Maize farmers in East Africa have a new basket of options

RIU

Validated RNRRS Output.

Farmers in Kenya, Tanzania and Uganda are using a new 'basket of options' to fight a maize disease know as grey leaf spot (GLS). They tested and approved the practices in farmer field schools, and posters, leaflets, radio programmes, videos and a television documentary are helping to spread the new knowledge. Seed companies are also using a rapid screening method to select locally available varieties with good levels of resistance. A wide range of stakeholders in the East African region, including individual farmers, farmer groups, seed companies, community-based organisations, NGOs and researchers, is using these new options. More than 20,000 households are benefiting from the package, and demand for the promotional materials continues to grow.

Project Ref: **CPP04:**
Topic: **1. Improving Farmers Livelihoods: Better Crops, Systems & Pest Management**
Lead Organisation: **CABI, Africa Regional Centre, Kenya**
Source: **Crop Protection Programme**

Document Contents:

Description

CPP04

Research into Use
NR International
Park House
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Geographical regions included:

Kenya, Tanzania, Uganda,

Target Audiences for this content:

Crop farmers,

A. Description of the research output(s)

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

Promotion of Integrated Pest Management (IPM) Strategies for Maize Grey Leaf Spot (GLS)

Short title: IPM Strategies for Maize GLS

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

DFID 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.

R numbers:
R7566 (ZA0371)
R8453 (ZA0677)

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

Promotional materials to **raise awareness** of the **identity** and importance of **maize GLS** amongst key stakeholder groups (primary, secondary and tertiary) in Kenya, Uganda, Tanzania and Zimbabwe were developed under R7566 and R8453. These include posters, leaflets, radio programmes, videos and a television documentary (Simons, 2006).

A rapid **protocol** for **screening** GLS-**resistance,** using both natural inoculum in fields situated in disease hot spots as well as artificially enhanced inoculum, was developed (R7566) and promoted (R8453). This protocol enables the selection of suitable, locally available maize cultivars and supports maize breeding and selection programmes (Simons, 2003).

Consultations with seed companies and breeders, led to the identification, documentation and validation of GLS-resistant/tolerant maize **germplasm** under R8453. These include; in Kenya, Kakamega Synthetic I and II, KH634A, KH600-14E (from KARI), KH631Q, EMB204 (KARI/CIMMYT); SC DUMA 41 (SC 407), SC DUMA 43 (SC 407) and SC Simba 61 (SC 627) (from SeedCo); in Uganda, DK8031, DK8051 and DK8071 (from Monsanto); SC Simba 61 and SC Duma 41 (from SeedCo); PAN67, PAN77 PAN15 and PAN691 (from Pannar); H517, H520 and H624 (from Kenya Seed Company), Open Pollinated Varieties (**OPVs**) Longe 3H and Longe 6H; and in Tanzania UH 615, UH 6303 and Simba 61 (from SeedCo). The majority of the **varieties** are very early maturing and therefore preferred by many smallholder farmers who depend on the rainfed production system. Many of these new, GLS- resistant/tolerant varieties no longer carry a price premium above traditional varieties (Simons, 2006).

The effect of different **cultural practices** on the incidence and severity of maize-GLS was validated and promoted (R7566, R8220, R8406 and R8443). These include crop rotation and speeding up decay by burying debris to decrease the survival of the disease inoculum in the field (Ajanga, 2001; Ajanga, 2002; Kinyua, 2003; Simons, 2003).

A strategy for promoting **IPM** based on a “basket of options” for the management of maize-GLS, including residue management and use of resistant/tolerant varieties was developed (R7566; R8405). Promotional tools include Farmer Field Schools (FFS), posters, leaflets, videos, radio programmes and talk shows, and a TV documentary (Simons, 2003; Simons, 2006).

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

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

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

Maize

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						

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 (RNRRS and non RNRRS)? (**max. 300words**).*
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.

Maize is an extremely important staple food throughout sub-Saharan Africa, and has been a primary focus of agricultural research. The maize production system relies primarily on smallholder agriculture characterised by use of minimal inputs and open-pollinated seed varieties (Ouma *et al*., 2002). However, farmers are faced with numerous production constraints ranging from drought, attack by pests and diseases, poor soil fertility, high costs of inputs, inadequate/lack of access to quality seed, and low maize prices (Mwangi and Elly, 2001; Stathers *et al*., 2004).

Value could be added by clustering with outputs addressing other constraints, such as: strategies developed for improving farmers' access to and management of disease resistant maize cultivars (R7429; R8220; R8406); integrated pest and soil fertility management (IPSFM) strategies for suppression of *Striga*, control of stem borers (e.g. push-pull habitat management system of maize stalk borer) and declining soil fertility in maize-based systems (R8212; R8215; R8449; R8452); FIPS-Africa approach of promoting farm inputs in small packages through partnership with private sector (R8219/R7405; R8455); and strategies for improving farmers management and access to quality seed (R8480).

With the increasing demand for use of maize as livestock feed (Thornton *et al*., 2002), improving the yield and fodder nutritive quality of maize offers potential for the crop-livestock farmers in the maize systems e.g. maize fodder contributes about 34% of total feed in the intensive smallholder dairy systems in the Kenyan highlands (Romney *et al*., 2003). Therefore there is an opportunity for clustering with outputs aimed at increasing crop-livestock systems e.g. R7955 (Strategies for feeding smallholder dairy cattle in maize forage production systems and implications for integrated pest management).

In both cases a suitable strategy for promoting the uptake and use of outputs to address multiple constraints would be through the approach used in R8299 and R8454 to accelerate the uptake of research outputs through pre-existing networks, especially of farmer field schools.

Validation

B. Validation of the research output(s)

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

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

Cultural practices influencing the occurrence of maize-GLS were identified through detailed socioeconomic surveys of smallholder maize farmers. The decay of *Cercospora zeae-maydis* on maize debris over time was evaluated by scientists (KARI and CABI) using denaturing gradient gel electrophoresis and specific primers for detecting the pathogen in soil (Kinyua, 2001). Validation of the basket of options for the management of GLS was done through a range of farmer participatory approaches (integrating the knowledge and interests of scientists and farmers) at critical stages of maize growth (immediately after crop emergence, during top dressing, at flowering, grain filling and harvesting). For example, the effect of soil fertility, infested crop debris, type of maize maturity and fungicide use on occurrence and severity of maize GLS was quantified via extensive demonstration field trials (on farmers' fields and on-station) established in Kenya and Zimbabwe (2-3 seasons).

To verify performance/acceptance of GLS-resistant varieties under resource-poor farmers' conditions, an experimental participatory methodology was used, where maize field trials (located at the centre of a farming community) were sown with 3-5 varieties and managed exclusively by host farmers in collaboration with local counterpart (e.g. agricultural extension officer/NGO). The relative farmers' importance of selected traits (e.g. yield, kernel quality, cob size and resistance to foliar diseases), was assessed through participatory pair-wise and/or individual matrix ranking. In Uganda, "mother/ baby" trials were used. A set of promising maize cultivars were evaluated under optimal and farmer-representative management conditions in the "mother" trial (designed by researchers), and a subset of the cultivars were planted and managed exclusively by the farmers in the "baby" trial. This approach established linkage of the local partner to the community, and made provision for indigenous knowledge of the local farmers' problems, resulting in selection of new high yielding GLS-resistant hybrids (e.g. UH6303 yielding 8 tons/ha in Tanzania). Farmer-exchange field visits (at least two per country) and group meetings (>10 per season), where farmers (both gender) gathered to assess a technology, were conducted and supplemented with learning tools (posters, leaflets and training videos). Validation was also done during field days (at least one per growing season/country) and agricultural shows (annual), where participants (including pupils) could examine demonstration trials (closely inspecting different treatments) and through radio talk shows involving question and answer sessions between farmers and technical experts.

In all countries validation was mainly by smallholder farmers (>50,000 extreme to moderate poor) in collaboration with scientists (multidisciplinary) and other partners including: IFAD/FAO FFSs, NGOs e.g. Catholic Relief Services (CRS), Sustainable Community-Oriented Development Programme (SCODP), and CARE-Kenya; seed companies (Faida Seeds, Lagrotech, Western Seed Company, Kenya Seed Company, Pioneer and Monsanto); village schools and the Ministry of Agriculture's National Agriculture and Livestock Extension Programme (NALEP) supported by Swedish International Development Cooperation Agency (SIDA), in Kenya. In addition, validation was facilitated by NARO, NGOs (IDEA, UNFA), Pannar Seed Co., FICA, Faida Seed, and Western Seed in Uganda, and in collaboration with the CPP-funded project R8406, as part of the District maize promotion strategies in Tanzania.

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)****.*

The outputs have been validated in the “hotspots” of GLS in Western and Central Kenya, major areas of maize production within the high potential humid/highland rainfed farming systems, where over 50% of farming land is committed to maize production and the maize enterprise is a key source of livelihood, particularly to the vulnerable female-headed households. Validation was mainly undertaken in Busia, Bungoma, Kakamega and Kiambu Districts (under R7566, January 2001 – December 2003 and R8453, June/November 2005). The outputs have also been validated in 19 key maize growing districts in Western (Masindi, Hoima, Kibaale, Kasese and Bushenyi), Central (Wakiso, Luweero, Masaka, Mubende, Kiboga and Mukono), Eastern (Jinja, Iganga, Kamuli, Mayuge, Tororo and Busia) and Northern (Lira and Apac) regions of Uganda (May/December 2005). Maize production in these areas (largely under highland rainfed system) is carried out by both the predominant smallholder (70-75%) and the emerging medium/large-scale (20-25%) farmers, with average farm size of 0.2-0.8ha and 0.8-4.0ha, respectively. In addition, the outputs have been validated in Tanzania within the GLS ‘hot spots’ parts of the Southern Highlands (covers 28% of the mainland Tanzania, but accounts for 40% of total national maize production), particularly in Njombe and Mbeya districts (July - November 2005), and other districts (Mbozi, Iringa/Kilolo, and Mbarali) with potential increased GLS infestation. These areas are predominantly under the highland smallholder rainfed system, which is largely mono-cropped, although to a limited extent, some intercropping and mixed cropping systems exist.

Current Situation

C.   Current situation

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

The various outputs are being used by a wide range of stakeholders (primary, secondary and tertiary) including individual farmers, farmer groups, seed companies, community-based organisations (CBOs), NGOs and researchers in East African region. Maize-GLS screening technologies have been incorporated in the national maize breeding/selection programmes e.g. KARI-Seed Unit (Kenya), National Crops Resources Research Institute (NACRRI) - Namulonge (Uganda) and ARI-Uyole (Tanzania) in partnership with CIMMYT’s programme on characterisation of maize germplasm grown in eastern and southern Africa, and commercial seed companies (e.g. SeedCo Ltd., Western Seed Company, Pioneer, Monsanto, Kenya Seed Company and Lagrotech). Baseline data on the farmers’ choice of maize cultivars and the information on areas with high demand for maize have helped the national and international maize breeders to breed maize cultivars that match the farmers' needs. Private seed companies e.g. Highland Seed Growers are multiplying and promoting superior GLS-resistant maize varieties for resource-poor farmers in Tanzania. Some of the released GLS-resistant varieties are being grown by smallholder farmers for domestic use as staple food and source of income through sale (surplus) in local markets. The promotional tools (posters and leaflets) are currently being used for training by agricultural extension staff, Seed Certification Agents (e.g. Kenya Plant Health Inspectorate Services), Farmer Field School Networks, CBOs, NGOs, input dealers, and seed companies (e.g. SeedCo Ltd). However, there is increasing demand for more copies from other stakeholders, such as agricultural training institutes e.g. colleges/universities in East Africa.

*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).***

The outputs are currently being used primarily in the three East African countries where validation and promotional activities were undertaken. These include the major areas of maize production within the high potential humid/highland rainfed farming systems in Western and Central provinces (as described in Question 11). The promotional materials have also been used in parts of the Rift valley region, in Trans Nzoia district where training seed stockists and growers was undertaken by KEPHIS (May/April 2006). In Uganda, the promotional materials are being used in the maize production areas (by both largely under highland rainfed system) by both smallholder (70-75%) and the emerging medium/large-scale (20-25%) farmers in the 19 districts mentioned under Question 11. In Tanzania, the outputs are being used within the GLS 'hot spots' of the Southern Highlands covering 28% of the mainland Tanzania in Njombe, Mbeya, Iringa/Kilolo, and Mbarali districts. These areas are predominantly under the highland smallholder rainfed system, which is largely mono-cropped, although to a limited extent, some intercropping and mixed cropping systems exist.

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

The use of the outputs in Kenya, Uganda and Tanzania is still within the districts (and a few neighbouring districts), where promotion was carried out. The scale of use of the outputs is high within the areas where validation of the outputs was done and by institutions that were involved in the validation process. For example, in Busia, Bungoma and Kakamega Districts in Kenya, the outputs have been adopted by more than 90% of the maize farmers. The use has increased from the initial members of farmers' groups (each targeting approximately 30 families) in the East African region, to >20,000 households in areas (districts mentioned in Question 11) where there was direct contact with farmers in 2005/06. The use is still spreading within the neighbourhood in areas where promotion work has been undertaken, but the rate of spread is not very high in some areas, particularly in Tanzania. This has largely been caused by lack of financial support to scale-up the promotion work.

*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).***

The key elements for the success in the promotion and/or adoption of the outputs include presence of a strong multi-disciplinary research team of crop and social scientists, working with crop research and development institutes (e.g. CABI, CIMMYT), crop protection department in the agricultural ministries in respective countries (e.

g. MoA, MAAIF and MAFS in Kenya, Uganda and Tanzania, respectively) and NARS. During development of the outputs, the project collated available multiple knowledge bases and "re-worked" them according to farmers' and system needs; developed productive partnerships; and sought opportunities for spill-overs to other locations. This social network plays a fundamental role in the adoption of new technologies, particularly if they require collective action. Tapping into the farmers' networks and mechanisms for information exchange and collective action facilitated the diffusion and adoption of new technologies. The involvement of the private sector at an early stage of technology development, as a potential key partner in the delivery pathway, raises their awareness of the research outcomes. Private e.g. the Southern Highland Seed Co. and public seed companies (e.g. KARI Seed Unit and TANSEED) which are already multiplying and delivering conventional maize cultivars are expected to preferentially multiply and promote superior GLS-resistant maize.

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).***

Promotion of the outputs has largely been in the maize-GLS "hot spots" located in the high potential maize production areas characterised by both smallholder rainfed (humid and highland) farming systems in East Africa, where validation took place (see Question 11). In Kenya, current promotion is high mainly in the western region, alongside other IPM activities (e.g. use of pest an disease resistant varieties, soil and post-harvest management of maize) being undertaken by government institutes (KARI-Kakamega; KEPHIS), programmes by the Ministry of Agriculture (NALEP), seed companies (SeedCo; Western Seed) and NGOs (SACRED Africa; FRIKECON) involving individual and/or group of farmers and IFAD/FAO-FFSs. In Uganda, promotion and uptake of the outputs is high within the 19 districts covered under R8453 (but low in other maize growing areas) and is ongoing, under the Crop Protection Department in the Ministry of Agriculture, in partnership with the cereals programme under National Crops Resources Research Institute (NACRRI), Namulonge. Despite the high uptake in the Districts where validation took place, little promotion is currently taking place in Tanzania, attributed to a lack of financial and other logistical support aspects, particularly regarding liaison between research and extension in promotional activities.

*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)**.*

Besides logistic problems and limited availability of promotional materials (posters, leaflets), products (e.g. seed), and high cost of airtime for radio and TV broadcasting (for recorded radio programmes and documentaries), other barriers include reluctance among some smallholder farmers to switch from their 'traditional' maize varieties to the newer, resistant varieties. With the introduction of structural adjustment programmes (SAPS) in the region (generally associated with the removal of subsidies), there has been a significant increase in the price of seed of improved maize varieties and subsequent decline in the use of other outputs e.g. fertiliser. This has led to a decline in the return from crop production, affecting people's livelihoods e.g. less money to purchase inputs. The farmers (end users) are also widely dispersed with poor infrastructure hampering access to product, input markets and information. Due to lack of coherent seed policy in the East African region, seed insecurity and widespread food insecurity have become a widespread phenomenon. In addition, the ignorance of decision (policy) makers, regarding the potential danger of maize-GLS and associated threat to national food security, has resulted in low prioritisation of the problem, hence, low priority in funding promotional activities.

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).***

Full realisation of the benefits of the generated outputs can be enhanced through strengthening of cross-disciplinary linkages and cross-sectoral approaches. There is need to strengthen the integration of the end-users and delivery agents to ensure that research outputs are both relevant and deliverable to farmers. The skills (development and re-packaging of information) of most intermediaries providing information services to farmers are generally weak. Considerable effort is required to up-grade their capacity. Besides structural rigidities, seed quality control systems must be modified and/or simplified to reduce delays and costs, and ensure that certification standards are not excessively strict (e.g. variety and certification procedures are often cumbersome and expensive). Seed regulations should be harmonised across different countries to ease variety movement and seed imports. Information (e.g. performance and suitability of newly developed and local farmer-developed varieties, rainfall patterns, etc.) exchange on GLS-resistant maize seed among different seed experts in the region is required. These challenges could be overcome by supporting regular seed policy reviews, seminars, seed networks, emerging seed entrepreneurs (e.g. individual/ family seed companies, NGOs, cooperatives or farmers' groups), and improvement of the regional capacity for seed policy formulation and implementation.

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).***

- Participatory approaches are very critical to take account of the perceptions of farmers and understand the decision making process.

- Knowledge and information play a central role in enabling both moderate and extreme vulnerable poor farmers to respond to opportunities that will improve their agricultural productivity. However, access to information is often variable, partly due to differences in farmers’ circumstances, ability to adopt technological options and availability of extension-communication infrastructure. Therefore, information should not be disseminated through communication channels to which many households have limited access.

- There is need to harmonise both the demand and supply of dissemination outputs. Production of promotional materials (on particular innovations) and the media in which they are produced should, as far as possible, be based on farmers’ (end user) demand, and communicated and internalised effectively by the target beneficiaries.

- More contact with the end user (farmers) is required e.g. through regular meetings, field days, and agricultural shows, and translation of promotional materials in local languages.

- Technical innovations conveyed through seeds of improved crops have potentially short delivery pathways and can be quickly utilised by the targeted end-user.

- Dynamic leadership, good organisation and communication within farmer (end user) groups, close partnership with technical organisations (intermediate beneficiary) in host countries, good choice of technology and/or dissemination pathway, and careful attention to details to produce quality output, are vital.

- Linkages with local authorities, research programmes of international and national agricultural research systems (IARS and NARS) are important for the sustainability of successful approaches.

- Linkages with development organisations (e.g. CABI and CGIARs) are important for up-scaling and mainstreaming.

- Partners from the private sector can secure the supply of new genetic materials (seed) and/or disseminate appropriate IPM technology to other farmers (beyond the projects' location), and relate successes to policymakers.

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.

No formal impact studies have been carried out as yet.

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*

Awareness of maize-GLS (knowing what it is, how it appears in the field and how to reduce disease spread) has been created and therefore yield losses reduced through management of the disease. Although there is no data available on the impact of the outputs on poverty of the beneficiaries, it is well documented that increase in maize production can provide a pathway out of poverty through improvement of household nutrition, cash income, asset building and employment. This is necessary in sub-Saharan Africa where one third of the population live under the poverty line of 1US dollar per day. For example, both male and female smallholder farmers (both moderate and extreme vulnerable poor) suffer a yield loss of 45% and 34.6% in Kenya and Zimbabwe, respectively, due to lack of the use GLS-tolerant varieties or other cultural practices that reduce the incidence of maize-GLS (Simons, 2003). In Tanzania, approximately 40% of the national maize production and upto 90% of the annual purchase of maize for the national strategic grain reserve is normally done in the Southern Highlands (Stathers *et al*., 2004). Cultivation of the GLS-resistant maize variety UH6303 by the extreme vulnerable poor smallholder farmers (both gender) in the Southern Highlands (Mbozi, Njombe and Iringa Districts), in the 2005 cropping season, resulted in an increase in yield of upto 39.7% (Temu *et al*., 2005). In Uganda, farmers groups in Iganga District demonstrated improved sale of the GLS-resistant maize seed, Longe 1 (a cross of Kawanda Composite and CIMMYT population 49) and enhanced women control over the generated resources. The maize seed was sold to members at the equivalent of US$ 0.50 per kilogram, which is about 20-40% cheaper than commercial hybrids (CIMMYT, 2003). Higher benefits can be accrued in future with the increasing demand for food security with the increase in population. With access to market, the poor smallholder farmers are already pulling themselves out of poverty and can be facilitated and accelerated with adequate services, institutional and policy support and provision of proper technologies, constrained by low productivity.

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? ***(max 300 words)***
This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

The outputs have direct benefits to farmers through reduced reliance on non-sustainable pest management technologies and avoidance of pesticide contamination, and to consumers through reduced environmental contamination from inappropriate use of pesticides. Indirect benefits can be realised from a stable and diverse cropping system which is based on more benign methods (IPM strategies) and/or safer (reduced) use of toxic pesticides. It is estimated that only 0.1% of applied pesticides reach the target pests, leaving the bulk of the pesticides (99.9%) to impact the environment (Pimentel *et al*., 1991). Pesticide runoff and airborne pesticide "drift" pollute surface waters and groundwater and causes both short- and long-term effects (e.g. elevated cancer risks and disruption of the body's reproductive, immune, endocrine, and nervous systems) on human health (Pimentel *et al*., 1991). Such risks can be minimised due to reduced human exposure to pesticides (through "pesticide drift" from the spraying of fields), following adoption of the IPM strategies. Proper scouting results to timely application of fungicides, which reduces the number of fungicide applications from three to one. Use of crop rotation reduces initial inoculum to a low level (Ajanga, 2002; Kinyua, 2003) permitting conservation tillage (under low level of disease), which minimises disturbances to the soil, leading to increased retention of water, nutrients and reduces erosion of topsoil. In addition, by rotating two or more crops in a field, resulting to improved soil quality and minimal weed growth. In general, the IPM strategies against maize-GLS lead to reduction of the disease among the farming communities and promote sound intensification strategies for maize production, allowing the land to be more productive while sustaining the environment.

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

None reported.

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)***

With the high dependence of the population (upto 80%) in sub-Saharan Africa on agriculture, and maize being a major staple food crop (World Bank, 2002), adaptation to climate change (all those responses to climatic conditions that reduce vulnerability) is an integral and urgent part of the overall poverty reduction strategy. One of the impacts of climate change is the decrease in grain yields (including maize), diminishing food security in Africa (IPCC, 2001). The poor people are more vulnerable to deviations from average and extreme climatic conditions (UNDP, 2003) and climate related disasters have more severe impact on female-headed households, particularly where they have fewer assets to start with (FAO, 2002b). Enhanced accessibility and adoption of GLS-resistant varieties (with other farmer/consumer desirable characteristics), coupled with use of low-cost crop management practices and empowerment of farmers (both gender) through capacity building, can reduce the risk of potential catastrophic consequences of the failure of maize crop, caused by GLS epidemics. Helping poor people to strengthen their livelihoods improves their capacity to adapt to variability (symptom of climate change). Therefore, the outputs can increase the capacity of the poor people, reduce the risk of natural disaster and increase their resilience to cope with climate change.

Annex

Annex

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