Basket of remedies revives ailing Ugandan banana industry

RIU

Validated RNRRS Output.

In Uganda, worn-out soils, pests, diseases and social problems mean trouble for the banana industry. A basket of remedies is helping the industry get back on its feet—new varieties, manuring and mulching, biological controls for pests, and disease-free planting material. New varieties of banana are already being sold in Uganda, Kenya, Rwanda and Tanzania. Several agencies distribute clean plantlets produced by tissue culture to farmers in these countries, and in Burundi and D.R. Congo as well. Plus, in Uganda, a local laboratory has been set up that could produce 10 million plantlets a year. Consumers like the new varieties. Prices are rising and farmers are expanding their plantings to meet demand. So, Uganda has a great opportunity to supply bananas to urban and regional markets.

Project Ref: **CPP54:**
Topic: **1. Improving Farmers Livelihoods: Better Crops, Systems & Pest Management**
Lead Organisation: **CABI, UK**
Source: **Crop Protection Programme**

Document Contents:

Description

Research into Use
NR International
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Geographical regions included:

Burundi, Congo DR, Kenya, Rwanda, Tanzania, Uganda,

Target Audiences for this content:

Crop farmers,

CPP54

A. Description of the research output(s)

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

Integrated Pest Management in Banana

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

Crop Protection Programme

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

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Other local partners	Uganda: Farmers and farmer groups/associations (e.g. Bamunanika Farmers' Group); Agricultural Extension [AGRIC-Extension]; Representatives of banana traders, processors and exporters; Mukono Agricultural Research and Development Centre (ARDC); Local community leaders (LCI, LCII and LCIII); Sub-county chiefs; National Agricultural Advisory Service (NAADS); National Agricultural Research Organisation (NARO); Ministry of Animal Industry, Fisheries and Food; NGO (including CARITAS, ADRA, VEDCO, JEEP, Plan International, BUCADEF, SASAKAWA, Africa Global 2000, COD, SAO)

Associate partners

Dr R. Lamboll (social scientist, Natural Resources Institute, Chatham, UK) and **Dr S. Abeyasekera** (statistician, University of Reading Statistical Services Centre, Reading, UK) worked with, and provided advisory inputs to, R7567 and R8342.

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

[1]

Banana [1] production, by providing a vital source of **staple food** as well as **income**, is a fundamental necessity in terms of the livelihoods of millions of resource poor, rural farming communities throughout Africa and Asia. In **Uganda**, the world's second largest producer, bananas are the most important food crop and the second most important cash crop, but production and productivity have been declining largely due to reduced **soil fertility** and highly destructive **pests** and **diseases** - banana **weevil**, parasitic **nematodes**, **sigatoka leaf spots**, **fusarium wilt** (**Panama disease**) and **banana xanthomonas wilt** (BXW) together with socio-economic factors e. g. labour. Collectively, projects R7567 ('Integrated management of banana diseases in Uganda'), R7972 ('Integrated management of the banana weevil in Uganda') and R8342* ('Promotion of improved IPM practices for banana diseases'), undertaken between 1 January 2000 and 31 March 2005, introduced, developed and evaluated alternative improved and sustainable **banana crop and resource management interventions** and

promoted and disseminated those considered suitable for uptake and adoption to farming communities across a diverse range of agro-ecological environments. This was achieved largely through the Uganda National Banana Research Programme [UNBRP] **benchmark sites** programme). Outputs therefore include these interventions and new knowledge related to them, foremost among which are:

Indigenous and newly introduced banana **varieties** (**AAA-EA** Highland types, **FHIA** types, **Cavendish**, **Gros Michel**, **Yangambi KM5**, **SABA, PITA** 14 and PITA 17) for which the **agronomic attributes**, **resistance** to pests and diseases and **post-harvest** acceptability (i.e. as cooked food, dessert fruit, juice, fermented beverages, processed foodstuffs, materials for food preparation and handicrafts) have been determined. **Farmer preferred** varieties were identified.

- Increased plant **growth**, **yield** and resistance to pests and disease through the application of **manure** and **mulch**, as confirmed by banana growers.

- Improved control of banana weevil through improved systems to produce and deliver **biological control** agents (***Beauveria bassiana***) as part of an IPM approach, as confirmed by farmers.

- Establishing new banana plantings using **clean planting material** (tissue culture-derived) as opposed to suckers obtained from mother plants.

The relative benefits (including economic in some cases) of these options were determined in consultation with end users within farming communities and based on their own perceived needs and aspirations.

- An active **network** of banana stakeholders has been established, by applying a **participatory development communication** (PDC) approach, through which knowledge of, and resources required for, recommended management interventions for banana, and specifically BXW, are being conveyed to intended beneficiaries. This approach requires close collaboration between stakeholders (including farmers and farmer groups) as intermediary '**service providers**' but would be applicable to address information needs and constraints in other locations and environs.

Associated, supporting outputs include: established on-station and on-farm evaluation/multiplication sites; documented technical and training protocols; various **communication materials** relating to pest and disease management; datasets.

[1] In this proforma the term banana relates primarily to cultivated desert bananas, plantain and other cooking bananas including the East African highland (EA-AAA) 'matooke' varieties

* Note: outputs emanating from the BSV component of R8342 are addressed in the proforma prepared for project R7529 ('Epidemiology of Banana Streak Virus (BSV)' by L Kenyon, NRI

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

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

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

Bananas, including East African Highland (EA-AAA) bananas

A number of the outputs highlighted above could be applied to other commodities, specifically in relation to:

- New knowledge acquired in relation to effects of improved soil fertility (mulch/manure application) on crop growth and pest/disease resistance, and its relevance in reducing fungicide use
- Knowledge acquired by farmers and other stakeholders on pest/disease constraints and their management
- Methods of production, storage and delivery of fungal biocontrol agents, particularly for perennial crops
- Protocols for on-farm, farmer participatory research and data management, analysis and interpretation, particularly for perennial crops.
- Approaches to farmer training
- Participatory establishment and utilisation of communication pathways and application of a participatory development communication (PDC) approach

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

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

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

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

9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources. Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.

Banana health and productivity
DFID CPP projects R7529 ('Epidemiology, vector studies and control of Banana Streak Virus [BSV] in East African Highland bananas'), R6580 ('Non chemical control of banana nematodes in E. Africa') and R8484 ('Identification of insect vectors of Banana Xanthomonas Wilt') and DFID CRF project 7466 ('Farmer participatory testing of banana IPM options for sustainable banana production in Eastern Africa') provided new knowledge of

BXW, BSV and nematodes parasitic to banana and also led to the identification or development of new and improved management approaches (e.g. break crops). Clustering these outputs with those highlighted in this proforma would provide farmers with a broader range of options for tackling banana health related constraints across a more diverse range of pest and disease pressures and using an IPM or CPM approach.

Improving uptake

In terms of improving and scaling out uptake and adoption of outputs, value may be added by reference to, and application of, outputs of CPP project R7488, which involved a study of factors affecting uptake and adoption of crop protection research in banana-based cropping systems in Uganda. Clustering with other projects which addressed uptake and adoption in other crops (e.g. R7512, R8448, R8313) or for pest management generally (e. g. R7500) may also be beneficial. The outputs of R8429 and R8281, which investigated links between demand and supply of agricultural information in Uganda (providing a link with NAADS private sector service providers), R7865 ('Strategies for scaling-up'), which had a partial focus on Uganda, and R8363 ('Scaling-up through communication'), should also be considered. Approaches to improving farmers access to information, training and new products (e.g. R8422) should also be addressed, as they involve novel learning (e.g. participatory videos) and communication approaches and tools to improve farmers' understanding of important, but difficult to observe pests and diseases.

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[1] In this proforma the term banana relates primarily to cultivated desert bananas, plantain and other cooking bananas including the East African highland (EA-AAA) 'matooke' varieties

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Validation

B. Validation of the research output(s)

As defined by DFID RIUP guidelines, uptake of outputs would be of greatest benefit to the 'moderate poor', who are heavily dependant on, and likely to attain, successful banana production. However, there would be indirect benefits to other groups including the extreme poor, through improved access to a valued, nutritious and affordable food source for example.

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

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

The outputs of R7567 and R7972, as related to new and improved banana varieties and cultural management practices, were validated in Uganda principally by farmers under a range of agro-ecological conditions at

locations where banana production and productivity were in various stages of decline. Validation was initially based on on-station and on-farm trials which demonstrated the beneficial effects of planting new improved varieties, particular FHIA 1, FHIA 17, FHIA 23 and FHIA 25, establishing plantings with clean plant material, utilising improved approaches to weevil biocontrol and enhancing soil fertility through manure/mulch application on plant growth, yield and resistance to pests and disease including leaf spots, fusarium wilt, weevils and nematodes. Subsequent selection, promotion (largely farmer-farmer), uptake and adoption of management interventions provided an important stage in their validation and provided quantitative and qualitative information on farmers' perceptions of attributes (including post-harvest). Follow-on project R8342 scaled-out promotion and dissemination of management options approved by banana stakeholders. Using participatory methods (e.g. participatory development communication, PDC) partnerships and communication/uptake pathways were established between farmers and other banana stakeholders in the local community as intermediary 'service providers'. Though these channels recommended management interventions are promoted to farmers, including cultural measures a set of (e.g. debudding, removing infected plants, sanitation, clean planting material) for the rapidly spreading and highly destructive BXW disease.

More comprehensive and detailed validation of outputs was achieved through R8482 'Promotion and assessment of IPM approaches in Uganda, with emphasis on banana bacterial wilt' (not part of this proforma cluster), which revealed that stakeholders considered FHIA types to be performing well, were highly regarded by growers, had been widely disseminated and adopted and are suitable replacements for traditional matooke types (AAA-EA highland bananas) on which banana production in E. Africa is heavily reliant. Established communication approaches were also proving successful, many stakeholders proactively developing partnerships and initiating activities to successfully control BXW as Uganda's major production constraint. Farmers showed improved understanding of BXW and were implementing recommended management measures that resulted in disease control. Extensive feedback was also obtained on the benefits and drawbacks of the communication process and promotional activities, allowing key factors that may limit uptake of information and management practices to be identified. Organisations involved in the various stages of validation described include extension, NGO, community based organisations (CBO), NAADS, local councils, national government, UNBRP and IITA. The moderate poor, and female and male farmers in particular, have a vested interest and direct reliance on banana production and were the main focus group for the stages and mechanisms of validation outlined above.

Beyond Uganda, the IPM options for weevil, nematode and fusarium wilt control have been validated by KARI, Kenya, varieties resistant to fusarium wilt (mainly Cavendish) being multiplied by tissue culture and distributed to farmers to replace susceptible types (Gros Michel). Banana yields consequently increased from 8 to 30 tonnes/ ha. Farmers were trained through farmer field schools (FFS), 5,000 in banana production and post harvest handling and 600 in use of clean planting material. A programme of importation, validation, mass propagation and dissemination of clean planting material of superior banana varieties, including FHIA types and Yangambi KM5, has also been undertaken in Kagera, Tanzania, through the Kagera Community Development Program (KCDP), varieties being validated on-station and on-farm by researchers from ARDI Maruku and farmers, supported by KCDP staff, NGO, primary, schools, district agriculture departments and progressive farmers. INIBAP International Transit Centre, Belgium, provided *in vitro* plants with one million suckers being distributed to farmers by 2002. In DRC, BXW management measures have been implemented with the support of local organisations, including FAO, PAM (Food for Work), Catholic University of Graben, MINAGRI, International Red Cross and several NGO (APREDECI, APANIVIP, IFECED, FUKAINALAMIA, TUWASIKANYE), as well as NARO and other organisations from Uganda.

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

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

In Uganda the IPM outputs were initially validated across a range of agro-ecological zones and specifically at benchmark sites demarcated by the UNBRP as representative of contrasting levels of banana production decline located in Luwero (Central Uganda), Masaka/Ntungamo (South Uganda) and Mbarara/Bushenyi Districts (Western Uganda) that represent, respectively, areas of severe, intermediate and moderate levels of decline respectively. In Luwero, for example, many farmers have already abandoned production while productivity in Mbarara/Bushenyi remains high. It is at these sites that the UNBRP implements the majority of its research activities to address major banana constraints. Subsequent validation was undertaken between July 2003 and March 2005 in Luwero, Mukono and Kayunga Districts, Central Uganda, followed by more extensive and direct assessment (R8482) across villages, parishes and sub-counties in Luwero, Kiboga, Mubende and Kyenjojo Districts between April 2005 and January 2006. These latter four districts were affected to differing degrees by BXW and had information on the disease and its management communicated to the communities by differing approaches, including PDC. Validation was undertaken principally within rainfed highland systems and primarily with the needs of moderately poor, smallholder farmers in mind. In Kenya validation of IPM interventions was undertaken in Muranga and Maragwa Districts, Central Province, between 1999 and 2003, the focus being on moderate poor, extreme dependent poor and extreme vulnerable poor in smallholder rainfed highlands. The same approach is intended for Western and Nyanza Provinces. Clean planting material is being distributed in Eastern Province (Meru south, Tharaka and Machakos Districts). In DRC, validation of BXW control measures has been ongoing since early 2004 in North Kivu Province.

Current Situation

C. Current situation

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

FHIA 17 and FHIA 23, as acceptable dessert bananas, are being validated on local (Kampala) markets and in Kenya and Rwanda as replacements for Gros Michel (susceptible to fusarium wilt). They are also sold in Kampala markets and in Mbarara, Bushenyi and Luwero. Also in Kenya, IPM interventions are promoted through e.g. training (FFS), distribution of brochures, field days, agricultural shows/trade fairs, demonstration plots and visits to research centres by farmers, traders, politicians, local leaders and school children, efforts supported by KARI, MOA, NGO, CBO, political leaders, farmers/farmer groups and traders.

Agro Genetic Technologies Ltd (AGT) [2] is supplementing production of clean, tissue culture derived plantlets in Uganda on a commercial basis. In Uganda, Kenya and Tanzania plantlets are also being disseminated by Maendeleo Agricultural Technology Fund (MATF), via BUCADEF. The Crop Crisis Control Project (C3P) is

disseminating plantlets in Burundi, DRC, Kenya, Rwanda, Tanzania and Uganda to address BXW.

In Uganda PDC continues to be used to stimulate community action against BXW, information being provided through mass media, posters, brochures, billboards, going public, training of trainers (TOT) and teaching of schoolchildren. NGO, extension, research organisations, local leaders and farmers are instrumental in providing technical information, mobilising communities and implementing control measures. In DRC, Tanzania and Kenya, where BXW emerged in 2004, 2006 and 2006 respectively, management interventions, a similar approach is being applied with assistance from Uganda (MAIIF and NARO). In DRC expertise is provided by Catholic Graben University and North Kivu Agriculture Services. NGOs, local administration and religious groups assist in mobilising farmers. In Kenya knowledge of BXW and management measures are validated by KARI and transferred to researchers, agric. extension, NGOs, local government personnel, plant health inspectors, farmers, traders and transporters through C3P.

INIBAP, through its regional networks [3] and in partnership with a broad range of organisations, has and continues to implement a number of initiatives in Africa and elsewhere that involve introduction, evaluation, conservation, dissemination and assessment of the impact of banana management technologies, including improved varieties (e.g. FHIAs).

[2] AGT was the first commercial agro biotech laboratory in Uganda and the largest tissue culture laboratory in E and C Africa. It has capacity to produce 10 million plantlets per year. http://www.agtafrica.com

[3] BARNESA, MUSACO, MUSALAC and BAPNET)

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

In Uganda improved banana varieties are being used in Luwero, Mbarara and Bushenyi as dessert, juice and food. These varieties have revived the opportunity for Central Uganda to supply dessert bananas to urban and regional markets. Management interventions for BXW are being used in many districts of Uganda, including Mpigi, Mubende, Kiboga, Kyenjojo, Kabarole, Mityana, Bundibugyo, Kabale, Mbarara, Ntungamo, Isingiro, Bushenyi and Masaka.

In neighbouring Kenya banana production technologies, including outputs of R7567, R7972 and R8342, are being utilised in Central and Eastern regions where BXW is not present. Measures to tackle BXW (described above) are being applied in Western Kenya (Busia, Teso and Bungoma Districts), where 64% of Kenyan bananas are produced, as well as in Masisi and Rutshuru Territories (North Kivu Province), DRC, and in Kagera Region, Tanzania (where BXW was first reported as recently as early 2006).

FHIA 17 and FHIA 23, introduced to Kenya, are showing market acceptable attributes as dessert bananas at regional markets in Nairobi (Wakulima) and Kigali (Nyamirambo and Kyibisagara), and are fetching relatively high prices. At Wakulima average clusters of FHIA 17 and FHIA 23 fetched UgSh 1660 and UgSh 1875 respectively.

In Tanzania improved varieties introduced through the KCDP project (initiated in 1997) are being cultivated in Kagera Region.

Efforts to control BXW in DRC and Tanzania (see above) are continuing using the management interventions

employed in Uganda, including through R8342, R8482, R8484, and with the support of Ugandan personnel contributing to these outputs.

Clean tissue culture derived plantlets are being disseminated in Burundi, DRC, Kenya, Rwanda, Tanzania and Uganda to address BXW (se Question 12 also).

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

In Uganda almost 15,000 plantlets of improved FHIA varieties preferred by farmers as dessert bananas and for juice/gin production have been distributed to 700 beneficiaries. A positive response to the varieties on local and regional markets and increasing farm gate prices have led farmers to increase production by expanding existing plots.

Surveys (including those undertaken through R8482 and INIBAP-led project R8347, see Question 20 also) of BXW affected areas and peripheral, threatened areas in Uganda have shown BXW awareness campaigns are proving successful. The majority of farmers can recognise key symptoms and know how to manage the disease. However, and although the rate of disease control has been rising, not all farmers are implementing recommended management interventions. R8482 revealed that, of 141 farmers consulted in Luwero, Kiboga, Mubende and Kyenjojo Districts (69% of who were affected by BXW), 98% were aware of the most distinguishing disease symptoms, 88% of possible mechanisms of disease spread and 73% of at least one recommended control measure. More than 80% of farmers consulted in Luwero and Kiboga, where PDC had been used for some time, practiced at least one control measure. Of 43 villages were PDC had been used, 91% had taken action to counteract BXW, 70% establishing task forces for this purpose, with 1473 farmers (41% of the farmer population) provided with some form of training in disease management. R8482 also showed that of 345 farmers in Luwero District, Uganda, who had been made aware of FHIA 17, FHIA 25 and other outputs, 77% had adopted FHIA17 (as a desert and for juice) while 73% and 67% were applying mulch and manure (respectively) among other recommended interventions. About 60% had adopted practices to control BXW, primarily uprooting of plants (62%) and removal of the male bud (61%).

In DRC, 100 ha of banana land has been uprooted, destroyed and replaced by annual crops to counteract BXW.
In Tanzania farmers are being trained in BXW control and provided with informative posters and leaflets - in affected areas of Kagera up to 90% of farmers are implementing appropriate control measures.

In Tanzania, farmers were trained in BXW recognition and management before the disease outbreak and were provided with information materials (posters and leaflets), 90% are now uprooting affected bananas and 60% dubudding plants as control measures in affected areas of Kagera. Sensitisation is continuing and use of recommended practices among farmers increasing.
In Kenya 600 farmers have graduated from experiential farmer field school training in banana management and subsequently established plantings that other farmers may visit to learn about new technologies.

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

Numerous organisations have contributed to the outputs and to their promotion, uptake and adoption and could play an important future role. They include international organisations (e.g. INIBAP, IITA, CABI), regional organisations/networks (e.g. ASARECA, BARNESA) that play an important role in developing, promoting and implementing regionally agreed strategies. National agricultural ministries and the research fraternity (e.g. NARS, Universities in-country and overseas) have been instrumental in recognising, prioritising and taking appropriate measures to counteract the threat of BXW. Advisory, research and development organisations have been instrumental in identifying and raising awareness of constraints and supporting the introduction, development, promotion, dissemination and adoption of appropriate management options, particularly from a technical perspective. They include NARS (e.g. NARO in Uganda, KARI and ATIRI in Kenya, ARDI in Tanzania), local government, NGO, CBO, NAADS, telecentres, agricultural extension services and other advisory bodies, media, religious organisations and schools. Farmers, farmer groups and associations (in some cases formed in East Africa specifically to take up project outputs), are crucial to promotion and dissemination of new technologies, largely as farmer-farmer interaction has been shown to be a primary source of direct knowledge transfer within the farming community. The creation of a task force, steering committee and technical committee to develop an action plan and co-ordinate activities in Uganda would appear to have be a key platform through which BXW is being tackled, while the establishment of a stakeholder network, as a specific output, has contributed greatly to the effective transfer of information and subsequent uptake/adoption of other outputs and banana management options generally within Uganda. CRS (Catholic Relief Services), through the C3P programme, has played a major role in supporting regional efforts to tackle the disease and has the scope to continue to do so and to promote the outputs and support banana IPM generally (see Question 23 also). Finally, DFID provided financial support for the outputs specified, and indeed a significant component of banana research and development outputs in East Africa over the last few decades would not have been possible without the financial support of agencies such as DFID, Rockefeller, IDRC, USAID, World Bank and Gatsby.

Current Promotion

D. Current promotion/uptake pathways

16. ***Where*** *is promotion currently taking place? Please indicate for each country specified detail what promotion is taking place, by whom and indicate the scale of current promotion* ***(max 200 words).***

Refer also to questions 12-14 above.

In Uganda promotion of the IPM interventions is continuing, through participatory methods and specifically via the stakeholder partnerships established under R7567 and R8342. As control of BXW remains the primary objective, activities are much focused in this direction, with case studies of successful control being highlighted within communities in training sessions and workshops. Further dissemination, certainly through farmer-farmer interaction, and uptake of the improved varieties should occur, particularly in areas free of the disease.

In Tanzania, BXW control activities are ongoing in five districts of Kagera Region and are to be scaled out to four in Kigoma Region by district agricultural departments and Plant Health Services (PHS) as part of the C3P project.

In Western Kenya, via the C3P project, the practical BXW control measures employed in Uganda are to be validated, while awareness of the disease is being raised in unaffected areas through the mass media, Going Public and dissemination of advisory posters and brochures.

In DRC efforts to control BXW, by debudding, rouging and sanitation, continue at Masisi. At both Masisi and Rutshuru some affected plantings are being uprooted and destroyed.

17. What are the current barriers preventing or slowing the adoption of the output(s)? Cover here institutional issues, those relating to policy, marketing, infrastructure, social exclusion etc. ***(max 200 words)****.*

The barriers differ for different outputs, with some (e.g. BXW) requiring collective action and others more individual management decisions eg Sigatoka management through resistant varieties

1. Perceptions of farmers and other stakeholders:
Among banana stakeholders' [4] including farmers, some take the view that management (of BXW for example) is 'someone else's responsibility'. This view is at least partially being reinforced by current government agricultural policy.

Farmer prioritisation and decision making influence uptake/adoption of outputs and hence pest control, but their actions can be inappropriate for the community as a whole. Farmers have, for example, adopted BXW interventions for EA-AAA matooke banana but overlooked other varieties (e.g. Kayinja=Pisang awak) as they consider them to be of lesser importance.

2. Technical capacity of farmers and other stakeholders to recognise pests, diseases and other constraints, particularly in the early stages of development, to prioritise them in terms of impact and to identify appropriate management interventions.

3. Farmers' financial and other resources to tackle constraints are limiting.

4. Human and financial resources are required to scale out using effective approaches such as participatory communication approaches to management, but in some cases there is a limited number of (and lack of capacity within) supporting organisations, and insufficient financial resources,

5. Poor co-ordination of intermediary organizations and the activities they undertake is a major constraint to effective mobilisation of communities and promotion of outputs.

6 Absence of an over-riding national or regional policies e.g. for BXW control, where
free movement of banana material, including via market processes (traders etc) contributes to pest and disease spread.

Demand for outputs may be lacking or, where demand is evident, it cannot be met by supply e.g dissemination and adoption of improved varieties via regional and international markets is restricted by production capacity of farmers.

[4] Includes findings of a survey of farmers, sub-county task forces, District Agric. Officers, village leaders and NGOs undertaken under R8482 and with a focus on BXW

18. What changes are needed to remove/reduce these barriers to adoption? This section could be used to identify perceived capacity related issues ***(max 200 words).***

1. Increased communication and interaction within communities and collective 'ownership' of the problem. Banana stakeholders, from farmers through marketing organisations to policy makers (and the public in general), should be better sensitised as to the value of banana (in terms of food, income and as a cultural resource), how it is threatened and how their failure to act will have a negative impact. Communication tools and approaches which engender understanding, ownership and motivation to act are needed.

Increased funding is required, particularly to raise stakeholder awareness and mobilise communities to action.

2. The ability of stakeholders, particularly farmers, agric. extension and other farmer advisory bodies, to recognise and diagnose constraints is critical and should be improved. How this is achieved requires very careful consideration, possible options being 'classroom' training, demonstration plots, FFS, farm-farm visits, videos, drama presentations, reading materials and mass media broadcasts. Experiential learning processes are widely considered to be most effective. This process should be supported by development of rapid, user friendly diagnostic tools. Training in pest and disease diagnosis and management should also be included in teaching curricula of schools and universities.

3. Access to credit increased technical efficiency in Central Uganda (Smale and Tushemereirwe, 2005).

4.+5. Efforts to promote output adoption should be better funded and coordinated, through task forces or other coordinating bodies established locally, nationally or regionally, with strong partnerships established between stakeholders and networks extended to, or established in, all areas that could benefit.

6. Where necessary, and if feasible, local and international restrictions should be placed on the movement of banana material to prevent pest and disease spread.

New varieties must be promoted more effectively at local, national, regional and international markets to increase demand, and production increased through GAP to meet demand.

19. What lessons have you learnt about the best ways to get the outputs used by the largest number of poor people? ***(max 300 words).***

Communities must be convinced that some constraints (e.g. BXW) will impact on all, whereas others (e.g. soil infertility) impact on individuals. Where collective responsibility and a concerted and coordinated effort is required then suitable approaches, incentives or means of motivation need to be identified with communities. This is particularly important where a constraint is highly destructive, spreads rapidly or is already widespread and will impact heavily in terms of food and income (e.g. BXW).

Participatory communication methods (e.g. PDC, participatory monitoring and evaluation) have proved effective

for sharing of experiences (successes, failures and challenges) and in facilitating collective adoption of GAP. Scaling out this approach would be beneficial but requires human capacity, adequate funding, good planning and effective co-ordination and monitoring. Participatory approaches also provide an effective mechanism for feedback on issues at farm level that need to be addressed with the support of others in the community.

More assertive community mobilisation and sensitization may be required to encourage communities to address constraints, possibly based on legal enforcement (byelaws). However, this process needs careful monitoring with regard to feasibility and outcomes.

A steering committee, task force or similar body is required to co-ordinate activities undertaken by the various stakeholders in a community, and to monitor and evaluate activities using an appropriate system. This is also important where there is a need to address more than one constraint and management approaches may conflict.

Farmers should be better educated on constraints, to improve their understanding and enable them adopt the most appropriate interventions. Improving farmers' capacity would mean that when management interventions are communicated to farmers and other stakeholders as an inclusive package (eg BXW control) they are able to select as appropriate.

In order to effectively acquire funds, the impact (including potential) of a constraint on production, productivity and livelihoods must be clearly conveyed to funding agencies.

Farmers, with the support of organisations within the community, must move swiftly to tackle relatively major constraints. Countries finding it more difficult to leverage funds quickly therefore could, as well as sharing knowledge and resources, benefit financially from regional or international co-operation.

Impacts On Poverty

E. Impacts on poverty to date

20. Where have impact studies on poverty in relation to this output or cluster of outputs taken place? This should include any formal poverty impact studies (and it is appreciated that these will not be commonplace) and any less formal studies including any poverty mapping-type or monitoring work which allow for some analysis on impact on poverty to be made. Details of any cost-benefit analyses may also be detailed at this point. Please list studies here.

Banana farmers are faced by a broad range of inter-related bio-physical constraints including pests, diseases and soil fertility issues that are ideally addressed collectively but prioritised in terms of inputs. Individual constraints will have an impact on plant growth, health and hence crop yield and quality, but the precise effect of each is difficult to ascertain as they impact as a whole. Equally, the effects of management practices, such as the introduction of a new variety, can also be difficult to determine. A consequence of this scenario is that determination of the impact of specific constraints and of adoption of specific management approaches on livelihoods is not straightforward. Where a constraint, such as fusarium wilt or BXW, ultimately destroys the plant (or affects the bunch directly, as with BXW) yield is reduced by 100%. If interventions prove to be successful,

more accurate estimations of impact may be made for rural poor communities locally and on a wider scale. Costs on livelihoods of adopting interventions, of course, must be taken into account. In the case of BXW these are labour intensive and/or require high resource inputs.

No formal quantitative studies have been undertaken on the impact on poverty of the project outputs specifically. However, an economic assessment of banana genetic improvement and innovations in the Lake Victoria Region of Uganda and Tanzania has been undertaken by Smale and Tushemereirwe (2005) [5].

Furthermore IPGRI, within the framework of the INIBAP, undertook a study (DFID project R8437) [6] in Central Uganda in 2005 to determine the impact of BXW on affected communities as a basis for decision-making and strategic planning in relation to devising mechanisms for disease management. The study was supported financially by DFID, IDRC and USAID.

More informal, and largely qualitative, studies have been undertaken, usually on a local scale and within specific countries. Further information is provided under Question 21.

[5] Smale M. and Tushemereirwe W., (eds) (2005) An Economic Assessment of Banana Genetic Improvement and Innovations in the Lake Victoria Region of Uganda and Tanzania. IFPRI, NARO, ARDI, INIBAP. IFPRI Research Report. Washington, D.C.: International Food Policy Research Institute (forthcoming).

[6] DFID project R8437 (2005). Assessing the impact of the banana bacterial wilt, *Xanthomonas campestris* pv. *musacearum*, on household livelihoods in East Africa.

21. Based on the evidence in the studies listed above, for each country detail how the poor have benefited from the application and/or adoption of the output(s) ***(max. 500 words):***

- *What positive impacts on livelihoods have been recorded and over what time period have these impacts been observed? These impacts should be recorded against the capital assets (human, social, natural, physical and, financial) of the livelihoods framework;*
- *For whom i.e. which type of person (gender, poverty group (see glossary for definitions) has there been a positive impact;*
- *Indicate the number of people who have realised a positive impact on their livelihood;*
- *Using whatever appropriate indicator was used detail what was the average percentage increase recorded*

The Smale and Tushemereirwe study clarified the characteristics of banana growing households in the Lake Victoria region of Uganda and Tanzania in showing that, for example, approximately 25% of banana growing households are female headed. A wide diversity of varieties is grown, though even the most popular comprise only 10% of mats grown. In Uganda the average farm size, in terms of total land owned, is 1.43 ha, of which 0.73 ha is devoted to banana production with 35% of households selling banana, 29% buying and 13% both selling and buying in banana markets. A similar situation is found in Tanzania, where average farm size is 1.85 ha with 1.22 ha devoted to banana and 51% of households selling, 8% buying and 4% both selling and buying. Limited information is available on poverty groups, the situation varying significantly with location. Wealth (in terms of income and land area) and gender of decision maker had no association with adoption of banana hybrids in Kagera region. Incidence of pests and diseases was considered important. Labour was in surplus in highland areas but scarce in lowland areas, which has implications for management practices (i.e. high opportunity cost of

labour in lowlands).

INIBAP project R8437 supported the findings of R8482 in confirming that participatory approaches to controlling BXW in Central Uganda are proving beneficial, with farmers becoming more aware of the disease and of the recommended management options, with a consequent decrease in disease levels and yield loss in areas where sensitization and mobilisation have been carried out. R8437 showed that a 1% infection rate of banana mats was associated with yield loss of approx. 0.42%. With an average infection rate of 32% between 2001 and 2004, this would be expected to result in a total yield loss of 30–52% during that period, or 10–17% per annum. This would have had obvious implications with regard a decrease in the quantity of bananas harvested at household level, and hence on food supply and income. The study projected that interventions to control BXW at farm level should therefore be 90% and above if the disease is to be controlled effectively, and that an estimated monetary loss of US$ 4.0 billion could be realized if nothing was done to check the disease. Between 5 and 7% of farmers had already abandoned banana production.

Other studies have highlighted the damaging effects of BXW and other constraints and provide an indication of how the outputs have or may help to reverse their negative impact on livelihoods:

Farmers in Bukomero Sub-county (Kiboga District), Kimenyedde Sub-county (Mukono District), Bamunanika Sub-county (Luwero District) and Myanzi Sub-county (Mubende District), Uganda, have recorded reductions in BXW incidence or eradicated the disease since management interventions were adopted. Conversely, an upward trend in number of bunches and quantity of juice/waragi production was possible from fields of variety Kayinja. In South Western Uganda, BXW is being controlled more than ten sub-counties, with the disease being eradicated within one year from fields that previously had up to 80% of mats affected. Initiatives to add value to banana production processing juices (Jakana Foods Ltd), wines and local gin (waragi) (e.g. Kaseses Distillers), drying bananas, producing baked products (e.g. pancakes) and handcrafts are emerging. In addition, regional and international trade in bananas, albeit limited, is also starting to increase.

In some areas of DRC where banana production previously reached 20 tonnes/ha (with returns of US$1600/ annum) no fruit is being harvested due to BXW. In other areas income has been reduced by up to 50% and the quality of marketable bunches and wines also being adversely affected (according to reports by Graben University, FAO and the MINAGRI). Reduced income is being used to purchase replacement food rather than for other needs. However, removal of affected and replanting with cassava, sweet potato, beans, sorghum, maize, soy bean has revived food production and farm income through sales of produce, allowing farmers to again pay school fees for children who had been forced to leave school as banana production declined, and to cover medical costs. It is estimated that 1000 households (6000-7000 persons) have experienced a positive impact on their livelihood, with earnings recovering by about 50%.

Of significance farmers commonly cultivate coffee alongside banana, as both are among the most important cash crops and favour similar agro-ecological conditions. However, with coffee production being seriously affected by coffee wilt disease (CWD), the negative impact on the livelihoods of such farmers will be much greater. In Kagera Region of Tanzania, for example, highland bananas were seen as a suitable replacement crop for coffee and cassava (important cash and food crops respectively) following the onset of CWD and cassava mosaic virus. However, these are now under threat from BXW.

Appendix 1 provides an indicative assessment of the impact on poverty, and capital assets specifically, of the outputs.

Environmental Impact

H. Environmental impact

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

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

Production, introduction and use of the management interventions - new varieties, clean planting material, mulch, manure, weevil traps, introduction of naturally occurring fungi, rouging and destruction of plants, debudding and other principally cultural practices – are likely to have beneficial rather than negative effects on the environment. Other than mechanical tools, all of the on-farm inputs are biodegradable and their natural degradation would enhance soil fertility.

Adoption of the outputs will help to safeguard existing banana varieties, introduce new banana varieties, thereby helping to revitalise banana production in areas of decline and increase genetic diversity. Increased diversity will in itself provide increased options for utilisation available to growers.

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

By their very nature, negative effects of the outputs on the environment would be negligible.

Destruction of land for expansion of banana production may lead to soil erosion and a decline in soil fertility [8]

Burning of wood and other materials to enable heat sterilisation of farm implements would, depending on scale of use, have some detrimental effect on the atmosphere and air quality [9]

The introduction of entomopathogenic fungi for biocontrol purposes may have some indirect and detrimental effect on the soil microbiota and macrobiota, through competition with and predation on other fungi and insects considered as beneficial.

[8] This could be addressed by preventing water run-off, providing amendments to enhance soil fertility and cultivating cover crops e.g. beans.
[9] Although not recommended, the practice of destroying large amounts of banana plant material to eradicate diseases (e.g. BXW) by burning would have more serious consequences, as would the widespread use of herbicides for the same purpose and chemical disinfectants. Smallholder farmers, however, can generally not access or afford pesticides or disinfectants.

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

Unlike annual and other perennial crops, bananas may be harvested and utilised throughout the year and as such provide an ongoing source of food and income. They are also tolerant of adverse environmental conditions, including drought. Post-harvesting of banana fruit to produce dried powders (from which matooke may be prepared), biscuits, crisps and drinks for example that have a longer shelf life than fresh fruit will also provide a valuable food source. Intergration of the outputs to improve health and productivity will therefore help the poor to cope better under difficult circumstances and particularly at times when fresh fruit and other produce is scarce.

Annex

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Appendix 1. Indicative assessment of impact of outputs on poverty to date

Poverty grouping	Capital assets Human, Social, Natural, Physical. Financial	Addressing vulnerability	Outcomes	Number of people
Moderate poor	**Human** Greater knowledge of banana pests and diseases Greater awareness of options available for managing bananas and their application Acquisition of new skills to better manage banana and control pests and diseases Improved access for training in banana management **Social** Greater awareness of sources of information and advice to better manage bananas Improved access to, and potential participation in, organised groups and networks of those with shared interest in banana	*Trends* Increasing popn. pressure Pests e.g. weevils Nematodes Declining soil fertility *Shocks* Drought Sigatoka BBW *Seasonality*	Increased and/ or sustainable productivity (R7567 showed average yield increases of 83% across a range of FHIA and AAA-EA varieties in Uganda due to mulching) and increased longevity (e.g. up to 21 years in Kagera, Tanzania) Improvement and conservation of soil fertility and hence crop production potential Contributing to: Food security	Variable depending on baseline situation, constraint addressed and output(s) adopted. May range from 100s locally to millions regionally

	management Strengthening of organisations providing support and advice to farming communities Enhanced potential capacity to influence formal banana research system **Natural** Improved access to high yielding banana varieties resistant/tolerant to pests and diseases Diversification and conservation of banana management resources e.g. germplasm, water Improvement and conservation of soil fertility and hence crop production potential **Financial** Increased income through sale of banana fruit and products Increased potential to invest financially in banana production (including plot expansion), processing, marketing and improved management Increased income to utilise for other needs **Physical** Increased income to secure shelter and buildings; obtain/ utilise a form of transport to access markets, meetings etc; maintain water and energy supplies; communicate and		Increased income through sale of banana fruit and products			

	access communication sources			
Extreme vulnerable poor	As for moderate poor taking into account:	As for moderate poor taking into account:	As for moderate poor taking into account:	
Assetless (or near assetless) male & female headed households in rural areas	Direct - Less time to engage in process and can only benefit directly if access to land is secure for may years over life of banana Indirect –processing Employment on farm	Little or no land Share-cropping	More emphasis on food security	
Women headed households (without adult male)	Less time to engage in and more likely to be excluded from process			
Poor people living in disaster prone or remote areas	Less likely to be engaged in process and more likely to benefit from product only		More emphasis on food security	
Poor people living in urban areas			Possibly lower prices Are poor people in urban areas eating bananas?	
Extreme dependent poor				
Elderly People with no family support				
Disabled people, people suffering chronic illness without family support				
Children of extreme poor				

Acronyms used in proforma

AGT	Agro Genetic Technologies Ltd
ARDI	Agricultural Research And Development Institute
ATIRI	Agricultural Technology and Information Response Initiative

BSV	Banana Streak Virus
BUCADEF	Buganda Cultural And Development Foundation
BXW[10]	Banana Xanthomonas Wilt
C3P	Crop Crisis Control Project
CABI	CAB International
CBO	Community Based Organisation(s)
CGIAR	Consultative Group On International Agricultural Research
CRF	Competitive Research Facility
CRS	Catholic Relief Services
DFID	Department For International Development
DRC	Democratic Republic of Congo
FAO	Food And Agricultural Organisation
FFS	Farmer Field School(s)
FHIA	Fundacion Hondureña De Investigación Agricola (Honduran Agricultural Research Foundation)
GAP	Good Agricultural Practice
ICM	Integrated Crop Management
IITA	International Institute of Tropical Agriculture
INIBAP	International Network For The Improvement Of Banana And Plantain
IPGRI	International Plant Genetic Resources Institute
IPM	Integrated Pest Management
IDRC	International Development Research Centre
KARI	Kenya Agricultural Research Institute
KCDP	Kagera Community Development Program
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MATF	Maendeleo Agricultural Technology Fund
MINAGRI	Ministry of Agriculture
MOA	Ministry of Agriculture
NAADS	National Agricultural Advisory Services
NARO	National Agricultural Research Organisation
NARS	National Agricultural Research Systems
NGO	Non-Governmental Organisations
PDC	Participatory Communication Development
PSA	Public Service Agreement
RIUP	Research Into Use programme
RNRRS	Renewable Natural Resources Research Strategy
TOT	Training Of Trainers
UNBRP	Uganda National Banana Research Programme
USAID	United States Agency for International Development

[10] Synonomous with BBW (Banana Bacterial Wilt)