to elucidate the links between molecular genetics of begomoviruses and the epidemiological characteristics of the diseases caused by these viruses. Our modelling studies on the evolution of begomoviruses have shown that this information is key to the further development of disease management strategies that do not provoke the virus to evolve into more harmful types. Investment into research elucidating the relation between molecular genetics and epidemiology of begomoviruses should be a priority area for further work.

We have shown that the evolutionary dynamics of *Bemisia tabaci* whiteflies caused by crop and pest management depends to a large extend on the life-history parameters of the whitefly that can undergo rapid evolutionary change. Although some information exists in this respect for other insect species, notably for aphids, virtually nothing is known about this key aspect in *Bemisia tabaci*. Research into evolving life-history traits in *Bemisia tabaci* should therefore be a key future research area.

We have shown that it is possible to elucidate the key effects of disease management on the evolution of begomoviruses. It has become evident that with further studies it should be possible to develop methods for the selection of resistant cultivars and to select crop and disease management methods that do not provoke the virus to evolve into more harmful variants. Future work needs to concentrate on:

- robustness of our present findings to other evolving virus traits.
- to develop experimental methodology to be able to dissect the contribution of various types of crop resistance in resistant cultivars, and develop selection programmes based on these methods.

9. Name of author of this report:
Frank van den Bosch and Mike Jeger

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Promotion of control measures for cassava brown streak disease	
DFID Project Reference No:	R8227	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	Natural Resources Institute, University of Greenwich	
Production System:	Forest/Agriculture Interface	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to annual and herbaceous crops in Forest/Agriculture production systems	
Commodity Base:	Cassava	
Beneficiaries:	Smallholders in Tanzania, Mozambique and Malawi	
Target Institutions:	Naliendele and Kibaha Agricultural Research Institutes in Tanzania. NGO -Save the Children and INIA in Mozambique, SARRNET in Malawi	
Geographic Focus:	Eastern and southern Africa [coastal zone]	
Total Cost:	£211,047	
	Planned	**Actual**
Start Date:	01 August 2002	01 January 2003
Finish Date:	31 March 2005	31 March 2005

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1. Project Purpose:

To contribute to poverty reduction and improved food security through better knowledge of the epidemiology of cassava brown streak disease and the promotion of disease control measures to rural communities for whom cassava is the staple food.

2. Outputs:

CBSD was shown for the first time to be transmitted by the whitefly, *Bemisia tabaci*. A form of tolerance to the disease was identified in an earlier project in local cassava cultivars. The present project multiplied and distributed these to 13 target villages in Tanzania and the distribution of planting material was supported by an information campaign that used FM radio, posters and leaflets, as well as training of extension officers in disease recognition and control. Six secondary schools were also used as community multiplication sites and aspect of cassava production and utilisation were incorporated into the curriculum. In Malawi, in collaboration with SARRNET, a large collection of local cultivars was screened for resistance to CBSD and some tolerant cvs identified. A similar exercise was conducted by INIA in Mozambique supported by the project. Supported by the CPP, NRI was until 2002, the only organisation working on CBSD and the body of knowledge built-up has been used by NGOs and by new research projects now in place, implemented by IITA with funding from Rockefeller foundation and others donors. Methods for working with CBSD have been summarised in a manual for use by other project. As a consequence of work done by the CPP-funded projects, IITRA has made resistance to CBSD a priority for new cassava varieties developed for the coastal regions of eastern Africa. Until recently, CBSD was thought to be confined to coastal regions of eastern and southern Africa, but in February 2005, we confirmed the disease in Uganda.

3. Contribution of Outputs to Project Goal:

Food security is a pre-requisite for poverty reduction and rural development in Africa. CBSD is the main biotic threat to food security in the coastal regions of eastern Africa. Management of

CBSD increases the useable root yield, improving food security and allowing surplus root production to sold directly or made into flour. Because of its direct effect on root quality, CBSD not only decreases food security but is also a constraint to the development of commercial cassava processing. The project has identified and promoted a control measure for CBSD which limits losses to the disease until more resistant varieties become available from the IITA programme. CBSD-tolerant varieties identified by the project have been widely distributed in Tanzania and Mozambique using village-based community multiplication, NGO food security projects and other rural development projects.

4. Publications:

MUGA, T. and THRESH, J.M. (2002) Incidence of cassava mosaic and cassava brown streak virus diseases in coastal Kenya. *Roots* **8**[1] 12–14.

HILLOCKS, R.J. and JENNINGS, D.L. (2003) Cassava brown streak disease: a review of present knowledge and research needs. *International Journal of Pest Management* **49**, 225–234.

THRESH, J.M and HILLOCKS, R.J. (2003) Cassava mosaic and cassava brown streak diseases in Nampula and Zambezia Provinces of Mozambique. Roots **8**(2), 10–15.

MARUTHI, M.N. (2004) Bionomics, morphometrics and molecular characterisation of a cassava *Bemisia afer* (Priesner & Hosny) population. *International Journal of Tropical Insect Science* **24**, 323–329.

MARUTHI, M.N., HILLOCKS, R.J., MTUNDA, K., RAYA, M.D. MUHANNA, M. and KIOZIA H. (2004) Transmission of *Cassava brown streak virus* by *Bemisia tabaci* (Gennadius) [In Press October 2004]

5. Internal Reports:

HILLOCKS, R.J. (2003) Report of a visit to Malawi to review project activities conducted by SARRNET and the National Root Crops Programme, 14–17 July 2003. Project R8227, Natural Resources Institute, Chatham, Kent, 2 pp.

HILLOCKS, R.J. (2003) Report of a visit to Tanzania to review CBSD dissemination activities, 17–24 August 2003. Project R8827, Natural Resources Institute, Chatham, Kent, 3 pp.

MARUTHI, M.N. (2003) Visit to Tanzania to carry out transmission studies on *Cassava brown streak virus* 5–25 April 2003. Project R8827, Natural Resources Institute, Chatham, Kent, 5 pp.

HILLOCKS, R.J. (2003) Report of a visit to Mozambique to evaluate the different ways that CBSD impacts on food security in the coastal Districts of Nampula Province covered by Save the Children, 27 September–05 October 2003. Project R8827, Natural Resources Institute, Chatham, Kent, 3 pp.

MARUTHI, M.N. (2003) Report of a visit to Tanzania to train the staff of Mikocheni Agricultural Research Institute (MARI), on the use of PCR techniques for the diagnoses of cassava mosaic and cassava brown streak viruses, 15–25 November 2003. Project R8827, Natural Resources Institute, Chatham, Kent, 4 pp.

HILLOCKS, R. J. (2004) Report of a project management visit to Tanzania, 13–28 March 2004. Natural Resources Institute, Chatham, UK, 8 pp.

GONDWE, F.M.T., MAHUNGU, N.M., HILLOCKS, R.J., RAYA, M.D., MOYO, C.C., SOKO, M.M., CHIPUNGU, F.P. and BENESI, I.R.M. (2004) Cassava brown streak disease in Malawi

and implications for food security. Working Paper No 1071/1, Natural Resources Institute, Chatham, UK, 15 pp.

6. Other Dissemination of Results:

MARUTHI, M.N. (2003) A laboratory Manual on Molecular Characterisation of Cassava Brown Streak Virus. Natural Resources Institute, Chatham, UK, 19 pp.

GOULD, R. (2003) Stopping the rot. Earth Watch. BBC World Service. 5 min. Television Trust for the Environment [Television documentary] [English].

HILLOCKS, R.J. (2004) Research Protocols for Cassava Brown Streak Disease. Natural Resources Institute, Chatham, UK. 24 pp.

HAMZA, H. (2004) Cassava virus diseases and post-harvest utilisation of cassava. Naliendele Agricultural Research Institute, Mtwara, Tanzania. 15 July 2004. [One-day Training Workshop for Extension Officers and Secondary School Teachers].

Information leaflets and posters
ARI NALIENDELE (2003) *Kudhibiti Ugonjwa wa Matekenya wa Mihogo*. 4000 copies. Naliendele Zonal Centre for Agricultural Research & Development, Mtwara, Tanzania. [Information Leaflet] [Kiswahili].

NRI (2003) Cassava brown streak disease 1. Disease symptoms 2. Disease control. 150 copies. Natural Resources Institute [with Ministry of Agriculture in Tanzania, Save the Children in Mozambique and SAARNET in Malawi]. Natural Resources Institute, Chatham, UK. [Posters] [English, Kiswahili and Portuguese]

7. Listing and reference to key datasets generated:

NARI (2004) monitoring and evaluation survey to assess knowledge of CBSD and training needs of village extension officers in southern Tanzania. Questionnaire, Excel spreadsheet and report. Naliendele Agricultural Research Institute, Mtwara, Tanzania.

NARI (2004) Results from on-farm evaluation of CBSD-tolerant cassava varieties in southern Tanzania. Data sheets and reports Naliendele Agricultural Research Institute, Mtwara, Tanzania.

NARI (2004) Results from on-station trials to evaluate cassava varieties for resistance to CBSD. Data sheets and reports Naliendele Agricultural Research Institute, Mtwara, Tanzania.

SRI (2004) Results from on-farm evaluation of CBSD-tolerant cassava varieties in eastern Tanzania. Data sheets and reports Sugarcane Research Institute, Kibaha, Tanzania

SRI (2004) Results from on-station trials to evaluate cassava varieties for resistance to CBSD. Data sheets and reports Sugarcane Research Institute, Kibaha, Tanzania

INIA (2004) Results from trials to screen cassava germplasm for resistance to CBSD in Mozambique. Data sheets and Report, INIA, Maputo.

8. Follow-up indicated/planned:

A 9-month follow-up has been funded in which CBSD-tolerant cassava varieties are being promoted for small-scale processing into flour as a commercial enterprise.

9. Name of author of this report:
Rory Hillocks

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Working with farmers to control sweet potato virus disease in East Africa	
DFID Project Reference No:	R8243	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	Natural Resources Institute, University of Greenwich	
Production System:	Forest/Agriculture Interface	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to annual and herbaceous crops in Forest/Agriculture production systems	
Commodity Base:	Root crops: sweet potato	
Beneficiaries:	East African farmers	
Target Institutions:	Namulonge ARI; Maruku ARI	
Geographic Focus:	East Africa	
Total Cost:	£245,182	
	Planned	**Actual**
Start Date:	01 November 2002	01 November 2002
Finish Date:	31 March 2005	31 March 2005

1. Project Purpose:

The broad aim of the project is to increase the productivity of sweet potato in East Africa by enabling farmers to grow the crop without the constraint of sweet potato virus disease or other pests and diseases. It aims to achieve this using participatory approaches to select superior resistant varieties and seedling accessions, identify appropriate cultural control measures, develop training tools and materials and train farmers and extensionists in disease control methods.

2. Outputs:

The project was based at national agricultural research institutes: Namulonge in Uganda and Maruku in Tanzania. The project collaborated closely with farmer groups, seven in both countries, providing training for facilitators on-station and farmers through project staff, project-trained facilitators and exchange visits amongst the groups. This training process included knowledge of the causes of sweet potato virus disease (SPVD), how to control it by cultural methods and the use and development of resistant varieties. The training also provided a test-bed whereby the project developed and validated training tools and materials.

The project conducted participatory varietal selection (PVS) with farmer groups in both countries testing 9 and 11 cultivars in Uganda and Tanzania respectively. These cultivars included high-yielding SPVD-resistant and high vitamin A orange-fleshed ones. Farmers generally considered all were useful and it was clear from results that what did well in one location and one season did not necessarily do well in other situations. There were trends, however, e.g., Naspot 1 yielded highly in most places and most situations; Naspot varieties were all generally very SPVD-resistant but some were Alternaria susceptible and SPK004 was the most SPVD-resistant of the orange-fleshed cultivars. Farmers seemed keen to receive a 'basket' of varieties so they can select. SPVD resistance was confirmed as an effective means of control. The project also identified more orange-fleshed local varieties as a contribution to the VITA A project.

The project also tested a range of cultural control measures. Farmers generally selected planting material from plants with a healthy appearance. This measure was therefore not tested but the

message to do so was reinforced in training. The main cultural control tested was roguing and this was demonstrably effective to the farmers, decreasing virus spread, increasing yield and improving the health of planting material. Isolation by distance and by a crop barrier was tested. Whilst both were when successfully tested, isolation by distance was unsatisfactory because of land shortages and vulnerability of isolated crops, and the sorghum barrier seemed to reduce the yield of the protected sweet potato.

Working with three farmer groups in Uganda and three farmer groups in Tanzania, the project has made farmers aware of how new varieties develop by growing seedlings of superior families and then selecting them, with national programme breeders, through up to 3 clonal generations in communal participatory breeding (PB) trials. Farmers have also taken material to their own gardens to experiment. Farmers retain a small number of clones which appear to be high-yielding, resistant to SPVD and Alternaria and are now being monitored closely by farmers for other necessary quality attributes.

One general constraint highlighted by the close collaboration with farmers was the importance of drought resistance in sweet potato. Drought destroyed several PVS and cultural control trials and was identified as a major reason why farmers did not continue growing the released varieties. It also severely affected the PB trials and one outcome of this is that the surviving selected accessions are likely to be drought resistant as well as disease resistant. Interestingly, unavailability of land in swamps to maintain planting was also a major constraint identified in a survey of SPVD done in Rwanda. There, SPVD was a major problem in one province.

In both Uganda and Tanzania, poster and leaflets explaining in different languages how to control SPVD were developed and used in training programmes for extensionists; a section on SPVD control was also include in a general Farmer Field School Technical Manual. Extensive training was provided to extensionists in Tanzania, especially through a collaboration developed with the Norwegian People's Aid. Planting material of superior varieties was also disseminated: to refugee-affected areas in Kagera, Tanzania and to refugees in Uganda.

3. Contribution of Outputs to Project Goal:

The project has sustained the livelihoods of poor farmers in East Africa through a variety of measures. The project has worked directly with small-scale farmers, mostly women and including refugees, HIV-AIDS affected families and farmers in refugee-affected areas. Planting material of superior varieties has also been provided to such groups.

The project has validated through a participatory approach the provision to farmers of a basket of superior disease-resistant varieties backed up by selecting healthy planting material and roguing young crops. The collaboration with farmers also identified that isolation by distance or crop barriers, whilst effective in reducing spread, was difficult to utilise in practice by small-scale farmers with limited access to land. PB has been developed for sweet potato in Africa for the first time. The protocol enabled farmers to make an effective contribution; although more work needs to be done, it appears that some high-yielding disease resistant and drought tolerant accessions have been identified.

Training tools and materials have been developed, improved and used to train farmers and extensionists in Uganda and Tanzania to enable information to be disseminated further. Involvement with NPA has allowed increased impact to be leveraged.

4. Publications:

LEGG, J.P., GIBSON, R.W. and HUGHES, J.D'A. (2003) Virus diseases of root crops in Africa: an overview. *Proceedings of Symposium of International Society of Tropical Root Crops.*

RWEGASIRA, G.M., MARANDU, E.F., GIBSON, R.W. and KAPINGA R.E. (2003) Control of sweet potato virus disease through farmer field schools approach in Kagera region, Tanzania. *Proceedings of Symposium of International SocietY of Tropical Root Crops.*

GIBSON, R.W., BYAMUKAMA, E., MWANGA, R.O.M., MPEMB, I. and KAYONGO, J. (2003) Evaluation of orange-fleshed sweet potato entries for resistance to SPVD and high yield. *Proceedings of Symposium of International Society of Tropical Root Crops.*

BYAMUKAMA, E., GIBSON, R.W., MWANGA, R.O.M., MPEMBE, I., and KAYONGO, J. (2003) Effect of shading and intercropping in management of sweet potato virus disease in Uganda. *Proceedings of Symposium of International Society of Tropical Root Crops.*

5. Internal Reports:

LEGG, J. Visit to Kagera Region, Tanzania, 5–9 July 2004.

RWEGESIRA, G.M. and MARANDU, E.F. Monitoring visit to NPA initiated activities in collaboration with MARDI.

BYAMUKAMA, E. Retention of improved sweet potato varieties in Masaka and Rakai districts: a follow up survey report.

MUGUNGA, M., MUTUMWINKA, M. and BYAMUKAMA, E. Report on national sweet potato survey, Rwanda 10–17 August 2004.

B. ADOLPH. Trip report of a visit to the CPP funded research project on 'Working with farmers to control sweet potato disease in East Africa', June 2003.

E. BYAMUKAMA. Retention of improved sweet potato varieties in Masaka and Rakai Districts.

A follow up survey report. August 2004.

RWEGASIRA, G.M. and MARANDU, E.F. Working with farmers to control sweet potato virus disease in the Lake Zone of Tanzania. March 2004.

Quarterly and annual reports as requested by CPP.

6. Other Dissemination of Results:

BYAMUKAMA, E., MPEMBE, I, KAYONGO, J, ADOLPH, B. and GIBSON, R. Establishing impact of participatory research in the adoption of new technologies in sweet potato research in Uganda. Presentation made to the International Society for Tropical Root Crops - Africa Branch 9th Triennial Symposium, 31 October – 5 November 2004, Mombasa, Kenya.

CBS Radio: Two 1-h broadcasts in Luganda on 8 and 22 June on CBS-FM radio.

KALYANGO, R. NAARI fights potato virus. *New Vision*, 29 September 2004.

LEGG, J.P., GIBSON, R.W. and HUGHES, J.d'A. (2003) Virus diseases of root crops in Africa: an overview. Presentation at Symposium of International Society of Tropical Root Crops.

RWEGASIRA, G.M., MARANDU, E.F., GIBSON, R.W. and KAPINGA, R.E. (2003) Control of sweet potato virus disease through farmer field schools approach in Kagera region, Tanzania. Presentation at Symposium of International Society of Tropical Root Crops.

GIBSON, R.W., BYAMUKAMA, E., MWANGA, R.O.M., MPEMBE, I. and KAYONGO, J. (2003) Evaluation of orange-fleshed sweet potato entries for resistance to SPVD and high yield. Presentation at Symposium of International Society of Tropical Root Crops.

BYAMUKAMA, E., GIBSON, R.W., MWANGA, R.O.M., MPEMBE, I. and KAYONGO, J. (2003) Effect of shading and intercropping in management of sweet potato virus disease in Uganda. Presentation at Symposium of International Society of Tropical Root Crops.

7. Listing and reference to key datasets generated:

Datasets on results of PVS and PB are held at Namulonge and Maruku ARI

8. Follow-up indicated/planned:

The project will continue the participatory breeding during an extension, maintaining a close collaboration with national programmes in Tanzania and Uganda so that there is an easy hand-over of selected material. The national programme in Uganda is developing its own PB programme funded by McKnight Foundation so our work will provide a firm basis for this.

The project will continue to work closely with other organisations particularly in Tanzania to disseminate project outputs more widely and deeply. There is a particular need because the CMD pandemic is causing considerable damage in the Lake Zone here. The opportunity is also there in Tanzania to extend results through the DFID-funded Tropical Whitefly Project.

9. Name of author of this report:
RW Gibson

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Evaluation and promotion of crop protection practices for 'clean' seed yam production systems in Central Nigeria	
DFID Project Reference No:	R8278	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	Natural Resources Institute, University of Greenwich	
Production System:	Forest/Agriculture Interface	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to annual and herbaceous crops in Forest/Agriculture production systems	
Commodity Base:	Yams	
Beneficiaries:	Resource-poor yam growers and those who serve them	
Target Institutions:	National and regional GOs and NGOs	
Geographic Focus:	Nigeria/West Africa	
Total Cost:	£196,510	
	Planned	**Actual**
Start Date:	1 January 2003	1 January 2003
Finish Date:	31 March 2005	31 March 2005

1. Project Purpose:

Yams are usually propagated through the planting of small tubers (seed-yams) and/or pieces of tuber (setts). The material is usually not treated correctly and the vegetative mode of propagation results in the carry-over and perpetuation of tuber-borne pests and diseases between seasons. Farmers have repeatedly highlighted the benefits of planting clean material for both yield and quality of ware yams, while acknowledging the higher costs involved in procuring such material. The project aim was to assess if scarcity and expense of clean planting material was the/a major constraint to yam production, and then to work with yam farmers through local partner organisations in Kogi and Ekiti states to evaluate systems for the cost-effective, sustainable and environmentally sound production of clean planting material. Appropriate ways of packaging and disseminating the project findings would also be identified.

2. Outputs:

Output 1. A household base-line situation analysis in riverine areas of Igalaland (Kogi State) and Ekiti in 2003 re-confirmed that most yam growers were purchasing their seed yams because they believed that seed quality was important. However, the high cost of the seed on the market was a limiting factor in increased yam production. Production of their own seed yams was considered a high risk activity which most growers would not consider entering into unaided. A typical coping strategy, especially in Ekiti but also in Igalaland, was to use yam setts. Igala farmers were obtaining much of their seed yam material from areas further south on the river Niger (Illushi). Farmers in Ekwuloko obtained their seed yam from illegal planting within protected forest reserves. In both cases the transportation costs were high. Credit emerged as a key constraint for the establishment of clean seed yam production, especially in Igalaland.

Output 2. On-farm trials in 2003–04 and 2004–05 confirmed that planting tuber pieces of 100–150 g pre-treated with a mild cocktail of a fungicide, and insecticide/nematicide and

wood-ash is an effective method of producing healthier seed yams. Pre-treatment of the planting pieces with neem leaf-slurry gave very variable results (sometimes beneficial, sometimes not), while the results for a pre-planting hot water treatment were also variable and seemed to be variety-dependent. Additional experiments have therefore been established to assess the effect of hot water on seed yam sett preparation by variety. A final repeat (second) of the experiment is currently underway. Results from the farmer's fields for the 2004 season are yet to be fully analysed, but indicate substantial improvement of yield, size and quality of seed tubers using the recommended pesticide mixture compared with farmers' normal practice.

A detailed household livelihood analysis incorporating a cost-benefit study of home seed yam production on four farms in Ekwuloko (Kogi) and four farms in Ado-Ekiti (Ekiti) in the 2004–05 season has generated much information and is currently being analysed. Early indications from the Ekwuloko case studies are that while households are involved in a diverse range of on- and off-farm income generating activities which place demands on labour, home production of seed yams can be cost-effective in some situations. However, because there are so many calls on the farm finances there is rarely sufficient funding available at the right time, nor the perceived sufficient incentives for farmers to attempt to grow their own seed yams.

Output 3. A series of yam pest and disease identification sheets and posters and a project promotional calendar were developed and distributed in the 2003–04 and 2005 seasons. A simple seed yam production guide based on the project findings is currently being developed in response to an expressed need by project partners (growers and extension agents).

Output 4. A wide range of stakeholders (including yam growers, extension agents and other NGOs) have been involved in the project activities through participating in planning meetings, hosting trial plots, visiting demonstration plots and attending participatory farmer field days following the harvests of farmer trials. Demonstration of the suggested method for seed yam production (resulting from the project findings) have been demonstrated to farmers at State Trade and Agricultural Fairs and at NGO field days. An end of project workshop is scheduled for 10–11 March 2004 to assess/review the project outputs and achievements with some of these stakeholders and further develop links and a network for promoting improved seed yam systems within Nigeria.

3. Contribution of Outputs to Project Goal:

The planned outputs of the project have largely been achieved, although more analysis of the livelihood data is still required. The findings from the livelihood studies will also need to be presented to the farmers involved for their views and interpretation. The project has confirmed that in the study areas yam production is a major contributor to sustaining the livelihoods of the people. However productivity, and hence farm income, could be improved if the supply of good quality seed yams could be increased. The project also showed that there are relatively simple systems available to the growers for producing their own good quality seed yams, but these are regarded as risky activities by the growers and require financial investment by the growers at times of the season when currently most do not have access to such funds. Provision of credit for small-scale farmers has been an issue for many years in Nigeria, and sustainable large-scale solutions have been elusive (e.g. the collapse in the 1990s of the state sponsored 'Peoples Bank' modelled on the Grameen Bank of Bangladesh). Commercial banks have little interest in the provision of credit for small-scale farmers given the risks and the relatively high transaction costs. Thus, while a targeted and sustainable micro-finance credit scheme would provide growers with funds at the appropriate time to allow them to start growing their own seed yams and increase their yam production and productivity a means of sustainable provision is required. Some NGOs in Nigeria do have long experience of such provision, and it would be possible to adapt the livelihoods approach to become a rights-based business plan which could become the basis of a partnership between NGO and farmer. The farmers would then become local suppliers of planting material and thereby eliminate the high costs of transportation from distant sites. By specialising in seed yam production it is more likely that they will be able to produce quality material, and these benefits should make seed yams more affordable.

4. Publications:

5. Internal Reports:

MORSE, S. and MCNAMARA, N. (2004). Evaluation and promotion of crop protection practices for 'clean' seed yam production systems in Central Nigeria. Report on Socio-economic component by DDS.

6. Other Dissemination of Results:

2003 Calendar: Use Healthy Seed Yams For Better Yields.

2005 Calendar: Use Healthy Seed Yams For Better Yields.

CLAUDIUS-COLE, A.O., COYNE, D., KENYON, L., AYODELE, M., MCNAMARA, N. and MORSE, S. (2004) Seed yam production systems: assessment of various pre-plant treatments of setts for production of nematode free material. First West and Central African Nematology Meeting, Douala, Cameroon, 8–10 November 2004.

COYNE, D., CLAUDIUS-COLE, A.O., ROTIFA, I., KENYON, L.. AYODELE, M., MCNAMARA, N. and MORSE, S (2005) Seed yam production systems: use of pre-plant treatment of setts for production of healthy planting material at IITA. Paper presented at farmers' field day organised by the NGO Food For All International (FFAI), Port Harcourt, Nigeria, 24 February 2005.

COYNE, D. honoured by D. MOWBRAY. *IITA Bulletin* No 1772 p 2. http://www.iita.org/news/bulletin/1772.pdf

DFID Project organises farmer's field day by CLAUDIUS-COLE. *IITA Bulletin* No. 1782 (13 December 2004) p.2 http://www.iita.org/news/bulletin/1782.pdf

OLUKAYODE OYELEYE Ekiti Farmers Boost Healthy Seed Yam. *The Guardian* (Nigeria) national newspaper. 5 December p. 20. http://www.guardiannewsngr.com/agro _care/article04/051204

How to Produce Healthy Seed Yams! Step-by-step demonstration/descriptor flyer for distribution at field days.

ROTIFA, I. IITA at Odu'a Trade Fair by. *IITA Bulletin* No. 1785 p.2 http://www.iita.org/news/bulletin/1785.pdf

IITA i-new: Seedy side of yams by D. MOWBRAY. 2003. www.iita.org

OYETUNDE, A. IITA i-new: Healthy seed yam production (in press). www.iita.org

KENYON, L. (2003) Improving the health of Dioscorea yams. 13th Triennial Symposium of the International Society for Tropical Root Crops, Arusha, Tanzania 10–14 November 2003
Pests and diseases of yam affecting seed health (A1)

The Bulletin: Meeting to promote clean seed yam production. IITA 21 April 2003
Winner in Eden By David Mowbray. *IITA Bulletin* No. 1752 p. 3 http://www.iita.org/news/bulletin/1752.pdf

Yam pests and diseases identification sheets: Virus symptoms, Insects and insect damage, nematodes, and fungal and bacterial diseases (A2 and A4).

7. Listing and reference to key datasets generated:

*DDS (2003) Raw data from a situation analysis-survey on yam seed production by households in Kogi state and Ekiti state Nigeria: Excel spreadsheets. University of Reading, UK.
*CLAUDIUS-COLE, A. (2004) Dataset: On-farm and on-station trials of yam pre-planting treatments in 2003. Excel Spreadsheets. International Institute of Tropical Agriculture, Ibadan, Nigeria.

*CLAUDIUS-COLE, A. (2005) Dataset: On-farm and on-station trials of yam pre-planting treatments in 2004. Excel Spreadsheets. International Institute of Tropical Agriculture, Ibadan, Nigeria.

*DDS (2005) Raw data from a household livelihood/cost-benefit analysis of four yam growers in Ekwuloko (Kogi State): Excel spreadsheets. Diocesan Development Service, Idah Nigeria.

*CLAUDIUS-COLE, A. (2005) Raw data from a household livelihood/cost-benefit analysis of four yam growers in Ado Ekiti (Ekiti State): Excel spreadsheets. International Institute of Tropical Agriculture, Ibadan, Nigeria.

*Audio-visual recordings organised through IITA and ADP for the farmer participatory field days conducted at Idah and Ekiti in 2004.

8. Follow-up indicated/planned:

The project findings led to the development of a proposal to CPP for a 10 month follow-on phase to the project (PM321). The proposal has recently been approved as project R8416/Za0648, which has the following intended outputs:

1. Components of commercial seed yam production systems (at Illushi) potentially applicable to the production of clean seed yams by small-scale growers identified.
2. Sustainability of small-scale seed yam production systems assessed in the contrasting ecologies and livelihood systems of Alla-Olakudu/Makoja and Ekwuloko
3. Implementation and benefits of a micro-credit scheme for seed yam production evaluated in Ekwuloko
4. Seed yam production systems/ technologies transferred to promotional partners.
5. Promotional materials needs and production responsibilities further identified.

The project findings have also stimulated the development of a proposal for wider dissemination and promotion of improved seed yam systems across West Africa through CORAF for three years. A response is awaited on the outcome of this proposal.

9. Name of author of this report:
Lawrence Kenyon

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Archiving data from integrated pest and disease management projects within the Uganda Banana Research Programme	
DFID Project Reference No:	R8301	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	Statistical Services Centre, The University of Reading	
Production System:	Forest/Agriculture Interface	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to annual and herbaceous crops in Forest/Agriculture production systems	
Commodity Base:	Banana	
Beneficiaries:	Research Institutes in Uganda	
Target Institutions:	Kawanda Agricultural Research Institute, Uganda	
Geographic Focus:	Uganda, East Africa	
Total Cost:	£56,375	
	Planned	**Actual**
Start Date:	01 May 2003	01 May 2003
Finish Date:	31 May 2004	31 May 2004

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1. Project Purpose:

Effective management of research data aimed at promoting strategies to reduce pests and diseases in banana production systems for the benefits of poor people.

2. Outputs:

Assembling of an archive of raw data, meta-data and study protocols of the CPP-funded IPM (R7567), BSV (R7529) and weevils (R7972) projects in a central archive by Data Management staff attached to the National Banana Research Programme (NBRP) based at Kawanda Agricultural Research Institute in Uganda. A system is also in place for archiving data and related information from other projects within NBRP.

Production of a manual documenting guidelines and procedures necessary for maintaining a good database management system in consultation with NBRP staff and facilitated through staff training in research data management. These guidelines have been agreed and accepted by NBRP staff, and endorsed by the Director General (DG) of the National Agricultural Research Organisation (NARO) in Uganda.

Development and documentation of an appropriate Data Management Strategy for all NBRP research activities. This document, entitled *NBRP Policy for Research Management with particular emphasis on data management and statistical analysis* has been accepted by NBRP staff. NBRP collaborators have been sent a copy for comment, after which it will be accepted as NBRP Policy.

3. Contribution of Outputs to Project Goal:

Project outputs contribute indirectly towards DFID's development goals in that enhancing research staff capacity to collect reliable data, and to manage and organise the data efficiently and effectively will enable them to produce research results based on solid, defendable, high quality data. Research scientists, research assistants, technicians and data

entry personnel in NBRP are now well sensitised to the importance of paying attention to data quality and maintaining the meta-data alongside data of a numerical nature.

The manual on *Guidelines and Procedures for Effective Data Management* has been printed by NBRP and is being distributed to NARO research scientists in each of Uganda's nine natural resource based research institutes.

4. Publications:

None.

5. Internal Reports:

ABEYASEKERA, S., and DALE, I. (2003) Report on a training workshop on research data management for staff of the Uganda National Banana Research Programme, 2 and 4–6 June 2003, UNBRP, Uganda. University of Reading, Reading, UK.

ABEYASEKERA, S. (2003) Visits to the National Banana Research Programme – Report Nos. 1 to 3*.

ABEYASEKERA, S. (2004). Visits to the National Banana Research Programme – Report Nos. 4 to 6*.

MULUMBA, Y. (2003) Back to Office Report from attending a short-term training programme at the Statistical Services Centre, The University of Reading, UK, 13 October – 7 November 2003. Biometrics Unit, Kawanda Agricultural Research Institute. 16 pp.

MUREKEZI, C., ABEYASEKERA, S., MULUMBA, Y., RWAKATUNGU, A., KUBIRIBA, J. and TUSHEMEREIRWE, W.K. (2004) *Guidelines and Procedures for Effective Data Management (with emphasis on banana research).* National Banana Research Programme, Kawanda Agricultural Research Institute, Kampala, Uganda, 35 pp. Shortly to be available at http://www.banana.go.ug.*

RWAKATUNGU, A. (2003) Back to Office Report on training at the Statistical Services Centre, University of Reading, UK, 20–31 October 2003. Biometrics Unit, Kawanda Agricultural Research Institute. 16 pp.

UNBRP (2004) *Uganda National Banana Research Programme Policy for Research Management with emphasis on Research Data Management and Statistical Analysis*. Kawanda Agricultural Research Institute, Kampala, Uganda, 14 pp. Shortly to be available at http://www.banana.go.ug.*

6. Other Dissemination of Results:

At the request of the Director-General of NARO, the manual giving *Guidelines and Procedures for Effective Data Management* is being distributed to all NARO research staff.

In addition to the above, copies of both the *Guidelines and Procedures for Effective Data Management* and the *NBRP Policy for Research Management with particular emphasis on Data Management and Statistical Analysis* will be placed on NBRP's website at www.banana.go.ug shortly after the guidelines manual has been distributed.

7. Listing and reference to key datasets generated:

Data archive of the three CPP-funded IPM (R7567), BSV (R7529) and weevils (R7972) projects is available at the Biometric Unit, NBRP, Uganda.

8. Follow-up indicated/planned:

Follow-up work is now progressing towards the development of a proper database management system for NBRP with assistance from a database expert from the World Agroforestry Centre in Kenya, and a little support from the Statistical Services Centre at the University of Reading. This work is being funded by Rockefeller Foundation as a direct result of initial work under project R8301.

DG-NARO Uganda has expressed his view that data management alone will not improve research quality without parallel improvement in research methods concerning appropriate study design and methods of data analysis. Discussions are on-going with DG-NARO to determine ways in which these issues can be addressed.

9. Name of author of this report:
Dr S. Abeyasekera

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Participatory breeding of superior, mosaic disease-resistant cassava: validation, promotion and dissemination	
DFID Project Reference No:	R8302	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	Natural Resources Institute, University of Greenwich, Kent	
Production System:	Forest/Agriculture Interface	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to annual and herbaceous crops in Forest/Agriculture production systems	
Commodity Base:	Root crops: cassava	
Beneficiaries:	Small rural producers, consumers and entrepreneurs in rural and urban areas	
Target Institutions:	Crops Research Institute, Kumasi, Ghana	
Geographic Focus:	Sub-Saharan Africa: located in W Africa, Ghana	
Total Cost:	£74,103	
	Planned	**Actual**
Start Date:	01 April 2003	01 April 2003
Finish Date:	31 March 2005	31 March 2005

1. Project Purpose:

Improving farmers' access to a diversity of superior, disease-resistant cassava clones appropriate to the needs of farmers and other end-users

The project continues the validation process and promotes (through MOFA facilitated by other donors) a method by which farmers and researchers work together to develop cassava varieties appropriate to local needs and conditions, including resistance to pests, weeds and diseases, particularly cassava mosaic. Farmers have identified limited markets as a problem. The project will address this through identifying opportunities for improving communication between end-users and those working on varietal development so as to enable germplasm improvement to enhance cassava utilisation. The project will also examine how the participatory breeding approach can fit within official variety release requirements, the latter being required to achieve widespread dissemination of cultivars

2. Outputs:

The project has continued the participatory breeding activities of the project in two communities and at an on-station trial, monitoring the characteristics of selected accessions in comparison to a range of check clones through two more generations. This has led to the selection of 39 superior clones that are being tested in further multi-locational community trials in Brong Ahafo and Ashanti Regions. Farmers, the CRI plant breeder and CRI plant pathologists all make broadly similar selections as indicated by a considerable degree of overlap between their choices. The farmers' selections in particular were also reasonably consistent from one generation to the next. The bases for the breeder's and the plant pathologists' choices were predetermined; the basis of the farmers' choices was determined by questionnaires at each harvest. The breeder placed most emphasis on yield, the plant pathologists on absence of foliar diseases and the farmers on a diversity of storage root characteristics (of which high yield is the main one) and canopy formation. The project capitalised on unique selections by different actors

by ensuring that selections of all actors were retained from one generation to the next. This did not slow the elimination of accessions excessively: the progress of selection of superior accessions occurred at a similar rate to that of conventional plant breeding. The selection process has identified genotypes with a high yield in farmers' conditions and with a relatively high and well-branched canopy intercepting a high percentage of light. The selected accessions appear moderately resistant to diseases and seem likely to shade out weeds. These results therefore validate the participatory selection process adopted, all actors, particularly farmers, being able to select in an effective and individual yet inclusive manner.

The method will not finally be validated until long-term adoption by farmers is demonstrated. This is being enabled in the communities in which the project works directly by allowing farmers to take cuttings of their preferred accessions to plant in their own farms. Relying on farmer-to-farmer transfer of superior accessions is expected to be slow. Furthermore, the project is well-placed within the official Ghanaian system to release superior genotypes through the Ghanaian Variety Release Committee, enabling official systems to distribute more widely. Analysis of previous release documents determined that we have considerable evidence for the farmer acceptability of our accessions and their resistance to diseases but lacked a broad range of multi-locational trials in specified agro-ecologies. This requirement was a main reason for planting the additional multi-locational community trials in Brong Ahafo and Ashanti Regions.

A further weakness of both our participatory approach and conventional cassava breeding at CRI was a failure to address the needs of cassava end-users other than farmers. This has been addressed by a survey in Ghana of:

1. end-users
2. current and potential end-uses of cassava
3. the activities of post-harvest researchers.

The achievements of these surveys have been collated in project working papers and have also led to an initial pair of trials of superior accessions selected by the project at farms of medium-scale manufacturers of cassava food products. The surveys were conducted either by or in close co-operation with the Crops Research Institute plant breeder. This activity in itself has achieved a closer working relationship with scientists at the Food Research Institute in Ghana, resulting in starch characteristics being included in cassava variety release documents for the first time in Ghana (and perhaps in Africa).

3. Contribution of Outputs to Project Goal:

The project has validated the participatory breeding approach of the project, demonstrating that it has provided a means by which farmers, a plant breeder and plant pathologists could work together in an effective and inclusive manners. It also provided an environment whereby farmers made a significant and consistent contribution to the outcome of selection. The previous phase of the project ensured that the original seedling populations comprised a wider diversity of genotypes than farmers could normally access and these were likely to be appropriate to the needs of Ghanaian farmers. Consequently, the overall project goal of 'Improving farmers' access to a diversity of superior, disease-resistant cassava clones appropriate to the needs of farmers' has been achieved for the communities with which the project is working.

However, farmers also identify a need for better markets for cassava and cassava clones also need to be appropriate (and therefore marketable) to other end-users. The project has therefore conducted surveys to identify the requirements of different end-users of cassava in Ghana and both current and potential end uses of the crop. It has established trials of superior clones selected by the participatory approach on medium-scale industrial food producers and enabled biochemical properties of cassava starch of future varieties to be determined. These are a first step to improving the suitability of cassava for a variety of current and new markets. This should increase the future profitability of cassava, enabling cassava to make currently poor cassava farmers richer – whilst also providing a better range of cheap food products for Ghanaian families, supporting industrialisation and improving the balance of payments of Ghana by displacing imported sources of starch.

Whilst the on-farm trials enable collaborating communities to access a greater diversity of germplasm, national release is required to achieve the wide dissemination available through official distribution systems. National release of varieties selected by participatory breeding would also provide independent and official validation of participatory breeding, encouraging others to reap its advantages. Multi-locational on-farm trials of selected accessions have been planted with the aim of achieving their recommendation for two major regions (Brong Ahafo and Ashanti).

4. Publications:

MANY-ADUENING, J. (2005) Participatory breeding for superior mosaic-resistant cassava in Ghana. Doctoral Thesis, University of Greenwich.

5. Internal Reports:

The following working papers have been prepared to enable early use of project achievements.

(2004) Informal exchange of cassava genotypes and farmers' knowledge and use of sexual propagation of cassava. 53 pp.

(2004) Participatory breeding for superior mosaic resistant cassava in Ghana: two years of seedling/clonal evaluation by farmers and scientists. 54 pp.

(2005) Participatory cassava breeding in Ghana: survey of cassava end-users.

(2005) Participatory cassava breeding in Ghana: a review of current and potential utilisation of cassava in Ghana and its implication for varietal development.

(2005) Participatory cassava breeding in Ghana: survey of cassava post-harvest research.

6. Other Dissemination of Results:

A presentation Combining the interests of farmers and scientists in a participatory approach to breed for superior mosaic resistant cassava was made to the International Society for Tropical Root Crops – Africa Branch meeting in Mombasa in November 2004.

7. Listing and reference to key datasets generated:

Yield and other key agronomic data sets have been prepared in Excel for the community trials in Nkaakom and Aworowa. They are owned by Dr JA Manu-Aduening, CRI, Ghana.

8. Follow-up indicated/planned:

A key achievement needed to complete the current project is to submit documentation of requisite characteristics of selected cassava genotypes to the Ghanaian Variety Release Committee and as a result to release one or more varieties in Ghana. This would achieve independent and official validation of our participatory breeding approach and provide a 'worked example' of how to achieve it to other researchers. It would also be valuable if quality characteristics of the starch and other end-user requirements are included in the release document, extending our achievement of this for conventional breeding to participatory breeding.

9. Name of author of this report:

RW Gibson

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Maximising, disseminating and promoting the benefits to farmers of cassava varieties resistant to cassava mosaic disease	
DFID Project Reference No:	R8303	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	Natural Resources Institute, University of Greenwich, Kent	
Production System:	Forest/Agriculture Interface	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to annual and herbaceous crops in Forest Agriculture production systems	
Commodity Base:	Root crops: cassava	
Beneficiaries:	Farmers and consumers of cassava in East Africa	
Target Institutions:	Namulonge and Maruku agricultural Research Institutes	
Geographic Focus:	East Africa: Uganda and Tanzania	
Total Cost:	£170,299	
	Planned	**Actual**
Start Date:	01 April 2003	01 April 2003
Finish Date:	31 March 2005	31 March 2005

1. Project Purpose:

Modern resistant varieties (MOVs) provide the main control strategy for the cassava mosaic disease (CMD) pandemic in Africa, but no single variety is perfect. The project, in partnership with the international TWIPMP, will validate MOVs and other control technologies including selection of planting material and mixing susceptible landraces with resistant varieties in a close working collaboration with farmers in Uganda and Tanzania (Lake Zone). Using this collaboration as a 'test-bed', it will develop farmer-validated promotional systems/materials for national (e.g. NAADS) and regional dissemination (IITA, EARRNET). Research on-station will also seek cassava genotypes resistant to *Bemisia tabaci,* the whitefly vector of CMD, which will provide additional protection to the existing CMD-resistant genotypes.

2. Outputs:

The project has participated with farmer groups in both Uganda and Tanzania, testing the use of CMD-resistant varieties and different cultural control practices, notably roguing and intercropping with a resistant cassava variety to protect a susceptible one. Field demonstration plots in 5 farmers' fields in Mukuono have demonstrated to farmers (and validated for researchers) the lower incidence of CMD in resistant varieties (00067; TME14; TME204 and NASE 10) and in CMD susceptible landraces (Njule; Kabwa) planted amongst a CMD-resistant variety (00067). Civil unrest in northern Uganda resulted in the abandonment of work in Lira and its late replacement with work in Soroti. Resistance was clearly the most effective means of controlling CMD but the cultural control measures did provide a means by which the farmers were able to sustain production of moderately resistant local landraces despite the pandemic.

A leaflet describing the causes, means of spread and various means of controlling CMD through the use of high-yielding resistant varieties has been developed by the Uganda team in English, Kiswahili and Luo. A draft of a guide in Kiswahili describing the causes, means of spread and

means of controlling both CMD and sweet potato virus disease which, like CMD, is spread by whiteflies, has been developed by the Tanzanian team. Members of the Tanzanian team have also visited Uganda to exchange ideas.

Training in how to control CMD has been provided to farmers in the collaborating farmer groups in Uganda. Here, however, the pandemic has long been established and most extensionists are already aware of the causes of the disease. In Tanzania, this is not the case and the project has collaborated with the Norwegian people's Aid (NPA) to provide training for extensionists, mostly within the Lake Zone but also further afield in the country. This collaboration with NPA has also extended to funding dissemination of planting material of resistant varieties. The following is an extract from a recent BTOR "NPA has 11 acres of mature cassava and 2 acres of sweet potato at their primary multiplication site alone, estimated as being able to provide 4–5 million cuttings of cassava sufficient for about 4,000 starter households this rainy season. They also have 3 satellite nurseries comprising a further 2.5 acres, through funding NGOs e.g., CARITAS & REDESO, making another million cuttings ready for another 1,000 households. Many farmers had been provided with planting material in previous seasons and now also have mature crops ready to provide cutting for other farmer groups. We visited 2 sites, one of 11.5 acres and another of 9.5 acres. We were told of at least 11 more such farmer group multiplication sites."

Populations of whiteflies 1–2 orders of magnitude greater than before the CMD pandemic have been observed, notably in Uganda but also in other countries affected by the CMD pandemic. Sooty mould is often observed blackening middle and lower leaves where the whitefly excreta has become infected with fungi. Chlorosis and stunting of middle and upper leaves occurs, caused on the upper leaves caused by adults feeding and on middle leaves mainly by nymphs feeding. A trial repeated in two seasons and involving eight varieties differing in apparent susceptibility to whiteflies was conducted in Uganda to assess the effect the use of insecticides controlling whiteflies would have on yield. The insecticides controlled the whiteflies, removing observable signs of whitefly feeding damage, reducing spread of CMD in susceptible varieties and generally leading to a greater root yield. The greater root yield occurred both in CMD-susceptible varieties and in near –immune varieties. Large numbers (279) of Ugandan landraces have been screened for resistance to whiteflies, leading to the identification of a few resistant ones, e.g., Njule. Some released varieties also seem to support relatively few whiteflies. Screening of advanced clonal accessions has also identified in clones in national advanced and uniform yield trials (AYT and UYT). In particular, the clones MM96/4271 and MM96/0686 supported few whiteflies and whitefly nymphs in UYT and were also chosen by farmers and scientists using other criteria. Resistance of identified clones has been confirmed in screenhouse preference tests.

Project scientists have also identified the presence of an outbreak of another whitefly-borne virus, cassava brown streak, in Uganda. This seems likely to result from the large numbers of whiteflies affecting cassava crops here and whitefly resistance may be a key component in its control.

3. Contribution of Outputs to Project Goal:

Cassava is amongst the most important food crops for the rural poor throughout Africa both for food and food security. A pandemic of CMD associated with superabundant whiteflies have been devastating the crop I East and Central Africa. The project has validated control methods and means of disseminating knowledge of them to farmers in East Africa.

The project has also shown that whiteflies are now a direct pest of cassava in Africa as well as the vector of its main disease. Major progress has been made towards identifying whitefly-resistant cassava varieties, not only in landraces but also in material sufficiently superior in yield and resistance to CMD to be being trialled for national release. If successful, this material will have a major role in controlling both direct and indirect damage by whiteflies and also protect the crop against the evolution of more whitefly-borne viruses.

4. Publications:

ALICAI, T., BUA, A., OTIM-NAPE, G.W., BAGUMA, Y.K., SSEMAKULA, G.N., SSERUBOBWE, W., OMONGO, C.A., AKULLO, D., TUMWESIGYE, S. and APOK M. (2003) Research and development strategies for controlling cassava mosaic disease and enhancing the competitiveness of cassava in Uganda. *Abstracts of Symposium of International Society of Tropical Root Crops.*

OMONGO, C.A., COLVIN, J., ALICAI, T., SSERUBOMBWE, W., LEGG, J.P. and OTIM-NAPE, G.W. (2003) Host selection by *Bemisia tabaci* of CMD-symptomatic and non-symptomatic cassava plants. *Abstracts of Symposium of International Society of Tropical Root Crops TORTUREOUS*

COLVIN, J., OMONGO, C.A., MARUTHI, M.N., OTIM-NAPE, G.W. and THRESH, J.M. (2004) Dual begomovirus infections and high *Bemisia tabaci* populations: two factors that drive the spread of a cassava mosaic disease pandemic. *Plant Pathology*, **53**, in press.

LEGG, J.P. SSERUWAGI, P. and BROWN, J. (2004). *Bemisia* whiteflies cause physical damage and yield losses to cassava in Africa. *6th International Science Meeting Cassava Biotechnology Network* (Abstract) p. 65.

OMONGO, C.A., COLVIN, J., SSERUBOMBWE, W., ALICAI, T., BAGUMA, Y., BUA, A., LEGG, J.P. and GIBSON, R.W. (2004) Host plant resistance to African *Bemisia tabaci* in local landraces and improved cassava mosaic disease resistant genotypes in Uganda. *6th Intnternational Science Meeting Cassava Biotechnology Network (*Abstract), p. 84.

COLVIN J., CHOWDA REDDY, R.V. REKHA, A.R. SSERUWAGI, P. MUNIYAPPA, V. SEAL, S.E. MARUTHI, M.N. (2004) Ecological and reproductive isolation amongst African and Asian *Bemisia tabaci* populations. Abstract for the 2nd European Whitefly Symposium, Cavtat, Croatia, 5–9 October 2004.

5. Internal Reports:

GIBSON, R. Quarterly and annual reports to CPP.

LEGG, J. (2004) Visit to Kagera Region, Tanzania, 5–9 July 2004.

RWEGESIRA, G.M. and MARANDU, E.F. (2004) Monitoring visit to NPA initiated activities in collaboration with MARDI.

GIBSON, R. and ADOLPH, B. (2004) Report on a project visit (A1076 (SPVD) and A1105 (CMD)) to Kagera Region, Tanzania, 8–13 November 2004.

RWEGASIRA, G.M. and MARANDU, E.F. (2005) Final monitoring report to NPA activities.

RWEGASIRA, G.M., MARANDU E, F. and MWITA, C.V. (2005) General evaluation of NPA work and support to MARDI.

6. Other Dissemination of Results:

ALICAI, T., BUA, A., OTIM-NAPE, G.W., BAGUMA, Y.K., SSEMAKULA, G.N., SSERUBOBWE, W., OMONGO, C.A., AKULLO, D., TUMWESIGYE, S. and APOK. M. (2003) Research and development strategies for controlling cassava mosaic disease and enhancing the competitiveness of cassava in Uganda. Presentation at Symposium of International Society of Tropical Root Crops.

OMONGO, C.A., COLVIN, J., ALICAI, T., SSERUBOMBWE, W., LEGG, J.P. and OTIM-NAPE, GW. (2003) Host selection by *Bemisia tabaci* of CMD-symptomatic and non-symptomatic cassava plants. Presentation at Symposium of International Society of Tropical Root Crops.

LEGG, J.P., SSERUWAGI, P. and BROWN J. (2004) *Bemisia* whiteflies cause physical damage and yield losses to cassava in Africa. Presentation at 6th International Science Meeting Cassava Biotechnology Network.

OMONGO, C.A., COLVIN, J., SSERUBOMBWE, W., ALICAI, T., BAGUMA, Y., BUA, A., LEGG, J.P. and GIBSON, R.W. (2004) Host plant resistance to African *Bemisia tabaci* in local landraces and improved cassava mosaic disease resistant genotypes in Uganda. Presentation at 6th International Science Meeting Cassava Biotechnology Network.

COLVIN, J., CHOWDA REDDY, R.V. REKHA, A.R. SSERUWAGI, P. MUNIYAPPA, V., SEAL, S.E. and MARUTHI, M.N. (2004) Ecological and reproductive isolation amongst African and Asian *Bemisia tabaci* populations. Presentation at the 2nd European Whitefly Symposium, Cavtat, Croatia, 5–9 October 2004.

OMONGO, C.A., COLVIN, J., BUA, A., ALICAI, T., LEGG, J.P. and BAGUMA, Y. The emergence of *Bemisia tabaci* (Hemiptera: Aleyrodidae) as a direct pest threatens sustainable cassava production in Uganda. Presentation made to the International Society for Tropical Root Crops – Africa Branch 9th Triennial Symposium, 31 October–5 November 2004 in Mombasa, Kenya.

7. Listing and reference to key datasets generated:

8. Follow-up indicated/planned:

The cassava mosaic pandemic continues to expand in and from the Lake Zone in Tanzania, having severe effects on the livelihoods of poor rural people there, many of which are unusually dependent on cassava for food because of dry conditions do not allow other crops to grow there. The project therefore plans to disseminate knowledge of and materials for control of CMD, training government and NGO extensionists using protocols and materials developed and disseminating resistant materials.

The heightened numbers of whiteflies on cassava remain a serious problem in Uganda and other countries affected by the pandemic, both in terms of direct damage and increased risk of whitefly-borne viruses. The project therefore plans to continue the work on identifying sources of resistance and developing a leaflet to inform farmers.

Both these activities will be extended through a) an extension of this CPP-funded project and b) the DFID-funded Tropical Whitefly Project.

9. Name of author of this report:
RW Gibson

PROJECT COMPLETION SUMMARY SHEET (PCSS)

DATE Sheet Completed: 15 March 2005

Project Title:	Promotion of improved IPM practices for banana diseases and pests in Uganda	
DFID Project Reference No:	R8342	
Programme:	Crop Protection Programme	
Programme Manager (Institution):	Dr Frances Kimmins (NR International)	
Sub-Contractor (project leader's institution)	CAB International, UK Centre, Egham, UK	
Production System:	Forest/Agriculture Interface	
Programme Purpose:	Benefits for poor people generated by application of new knowledge on crop protection to annual and herbaceous crops in Forest/Agriculture production systems	
Commodity Base:	Banana	
Beneficiaries:	Stakeholders involved in banana production, marketing and processing chain, consumers	
Target Institutions:	Farmer groups, NARO, NARES, CBO, NGO, MAAIF, NAADS and other organisations in Uganda	
Geographic Focus:	Uganda and UK	
Total Cost:	£269,913	
	Planned	**Actual**
Start Date:	1 July 2003	1 July 2003
Finish Date:	31 March 2005	31 March 2005

1. Project Purpose:

To assist the Uganda National Banana Research Program (UNBRP) to promote and disseminate recommended banana crop and resource management technologies to a wide range of stakeholders in Central Uganda dependant on the production of bananas for their livelihoods. Technologies include local and introduced, improved banana cultivars with tolerance or resistance to major pests and diseases including leaf spots, banana streak virus (BSV), fusarium wilt, weevils and parasitic nematodes. A fundamental component of the work was to identify and utilise intermediary banana stakeholders as partners to the UNBRP, who would provide appropriate channels of communication and thereby facilitate promotion and dissemination of technologies to beneficiaries based on demand. By empowering banana farmers to select and utilise improved management technologies, the project would help to increase production, productivity, utilisation and consumption of bananas and banana products in Uganda, increase food availability and income of poor people and ultimately improve the livelihoods of rural communities in particular.

2. Outputs:

By utilising a participatory approach a broad range of banana stakeholders, including farmers and representatives of extension services, non-governmental organisations (NGO), community based organisations (CBO), the National Agricultural Advisory Service (NAADS), local councils and national government were presented, by the UNBRP, with improved integrated pest management (IPM) options for banana production in Luwero, Mukuno and Kayunga districts of Central Uganda. Based on the relative attributes of the management options, stakeholder communities identified and selected those considered appropriate to their needs. Stakeholders were also identified who were capable and willing to act as intermediaries, or service providers, to communicate knowledge relating to the management options to local communities, thereby promoting their uptake, utilisation and ultimate adoption. Throughout the project a participatory development communication (PDC), rather than a 'top down', approach was employed to help

ensure success of the various activities. In each district the project worked through pilot or model subcounties, parishes and villages within which strong linkages and partnerships were developed and where activities were, and continue to be, coordinated and supervised by community task forces established during the project. In these areas, and indeed beyond, considerable success has already been achieved in promoting management approaches that are now being applied to the benefit of farmers and their associates. Given limited resources, the intention was that the model communities would act as a catalyst for more widespread promotion and adoption of improved management practices.

In the early stages of the project the rapid spread and damaging effects of banana bacterial wilt (BBW, caused by *Xanthomonas campestris* pv. *musacearum*) were becoming realised in Central Uganda, especially Mukono and Kayunga districts. As a result the UNBRP and other NARES in Uganda, and consequently this project, were compelled to reallocate resources to counteract the disease. While the project continued to address and promote IPM generally, steps were taken to incorporate and indeed emphasise BBW, by raising awareness of the disease and promoting management practices, such as male bud removal, considered to be appropriate. Research was also undertaken to identify and further improve management options for BSV, the results of which would contribute to, and update, the IPM promotional messages being conveyed.

3. Contribution of Outputs to Project Goal:

Overall, the outputs of this project have been achieved with considerable success. While the resources of the UNBRP are limited and insufficient to support direct promotion of IPM on a large scale, it has been very successful in utilising a participatory approach to facilitate and nurture multi-partner communication and promotion of IPM practices where the key decisions are made, and demand expressed, by banana stakeholders as the ultimate beneficiaries. In the communities in which the project has operated, communication pathways are now in place and, with the aid of communication materials developed as part of the project, farming communities have been empowered to employ more appropriate IPM practices for banana production. While systematic monitoring of the impact of the project activities has not been possible (see section 8), feedback from communities has suggested that the benefits of banana production are being more widely realised and that the willingness of farmers to produce bananas not only as food but also as a commercial enterprise has increased. A continuation of this trend will help to ensure that bananas can be produced in sufficient quantity and of a required standard, that improvements in food security will be attained and that the incomes and livelihoods of those involved in the banana commodity chain, particularly the rural poor and including consumers, will improve.

4. Publications:

TUSHEMEREIRWE, W., KANGIRE, A., SSEKIWOKO, F., OFFORD, L.C., CROZIER, J., BOA, E., RUTHERFORD, M.A. and SMITH, J.J. (2004) First report of *Xanthomonas campestris* pv. *musacearum* on banana in Uganda. *Plant Pathology* (in press)

5. Internal Reports:

ABEYASEKERA, S. (2004) Brief report on statistically related activities undertaken in Uganda under the Promotion Project R8342, 27 February to 4 March 2004. University of Reading Statistical Services Centre, Reading, UK.

ABEYASEKERA, S., MULUMBA, Y., RUTHERFORD, M., LAMBOLL, R.I., KENYON, L., NGAMBEKI, D. and ATIKU, L (2004). Data requirements to assess farmers' perceptions of research trial technologies and their current knowledge of pests and diseases. University of Reading Statistical Services Centre, Reading, UK.

ABEYASEKERA, S., ODOI, N., NGAMBEKI, D. and MULUMBA, Y. (2004) Farmers' perception of IPM technologies – piloting the survey procedure. University of Reading Statistical Services Centre, Reading, UK.

ATIKU, L., ABEYASEKERA, S. AND MULUMBA, Y. (2005) Eliciting criteria for evaluating banana cultivars. February 2005. NARO and University of Reading.

GOWEN, S.R. (2004) Bananas in 2020 and the global context. CPP Programme Advisors' meeting, 26 January 2004 (presented by S.R. Gowen). University of Reading, Reading, UK.

NARO (2004) R8342: Promotion of improved IPM practices for banana diseases and pests in Uganda. DFID Report July–December 2003. National Agricultural Research Organisation, Uganda.

NARO (2004) Progress on the IPM promotion activities, January-May 2004. Report for DFID CPP project R8342: Promotion of improved IPM practices for banana diseases and pests in Uganda. National Agricultural Research Organisation, Uganda.

NARO (2004) Progress on the IPM promotion activities, March-August 2004. Report for DFID CPP project R8342: Promotion of improved IPM practices for banana diseases and pests in Uganda. National Agricultural Research Organisation, Uganda.

NARO (2004) Selected success stories on BBW control in Mukono, Kayunga and Luwero districts. National Agricultural Research Organisation, Uganda.
.

NARO (2004) Monitoring performance of improved banana cultivars disseminated in Luwero district to intended beneficiaries via public agricultural extension and non-government organisations. August 2004. Nankinga, (ed.) National Agricultural Research Organisation, Uganda.
.

RUTHERFORD, M.A. (2004) Promotion of improved IPM practices for banana diseases and pests in Uganda DFID Crop Protection Programme Project R8342. Annual Report, March 2004. CAB International, Egham, UK.

RUTHERFORD, M.A. (2004) Promotion of improved IPM practices for banana diseases and pests in Uganda. DFID Crop Protection Programme Project R8342. Project Progress Report 1, September 2004. CAB International, Egham, UK.

RUTHERFORD, M.A. (2005) Promotion of improved IPM practices for banana diseases and pests in Uganda DFID Crop Protection Programme Project R8342. Project Progress Report 2, January 2005. CAB International, Egham, UK.

RUTHERFORD, M.A. (2005) R8342: Promotion of improved IPM practices for banana diseases and pests in Uganda DFID Crop Protection Programme Project R8342. Project Completion Summary Sheet, March 2005. CAB International, Egham, UK.

RUTHERFORD, M.A. (2005) R8342: Promotion of improved IPM practices for banana diseases and pests in Uganda DFID Crop Protection Programme Project R8342. Final Technical Report, March 2005. CAB International, Egham, UK.

RUTHERFORD, M., ABEYASEKERA, S., MULUMBA, Y, KUBIRIBA, J. and GOWEN, S.R. (2004) Data requirements with respect to biological assessments. University of Reading Statistical Services Centre, Reading, UK.

RUTHERFORD, M.A. and LAMBOLL, R. (2003) DFID CPP funded project R8342: Promotion of improved IPM practices for banana diseases and pests in Uganda. Report of visit to Uganda to plan project activities, 10–13 November 2003. CAB International, Egham and NRI, Chatham, UK.

6. Other Dissemination of Results:

Journal publications

KALORIZOU, H.A. GOWEN S. R. and WHEELER, T.R. (2004) Genotypic differences in the roots of bananas (*Musa* spp.) infected with migratory endoparasitic nematodes. *Annals of Applied Biology* (submitted July 2004)

KALORIZOU, H.A. GOWEN, S.R. and WHEELER, T.R. (2004) Genotypic differences in the shoot growth of bananas (*Musa* spp.) infected with migratory endoparasitic nematodes. Submitted to *Annals of Applied Biology* (submitted July 2004)

OGUTU, W.O., ODUOR, G.I., KARANJA, L. and GOWEN S.R. (2004) Potential of producing the entomopathogenic fungus *Beauveria bassiana* on locally available substrates. Kenya Agricultural Research Institute, 9th Biennial KARI Scientific Conference and First Kenya Agricultural Research Forum, 8–12 November 2004, KARI Headquarters Complex, Nairobi, Kenya. (*in press*).

TUSHEMEREIRWE, W.K., KANGIRE, A., KUBIRIBA, J. NAKYANZA, M. and GOLD, C. (2004) Diseases threatening banana biodiversity in Uganda. *African Crop Science Journal*, 12: 19–26.

Workshop proceedings

NARO (2003) Proceedings of the stakeholders' planning workshop for scaling up banana production, commercialisation and utilisation technologies in Luwero, district, 12–13 August 2003. Ngambeki, D. and Nankinga, C. (eds.) August 2003. National Agricultural Research Organisation, Uganda.

NARO (2004) Proceedings of the stakeholders' workshop for promotion of banana production, commercialisation and utilisation technologies in Luwero, Mukono and Kayunga districts. 26–27 February 2004. Nankinga, (ed.) National Agricultural Research Organisation, Uganda. 95 pp.

NARO (2004) Proceedings of the stakeholders' banana bacterial wilt sensitisation and IPM review workshops for promotion of banana production, commercialisation and utilisation technologies in Luwero, Mukono and Kayunga districts. November–December 2004. Nankinga, ed. National Agricultural Research Organisation, Uganda.

NARO (2004) Proceedings of the stakeholders' workshop while working with banana farming communities in Mukono, Kayunga to develop and disseminate, using participatory development communication (PDC), IPM technologies with special emphasis to banana bacterial wilt. June–August 2004. Nankinga, (ed.) National Agricultural Research Organisation, Uganda.

Oral presentations

NANKINGA, C. (2004) Working with communities in Mukono, Kayunga and Luwero districts to banana bacterial wilt. Paper presented a national workshop for control of BBW in the frontline districts of the Western Axis, 14–15 October 2004, Mukono, Uganda. NARO

NANKINGA, C. (2004) Approaches used in sensitising people and implementing BBW control in Uganda. Paper presented at the INIBAP international Banana Bacterial Wilt regional preparatory workshop, 15–16 December 2004, Kampala, Uganda. NARO.

OGUTU, W.O., ODUOR, G.I., KARANJA, L. and GOWEN, S.R. (2004). Potential of producing the entomopathogenic fungus *Beauveria bassiana* on locally available substrates. Kenya Agricultural Research Institute, 9th Biennial KARI Scientific Conference and First Kenya Agricultural Research Forum, 8–12 November 2004, KARI Headquarters Complex, Nairobi, Kenya.

RUTHERFORD, M.A. and VILJOEN, A. (2003) Fusarium wilt of banana in Africa – current status, recent research and management prospects.International Fusarium Wilt Symposium, Salvador, Brazil, Sept. 2003 (presented by M. Rutherford). CAB International, Egham, UK

Information factsheets, manuals etc

NARO (2004) Fact sheets of important banana constraints and their management. National Agricultural Research Organisation, Uganda.

NARO (2003) Banana production manual: a guide to successful banana production in Uganda. 2nd edition. TUSHEMEREIRWE *et al*. (eds). National Agricultural Research Organisation, Uganda.

NARO (2003) 2005 calendar depicting photographs and messages relating to symptoms, spread and control of BBW. National Agricultural Research Organisation, Uganda.

Photographic productions and displays

GOWEN, S.R and RUTHERFORD, M.A. (2004) Bananas for a cow. pp. 20–21 in: *Positive Developments: A photographic exhibition by NR International in association with The Eden Project*. Benedikte Siderman-Wolter, (ed.) Aylesford, NR International.

GOWEN, S.R and RUTHERFORD, M.A. (2004) Bananas for a cow. Photographic image exhibited at The Eden Project, 16–25 May 2004, as part of a photographic exhibition by NR International in association with The Eden Project. Benedikte Siderman-Wolter, (ed.) Aylesford, NR International.

NARO (2004) Photographic depiction of proceedings of stakeholders' Banana Bacterial Wilt sensitisation and IPM review workshops for promotion of banana production, commercialisation and utilisation technologies in Luwero, Mukono and Kayunga districts, November–December 2004. Nankinga, ed. National Agricultural Research Organisation, Uganda.

Video productions

NARO (2004) Documentary outlining the PDC procedure and protocols followed when working with the Mukono and Kayunga district communities to identify IPM and BBW communication needs and related technologies for solving them (21 minutes). National Agricultural Research Organisation, Uganda. National Agricultural Research Organisation, Uganda.

NARO (2004) A training and sensitisation documentary in English on BBW symptoms, transmission and control (12 minutes). National Agricultural Research Organisation, Uganda.

NARO (2004) A training and sensitisation documentary in Luganda on BBW symptoms, transmission and control (12 minutes). National Agricultural Research Organisation, Uganda.

NARO (2004) A documentary outlining the processes used in BBW sensitisation workshops and highlighting implementation of BBW control. National Agricultural Research Organisation, Uganda.

Drama productions

NARO (2004) A sensitisation drama production in Luganda entitled 'Bampalana' depicting community perceptions, symptoms, transmission and control of BBW. National Agricultural Research Organisation, Uganda.

Websites

TUSHEMEREIRWE, W., KANGIRE, A., SSEKIWOKO, F., OFFORD, L.C., CROZIER, J., BOA, E., RUTHERFORD, M.A. and SMITH, J.J. (2004) First report of *Xanthomonas campestris* pv. *musacearum* on banana in Uganda. Plant Pathology website: http://www.bspp.org.uk/ndr/july2004/2004-44.asp

7. Listing and reference to key datasets generated:

8. Follow-up indicated/planned:

This project has strived to provide banana farmers and other stakeholders with the technologies or 'tools' required to manage pests and diseases effectively and by doing so improve banana production. Many of these technologies were previously identified, developed, evaluated and, to some extent, promoted through preceding CPP funded projects. As such the project activities have been almost wholly adaptive. The intention to systematically monitor progress, in terms of the impact of the work on pest and disease control, banana production and farming community livelihoods, was not fulfilled for various reasons, including the emerging need to address BBW. This activity will therefore form the major component of a 10 month follow on phase of research to commence in April, also funded by CPP. This phase will monitor, evaluate and document the success of the promotional activities undertaken to date in selected areas and environments by seeking stakeholders' views and perceptions of the communication approaches employed, and by assessing the extent to which recommended management practices are being applied and proving successful.

9. Name of author of this report:
Mike Rutherford

Project Number:	R8437
Project Title:	Assessing the impact of the Banana Bacterial wilt *Xanthomonas campestris pv. Musacearum* on household livelihoods in East Africa
Production System & Purpose:	Forest/Agriculture Interface Purpose 1
Project Leader & Organisation:	R. Markham, INIBAP, France
Location:	Uganda
Start and End Date:	01 February 2005 – 31 July 2005

Project profile
In 2001, a banana bacterial wilt disease (hereafter referred to as the Banana X*anthomonas* Wilt - BXW) was detected for the first time in central Uganda. The pathogen destroys banana fruit bunches and often results in total loss of yield, threatening the livelihoods of millions of people who depend on banana as a food and income source in the Great Lakes Region of Central Africa. Previously known only from *Ensete* in Ethiopia, in just three years since its discovery in central Uganda, the disease has developed into a full-blown epidemic, spreading throughout the eastern, central and north-western districts of the country. There is a paucity of information not only on the distribution and incidence of the disease but also on the likely impact the disease will have on the largely rural poor communities that depend on banana. This makes mobilising resources to address the disease problem particularly difficult**.** The objective of this proposal is to carry out a thorough and objective assessment of the impacts of BXW on affected communities in order to provide a rational basis for decision making and to lay the foundation for sound strategic planning. This will ensure that the social and economic fall-out from the bacterial wilt disease is estimated to enable consequent deployment of adequate or appropriate control measures.

Previous achievements
Not applicable given the project's start date.

Achievements in current year
Not applicable given the project's start date.

Activities for next year
The overall output for next year's work is a comprehensive and reliable set of information on disease impact (social and economic), and likely outcomes of the epidemic (along the production-consumption chain) that would be generated and promoted to facilitate national and regional policies, planning and mobilisation of resources to deal with the problem, including prioritisation of R&D activities. The specific outputs are a socio-economic impact of BXW on rural communities in Uganda assessed: Participatory impact assessment surveys will be conducted at benchmark sites and impact of BXW on livelihood strategies and outcomes (income, food security, etc), of various categories of people at household and community levels established and its impart at the national level projected. Key stakeholders in the banana sector will also be informed of the extent of impact of BXW on livelihoods. Policy briefs targeting special interest groups, including government policy makers, donor agencies, national and regional research systems prepared and shared with the respective agencies.

Dissemination
See *Dissemination Annex*.