CROP PROTECTION PROGRAMME

Accelerated Uptake and Impact of CPP Research Outputs in Kenya

R8299 (ZA0571)

FINAL TECHNICAL REPORT

1 April 2003 - 31 March 2005

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This publication is an output from a research project funded by the United Kingdom Department for International Development for the benefit of developing countries. The views expressed are not necessarily those of DFID. DFID project reference number R8299 Crop Protection Programme.

Table of Contents

Abbreviations

CABI	CAB International
CABI-ARC	CAB International Africa Regional Centre
CBO	Community Based Organisation
CD	Compact Disk
CIAT	International Centre for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Centre
CIP	Centro Internacional de la Papa (International Potato Centre)
CPP	Crop Protection Programme
DFID	Department for International Development, UK
FAO	Food and Agricultural Organisation of the United Nations
FFS	Farmer Field School
GLS	Grey Leaf Spot (of maize)
ICIPE	International Centre for Insect Physiology and Ecology
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
IPM	Integrated Pest Management
IPPM	Integrated Pest and Production Management
IPSFM	Integrated Pest and Soil Fertility Management
KARI	Kenya Agricultural Research Institute
NGO	Non Governmental Organisation
SP-IPM	System-wide Programme on IPM

Acknowledgements

Very many people have taken part in this project in one way or another. They are too numerous to mention by name, but we would like to record our sincere and grateful appreciation to the following:

- ♦ The farmers in the field schools who told us what they wanted, tried out the new technologies, and told us what they thought of them.
- ♦ The field school facilitators who introduced the new technologies to the farmers, and also helped in some of the data collection.
- ♦ The staff of the collaborating institutions, particularly the IPPM FFS project and Kenya Agricultural Research Institute.
- ♦ The leaders and scientists of CPP and other projects and programmes who provided reports, materials and advice, and allowed us to adapt and reproduce their dissemination products.
- ♦ RNRKS programme managers, especially CPP, who put us in touch with the relevant projects.
- ♦ Those involved with the design, testing and production of the dissemination materials.

Executive Summary

The DFID Crop Protection Programme (CPP) has produced a large array of new technologies on weeds, diseases, insects and rodents, some of which are based on a material product, while others are 'knowledge based'. Making new technologies available to the farmers who need them is an essential step in turning good research into impact on livelihoods, but one which has not always received the attention it merits. This project focused directly on that step, to accelerate the uptake of CPP research outputs in Kenya. Thus the purpose of the project was to promote pro-poor strategies for reducing key pests, and so improve yield and quality of crops produced by small scale farmers in Kenya. This was achieved through three outputs:

- CPP research outputs adopted by farmers in Kenya
- CPP research outputs promoted and disseminated to intermediary institutions
- Farm level impact of adopted CPP research outputs determined.

Research outputs were promoted to farmers in Western Kenya through a network of farmer field schools (FFS) already established by an ongoing project funded by IFAD. The process was demand-led: farmers specified the crops they wished to work on each season, and indicated the constraints experienced in each crop. Technologies were collated from CPP and other research programmes, and presented to the FFS facilitators during three training workshops. The crops covered were beans, sweet potato, maize, sorghum, kale and groundnuts. The facilitators introduced the technologies to the FFS, and farmers chose the technologies to try out in their own and/or group managed plots. Approximately 3600 farmers were directly involved in the FFS with a further 1800 attending 30 FFS open days to learn from their colleagues, along with nearly 400 representatives of intermediary and other local organizations.

FFS members were surveyed for their preferences on the content and format of dissemination materials. Relevant existing materials were collated, and adapted and modified where necessary, while new materials were also created. Twenty two dissemination products were reproduced and disseminated to intermediary organizations as well as through the FFS. One of the products was a CD containing the source files for all the materials, allowing intermediaries to develop or reproduce further materials as required.

Surveys and farmer evaluations indicated positive impacts of the technologies tested by farmers. Farmers reported 10-15% yield increase in maize, sorghum and kale, and over 80% felt their food security had been improved. Increased marketed surplus was also reported in the same crops, contributing to improved farm incomes. Pesticide use did not increase, but fertilizer use increased in all crops except sweet potato where none was used. In all crops farmers reported an improvement in the content and timeliness of the crop production information they had received as a result of the project. Further work is required to make specific inputs available in connection with the technologies that the farmers found beneficial and wish to continue using.

Background

Innovation is the application of knowledge to do something new (Mytelka, 2000), and is necessary for any enterprise, including farming. An innovation may be a product, a process, a technique, a package, a market, but the key feature is that it is new to those using the knowledge, even if it is already well known to others. Thus the generation of new knowledge is not sufficient or even necessary for innovation, as relevant knowledge may already exist, but remain unknown and unused by those who could beneficially apply it. In the context of agricultural innovation, the uptake of research results and new technologies can thus be a major bottleneck in turning good research into improved livelihoods for the poor. In recognition of this, in 1999 the CPP commissioned a series of studies on the factors affecting the uptake and adoption of CPP research outputs (Hainsworth and Eden-Green, 2000), including ones specifically concerning maize and vegetables in East Africa. Earlier Rockefeller-funded work in Kenya showed that the major constraint to adoption of improved varieties and pest control methods in maize was the lack of information (Hassan, 1998). Studies by Mulhall and Garforth (unpublished) in Uganda and Rees *et al.* (2000) in Kenya showed that farmers get most of their information from other farmers. Likewise, information flow between researchers is generally good, but the key link in the knowledge network is between farmers and researchers. Often this link is weak.

One reason this situation exists is because scientists frequently feel that their new findings or technologies need to be refined before being ready for uptake. In some cases this is true, but often farmers are able to use and adapt new information through their own experimentation and experience as part of a dynamic and ongoing process (Reij and Waters-Bayer, 2001). Once this capacity is recognised, the opportunities and potential for uptake are greatly increased, at the same time providing opportunities for valuable feedback to the scientists.

This is the basis of farmer field schools, an approach originally devised for IPM in rice in SE Asia (Dilts *et al.,* 1996), but adapted for use in Africa by FAO, CABI and others (Loevinsohn *et al.,* 1998), and now being used successfully in a number of projects. One such project (IFAD funded through FAO) now has tens of thousands of farmers involved in integrated pest and production management in (IPPM) in E. Africa (Khisa *et al.*, 2002; Okoth *et al.*, 2002).

Facilitated by CABI, this approach was successfully adopted on a small scale in the SP-IPM pilot sites in Western Kenya (SPIPM, 2002). Over 100 farmers achieved 20% increase in maize yield, through a combination of planting KARI's KSTP-94 *Striga* tolerant variety, and intercropping and habitat management with *Desmodium* and Napier grass (the push-pull system developed by Rothamsted and ICIPE) against *Striga* and stemborers (Khan *et al*., 2000).

CPP research on pests has, in recent years, produced an array of new knowledge concerning weeds, diseases, insects and rodents, published in many papers and other dissemination materials. Some of this work is ongoing and requires further development, but much useful knowledge is already available. As the CPP Task Force on Uptake and Adoption pointed out (Garforth 2001), some technologies are a material product with potential for commercialisation, but many CPP outputs are knowledge-based with little potential for commercial uptake. These are the outputs on which we particularly focused in this project. While CPP has funded much valuable research in IPM, other research has also been undertaken, including work by KARI supported by DFID and others, Dutch funded work at ICIPE on stemborers, and Rockefeller funded work by KARI and others on soil fertility, so this project was not confined to promoting CPP research outputs only. Farmers do not compartmentalise their problems in the way scientists do, so our strategy for promoting CPP outputs was to address farmers' production needs through a demand-driven approach.

Demand for the work had been identified at several levels.

- The Programme Development Review of Maize Pest Management Research in East and Southern Africa commented that output B for the production system was unlikely to be achieved unless more active efforts were made to work directly with ongoing activities such as farmer field schools.
- The Review further recommended CPP should fund stand-alone projects that disseminate outputs and measure impacts.
- CPP funded socio-economic components/projects (such as R7404) had surveyed the target beneficiaries (poor farmers) and found there to be demand for the technologies that CPP had been developing, but that the farmers did not have the information and knowledge they need.
- Direct interaction with farmers through the IFAD funded farmer field schools project in East Africa had shown demand for information and new knowledge. The 2^{nd} African Regional IPPM meeting in Kakamega, Kenya (2000) concluded that due to the diversification in FFS, many groups were lacking a core technical focus, with IPM skills in particular in need of improvement. In the field schools demand had been increasing for information on vegetable production, which can provide both food and income.
- Research-Extension Liaison Committees in Western Kenya had reported a wide range of plant protection issues to be of concern to different farmers including moles in root crops, *Striga*, diseases of tomatoes, bean rots, root crop pests and diseases, banana diseases, fungi on napier grass, fruit tree pests and diseases (mango, citrus, avocado).
- Work under DFIDs Education Research Programme had shown that farmers in Africa are demanding more printed extension materials. Even though not all are literate, usually a family or group member can read for the others.

The project therefore had three objectives:

- To facilitate the adoption of CPP research outputs by farmers in Kenya. This was achieved through working directly with the field schools already established in Western Kenya under the IFAD funded project. A demand-led approach was used in which farmers were able to specify which crops they wished to work on in a given season, and then selected which new knowledge or technologies they wished to try out in their study plots.
- To promote CPP research outputs to intermediary organizations. Dissemination materials were developed and adapted in line with farmers' preferences, and distributed to many intermediary organisations. The materials include a CD

containing files of all the printed materials, allowing intermediary organisation to produce additional materials as required

- To assess farm level impact of the adopted CPP research outputs. Farmer participatory evaluation and survey methods were used to show the impact of the technologies tried in terms of meeting farmers' needs. The findings have been distributed on the CD of dissemination materials.

Project Purpose

The purpose of the project was to promote pro-poor strategies to reduce the impact of key pests, improve yield and quality of crops, and reduce pesticide hazards in high potential systems in Kenya. New knowledge was being sought on how outputs from research funded by DFID and others could generate benefits for poor people by application of new technologies on crop protection to high potential/peri-urban production systems. The project addressed ways of producing and distributing demand driven dissemination materials to intermediary organisations, and ways to document the impact on farmers' yields and livelihoods from adopting the new technologies.

Research Activities

Activity 1.1 Engage field schools

The project was directly linked to the Kenya component of the East African Sub-regional pilot project for Farmer Field Schools (FFS) on integrated production and pest management, funded by IFAD through FAO (IFAD IPPM FFS). The first phase of the IFAD project (1999-2003) established over 100 FFS. The pilot project planned to enter a second phase in 2004 that would last for three years. The CPP project worked with these FFS to prioritise crops, identify production constraints, and prioritise information needs and to validate and accelerate uptake of new technologies for coping with identified problems.

The first activity was a participatory identification of crop production constraints and options in order to promote technology that farmers viewed as having potential impact on their broad objectives and on their livelihoods. This was done through farmer interviews using a priority setting questionnaire and focus group discussions using ranking and acclamation.

Through ordered ranking and acclamation forty-seven, forty-two and fifty-two field schools participated in identifying priority crops in seasons one, two and three respectively. The farmers were asked to prioritize crops that they wished to study and learn about in each season. The selection of crops was based on importance of the crops to the farmers in terms of meeting their crop production objectives. Among these were food self sufficiency, food security and income generation.

In the first season the priority crops were sweet potato and beans. Beans were common in all the three districts (Busia, Kakamega and Bungoma) while sweet potatoes were more common in Bungoma. The same two crops were prioritised during the focus group discussions in which four field schools participated. In the second season maize and sorghum emerged as the priority crops. Kakamega and Bungoma districts preferred maize while Busia district selected sorghum for the season. In the third season groundnuts, kales and cassava were the top crops for Bungoma, Kakamega and Busia respectively. Cassava, though ranked third, was not selected because its production would go beyond the planned end of the project. In summary, six crops were selected by the FFS, two in each season (see Annex 1).

Activity 1.2 IPPM training seasons for field school facilitators

In the priority setting exercises farmers identified different production constraints, many of which they had no technological options for coping with. Technical experts from the lead institute and collaborators collated the problems and identified relevant technological options and CPP research outputs. These were used as the basis for week long training courses provided to FFS facilitators. The IFAD IPPM FFS project had in the first phase trained over thirty-three extension staff to become FFS facilitators. The training had included farmer participatory approaches, so in this work they needed only specific training on technical issues for the selected crops.

In 2003 and 2004, three IPPM courses were provided to thirty-three FFS facilitators in Western Kenya. Two of the courses were for the short season crops, beans, sweet potato, groundnuts, kales and cassava. Although cassava was covered in the course, the facilitators opted to leave it out since its production would go beyond the season. The long rain season course covered maize and sorghum.

For each course an interactive training format was used. There was a good balance of lectures and participatory group discussions as well as presentations (see Annex 2). As noted, the field school facilitators had already received training in participatory approaches so were conversant with the FFS group extension method. Therefore the course concentrated on technical issues of the crops.

Table 1. Summary of the training courses

Dates	Venue	No. of participants	Crops	Resource persons
25-29/8/03	Paradise hotel, Busia	33	Sweet potatoes and beans	KARI, CABI
9-13/2/04	Bishop Nicholas Stam Pastoral Centre, Kakamega	33	Maize and sorghum	KARI, ICIPE, ICRISAT and CABI
16-20/8/04	Bishop Nicholas Stam Pastoral Centre, Kakamega	33	Kales, groundnuts and cassava	KARI, CABI

Activity 1.3 Participatory identification of crop production constraints and options for adoption

As described in activity 1.1 above, the priority setting exercise was conducted for each of the three seasons to ensure consistency with the production potential and crop production practices. The approach used was a combination of simple group ranking and matrix scoring and focus group discussions using a checklist. Four of the participating farmer field schools were sampled for the focus group discussions while a questionnaire was administered to all of the farmer field schools by trained farmer field school facilitators. In the focus group discussions, the farmers were assembled by the farmer field school facilitators and discussions conducted to identify and agree on priority constraints and issues in crop production. Potential options for addressing the constraints were identified (see Annex 1).

Activity 1.4 Season long field schools

Season long field schools were run by the facilitators after they had received their technical training on prioritised issues. The facilitators included the learnt technologies (see Annex 4) in the FFS curriculum implemented through weekly meetings at the field school study plots. KARI supplied the planting materials and other inputs for the prioritised crops in each season. In the middle of the season, field days were held to evaluate the performance of the various technologies and also to share experiences and results with the wider community and intermediaries organisations. During the field school season, the facilitators distributed information and dissemination materials to farmers and intermediaries. Other activities included collection of baseline IPPM data and evaluation of the technologies.

Table 2: Field schools for different crops in three seasons

Season	Crop	No of FFS	Male FFS members	Female FFS members	Total
September – December 2003	Beans and sweet potato	66	409	789	1198
April – September 2004	Maize and sorghum	66	465	759	1224
August – December 2004	Kales	66	450	720	1170

Activity 2.1 Participatory prioritisation of appropriate dissemination materials

During the priority setting exercises (activity 1.3) FFS members provided information on what topics dissemination materials should cover. Further consultations were held with FFS facilitators and farmer groups to identify the appropriate types of media and to specify a priority list of dissemination materials.

For the consultations, two steps were adopted. Step 1 involved a workshop with the field school facilitators to set priorities in terms of crops and their constraints. During the discussions, priority information needs corresponding to priority crops and constraints were identified. These priorities were in the form of topics that the dissemination/information materials should cover. Step 2 involved further consultations made through the administration of a survey questionnaire and focus group discussions organised every season for two FFS groups from each of the three project districts. The objective was to review the information sources available and farmer requirements for information (in terms of content, format and delivery channels). Through these discussions, preferred information sources, channels and language were agreed. Criteria used in the evaluation included desirable characteristics of the source/channel such as accessibility, ease of understanding, demonstration value, reliability and language. Semi-structured interviews and focus group discussions were used to prioritise the appropriate materials (see Annex 1).

Activity 2.2 Preparation of dissemination products (information materials)

In response to the identified farmer information needs (topics, content, formats, etc) the project team adopted a two-pronged approach to sourcing information;

i) Where the relevant information was known to be available, we approached institutions/individuals who had developed the materials to seek authority to use and/or adapt them. Some of these materials had been developed under CPP funded projects while others were funded by other donors. We received very positive responses from most of the institutions, who provided both electronic and hard copy versions of the materials thus enabling us to reproduce and disseminate them. All sourced materials were evaluated and pre-tested as appropriate for dissemination by FFS facilitators/farmers during their pre-season training workshops.

ii) Where some required materials were not available e.g. in the case of beans and sweet potatoes, we developed the materials using technical expertise from CABI and other project partners. To ensure effectiveness, draft materials were pre-tested during the pre-season FFS facilitators/farmers training workshops. Final copies incorporating suggestions from the FFS facilitators and farmer representatives were then printed and disseminated.

Draft materials were presented to the facilitators during the training to evaluate the relevance and appropriateness of the content, language, pictures etc to their local situation. The facilitators' feedback, that included the replacement of English and Swahili words with local language, was then used to prepare the final products (see Annex 5).

Table 3. Information sources (R number is the DFID project reference number)

Crop	Organisation contacted	Information source
Bean	CIAT, Eastern and Central Africa Bean Research Network (ECABREN)	Posters, Project reports (R7965, R7569)
	CAB International-Africa Regional Centre	Posters (produced under this project – R8299)
Sweet potato	CAB International-Africa Regional Centre	Posters -(produced under this project – R8299)
	Kenya Agricultural Research Institute (KARI)	Project reports (R8040, R8167, R7492, R8243)
Maize	CAB International-Africa Regional Centre	Posters, leaflets (R7566, R7429)
	KARI Publications Unit	Leaflets
	International Maize and Wheat Improvement Centre (CIMMYT)	Manuals/Extension Guides
	International Centre for Insect Physiology and Ecology (ICIPE)	Project reports (R7564, R8212)
Sorghum	International Maize and Wheat Improvement Centre (CIMMYT)	Extension manual
	CAB International-Africa Regional Centre	Research reports (R8219)
	International Centre for Insect Physiology and Ecology (ICIPE)	Research reports Project reports (R7564, R8212)
Kale	Imperial College, London, Plant Protection Research Institute (PPRI), AfFOResT, Natural Resources Institute (NRI), Kenya Agricultural Research Institute (KARI)	Manual, Posters (R6764)
	Kenya Agricultural Research Institute (Katumani)	Manual
	CAB International-Africa Regional Centre	Project reports (R6615, R7266, R6616, R8312)
	DFID Crop Protection Programme (CPP)	Project reports (R6615, R7266, R6619, R8312)
Groundnuts	DFID Crop Post Harvest Programme	Leaflets
	NR International	Leaflets
	International Centre for Research in the Semi-Arid Tropics (ICRISAT)	Research reports (R7445, R8105)

Activity 2.3 Field school open days for intermediary institutions

The purpose of the open days was to introduce the new technologies and to stimulate the interest of many farmers and intermediary organisations as well as to create a situation in which informal contacts and learning could take place. To this end, the open days combined demonstrations, comparison and discussions on introduced techniques. Each open day was hosted by a participating field school and was attended by neighbouring field school members (those participating in the project and others who were not), non- field school farmers, NGOs, local leaders, government officials and field school network representatives. The field school facilitator worked with the host FFS and the local leaders to decide on the dates and the essential details of the open day that included selection of the study plot, what technologies would be shown, division of work and responsibilities and the necessary exhibition and distribution materials. The open day was publicized well in advance with sign boards displayed at the study plot. The visitors were taken around the study plot ensuring that they saw the important points of the demonstrations. The host FFS members explained the new technologies that were being compared with farmers' practices at each study plot. At the end of the study plot tour, the facilitator held a group discussion with the participants (both hosting FFS and visitors) about the technologies demonstrated. The discussions provided general information about the influence the open day had on farmers' knowledge and their opinions and perceptions of the technologies.

A total of thirty field school open days were held and attended by two thousand nine hundred and forty-two participants (Table 4). There was a good representation of various intermediary institutions that were expected to share/try out the new knowledge learnt with the farmers that they work with.

Activity 2.4 Distribution of information materials

Taking into consideration the farmers' preferred channels of information, the materials were disseminated using a three-pronged approach:

i) Through the government extension system and thirty-three intermediary organisations (mainly NGOs) that are involved in extension in the project area.
ii) One hundred (100) copies of a CD containing all the materials disseminated by the project has been made and disseminated to intermediary organisations, project partners and collaborators. It is expected that the information will reach more farmers as the organisations can print it on demand.
iii) Through the 66 farmer Field Schools that participated in the project. The materials were delivered as part of the participatory extension package.

Table 4. Field school open days

District	Division	Name of FFS	Date	Attendance							
				CPP FFS farmers	Non CPP FFS farmers	Non FFS farmers	NGO/ CBO	Network officials	Govt. officials	Local leaders	Total
Busia	Budalangi	Esifumbukhe	19/12/03	52	31	16	4	1	10	2	116
	Budalangi	Habanga	25/02/04	39	20	24	4	1	4	0	92
	Butula	Mwangaza	23/12/03	25	7	20	0	2	3	4	61
	Butula	Khaindikiri	10/03/04	22	20	15	1	3	3	2	66
	Funyula	Wekhonye	17/12/03	65	21	31	2	3	14	4	140
	Funyula	Nyakhobi	2/03/04	34	20	51	10	1	9	3	128
	Matayos	Wekhonye	4/03/04	30	12	9	0	0	5	2	58
	Matayos	Nakhomake	18/12/03	25	20	33	2	2	14	1	97
	Nambale	Songa mbele	4/02/04	41	18	40	0	0	7	4	110
	Township	Sibikhe Nesire	19/03/04	33	12	32	0	1	8	2	88
	Butula	Khaindikiri	11/08/04	34	24	22	2	2	2	1	87
	Funyula	Odiado	11/08/04	66	10	28	6	4	8	6	128
	Matayos	Namikoye	13/08/04	8	11	20	4	1	7	3	54
	Matayos	Buyama	06/08/04	20	6	33	1	2	7	2	71
	Nambale	Musokoto	06/08/04	30	20	5	6	0	3	0	64
	Township	Bwina	04/08/04	30	26	26	0	0	4	0	86
	Township	Mayenje	08/12/04	19	4	36	4	1	8	2	74
Bungoma	Nalondo	Lima	25/11/03	67	37	56	4	0	8	4	176
	Nalondo	Embako	25/02/04	64	10	168	0	1	4	1	248
	Kanduyi	Ranje Sinoko	4/12/03	16	5	90	6	0	5	1	123
	Kanduyi	Kitinda	26/02/04	57	22	13	0	2	3	2	99
	Nalondo	Lima	31/08/04	35	40	87	4	3	6	1	176
	Kanduyi	Neuni	02/09/04	42	20	24	3	1	2	1	93
	Chwele	Khaka	29/07/04	26	15	32	6	0	3	1	83
	Webuye	Bunang'eni	11/08/04	35	20	93	0	0	12	2	162
Kakamega	Lurambi	Masinga	2/04/04	46	24	30	4	3	6	3	116
	Lurambi	Emiele	4/12/04	87	49	31	0	3	6	5	181
	Navakholo	Konyero	20/03/04	43	20	15	1	6	6	4	95
	Lurambi	Taabu	13/08/04	20	15	127	1	3	4	4	174
	Navakholo	Konyero	22/09/04	41	10	8	1	5	3	4	72
Total											**3318**

Activity 3.1 Assessment of pre-adoption socio-economic situation and production practices of participating farmers

A survey was done to access the production systems of the participating farmers, production statistics and constraints, what farmers feel needs to be improved within the systems, initial farmer perceptions of IPPM technologies, their socio-economic situation and resource endowment.

10% of the farmer field schools were sampled. A survey questionnaire was administered to participating farmers in the sampled field schools by trained farmer field school facilitators. In all the three districts, six hundred and thirty three farmers with an average of about 3 acres of cultivated land were interviewed (Table 5). (See Annex 6)

Table 5: Household characteristics of farmers interviewed

Characteristic	Season 1 (Beans and sweet potato)	Season 2 (Maize and (sorghum)	Season 3 (Kales)
Total number of farmers interviewed	280	259	94
Average age (years)	46	46	46
Sex: Male (%)	66	58.7	63
Female (%)	34	41.3	37
Family size:			
Adult male (> 14 yrs)	2.1	2.2	1.8
Adult female (>14 years)	2.0	2.0	1.8
Children (≤ 14 years)	3.4	3.0	2.6
Average land (acres):			
Owned land cultivated	2.59	2.86	3.03
Rented land cultivated	0.47	0.36	0.28
Non cultivated land	1.22	1.24	1.15
Education of farmers (%)			
None	14.2	13.9	10.6
Non-formal	3.2	1.5	0
Primary	45.4	59.5	57.4
Secondary	36.1	23.6	30.9
Tertiary	1.1	1.5	1.1

Activity 3.2: Participatory evaluation of new IPPM methods

Participatory evaluation of the IPPM technologies was conducted in three districts in Western Kenya, to gauge farmers' views about the technologies. Farmer evaluation criteria were determined at the onset of the farmer field schools. The farmer field school facilitators for the sampled schools were trained on focus group discussions, scoring and ranking, and evaluation of IPPM technologies based on farmer criteria. The methods were used to explore farmers' perceptions, elicit criteria, understand their choices, and decision making in regard to the new technologies.

In the focus group discussions a combination of simple ranking, matrix scoring and weighting were used to evaluate the IPPM technologies for crops selected by the farmers for the short and long rain seasons. Farmers were facilitated to provide the criteria for technology evaluation and their rating of the technologies. Discussions were conducted in an open and free environment that encouraged total participation of all the farmers present. Scoring and then ranking was done to indicate the relative importance of each of these characteristics. The characteristics differed depending on the technologies. Simple ranking was used to enable the farmers to come to consensus in developing a ranked list of characteristics. Each farmer gave the highest rank (equal to the total number of characteristics) to the highest ranked characteristic, the next highest number to the next highest ranked characteristic, down to a score of 1 for the lowest ranked characteristic. The rankings for each farmer were then tallied on a master sheet. The total scores for each characteristic were used to put them in order of importance. Matrix scoring of the technologies was undertaken by asking all the farmers to assign a score for each characteristic in respect of each of the technologies. The maximum number of points (scores) allocated to each technology was an equivalent of the total number of technologies being evaluated. This was meant to provide an assessment of the ability of each of the technologies to supply the characteristics indicated by the farmers. The scoring exercise stimulated a discussion among all the farmers. The discussion led to a consensus on scores for specific characteristics of each technology, which were tallied on a master sheet. The exercise was repeated for all characteristics for all technologies. The technology with the highest score was considered to be the best. Different criteria were used in the evaluation for different technologies on the priority crops (Table 6)

Table 6. Farmer defined criteria for evaluation of technologies on the priority crops

Criteria	Beans	Sweet potato	Maize	Sorghum	Kale
Yield	X	X	X		X
Disease resistance	X	X	X	X	X
Pest resistance	X	X	X	X	X
Drought resistance	X	X		X	
Price	X	X			
Market demand	X		X		X
Adaptation to local conditions	X				
Maturity period	X	X	X	X	
Labour requirement	X				
Uniform maturity	X				
Seed availability	X		X	X	
Marketability (consumer preference)		X		X	
Food self sufficiency (food security)		X			
Length of harvesting		X			
Germination rate			X		
Striga resistance			X		
Bird attack				X	
Shelf life (storage)				X	
Requirement for additives				X	
Viability of seeds				X	
Colour					
Farm inputs required					X
Harvesting period					X

Activity 3.3 Post adoption socio-economic survey to assess impact on target farmers

A second socio-economic survey was carried out to asses the farmer perceptions of the new technologies and the extent to which they had adopted and adapted them. The survey also identified the benefits of the new technologies to the farmers. Focus group discussions involving farmers in the sampled farmer field schools and individual farmer interviews were conducted to assess the impact of the technologies. In the focus group discussions semi-structured interviews were conducted on a range of issues that included positive and negative changes that occurred in relation to yield, income, area, pest and disease control, losses and comparison of the new and existing technologies. Individual interviews were conducted using structured questionnaires (see Annex 8). A before and after analysis was conducted to assess the impact of the technologies and their contribution to farmers' income and livelihoods.

Activity 3.4 Wide dissemination of impact assessment study

The results of the impact assessment study were compiled on a CD together with the information materials that were disseminated during the project. One hundred copies of the CD have been disseminated to intermediary organisations, project partners and collaborators. A paper is in preparation for presenting the results in an international refereed journal.

Outputs

Output 1: CPP research outputs adopted by farmers in Kenya

The aim of much of CPP's funded research is to develop new knowledge and technologies for use by poor farmers to improve their livelihoods. Here the focus was on the application of the knowledge and technologies. The knowledge and technologies applied were selected based on farmers' demand, assessed during the study. Technological options that met farmers demands were sourced from research outputs of projects funded by CPP and others and were disseminated through three training courses provided to FFS facilitators (see Activity 1.2 and Annex 2). The facilitators subsequently evaluated the technologies through 66 FFS and FFS field days (see Activity 2.3).

Participatory identification of crops

Six crops were prioritized by farmers for study, two in each season (Table 7). The crops in bold are those selected for the season. In season 1 sweet potatoes and beans were priorities, though sweet potatoes were the first priority by ordered ranking while beans were just by acclamation. This indicates the need for care when assessing farmer 'demand', as the approach might affect the outcome. However, in the context of this study sweet potatoes and beans were, overall, clear priorities.

In season 2 maize was the top priority by some margin, by both methods. Beans again important, but were discounted due to them having been covered in the first season. Sorghum was therefore selected as the second crop, though it was ahead of other crops by a smaller margin.

In the third season beans and sweet potatoes again scored highly, but having been covered in season 1 were not repeated. Groundnuts, kales and cassava all received modest support, but the field school facilitators felt that cassava would not be practical due to the length of time it would require to cover all stages of production. Of the other crops mentioned, tomatoes received slightly more support than soya beans.

Production constraints and options for adoption

Through a participatory approach, the constraints in the production of beans, sweet potatoes, maize, sorghum, kale and groundnuts were identified in Busia, Kakamega and Bungoma (Table 8). The specific constraints varied depending on the type of crop but generally, these included attack by insect pests, diseases, marketing, lack of appropriate storage facilities, lack of quality seed and inadequate technical know-how. The major insect pest problems included sweet potato weevil, stalk borer, aphids and cutworms, for sweet potato, maize, kale and groundnuts, respectively. Examples of disease problems that were ranked first include bean root rot, maize streak, smut, stem rot and rosette virus on beans, maize, sorghum, kale and groundnuts, respectively

Table 7. Priority crops in three different seasons

Season 1	**Ordered ranking**			**Acclamation**		
Crop	**Priority 1**	**Priority 2**	**Priority 3**	**Priority 1**	**Priority 2**	**Priority 3**
Sweet potatoes	**19**	**10**	**7**	**8**	**3**	**11**
Beans	**7**	**10**	**14**	**14**	**14**	**5**
Cassava	7	6	3	4	6	3
Maize	2	1	1	9	4	5
Sorghum	2	4	7	3	5	1
Tomatoes	2	0	0	1	1	3
Groundnuts	2	5	4	2	6	10
Season 2						
Sweet potatoes	2	6	1	1	1	2
Tomatoes	1	2	0	0	0	0
Beans	1	19	7	3	11	0
Groundnuts	1	4	5	0	0	4
Loc. vegetables	0	3	4	1	2	2
Maize	**23**	**0**	**7**	**19**	**4**	**3**
Kales	1	1	2	0	0	0
Sorghum	**9**	**2**	**3**	**5**	**4**	**2**
Fillet millet	1	1	7	1	0	7
Cassava	3	6	2	1	2	2
Soya bean	0	1	1	0	0	0
Bambara nut	1	0	0	0	1	0
Season 3						
Beans	13	10	12	8	8	1
Groundnuts	**3**	**8**	**9**	**2**	**4**	**6**
Kales	**5**	**6**	**2**	**1**	**2**	**2**
Tomatoes	4	3	5	2	1	1
Soya beans	2	4	6	0	0	3
Sweet potatoes	13	7	6	1	3	8
Maize	4	3	3	8	4	0
Sorghum	3	2	3	0	3	0
Cassava	**4**	**5**	**4**	**3**	**1**	**4**

Interventions identified by the farmers for management of the production constraints were also identified through the same participatory process (see Annex 1). The commonest interventions included the use of crop varieties that are resistant to the respective pests and diseases, chemical control and cultural practices e.g. crop rotation and roguing. Whereas resistant varieties were in most cases considered as an appropriate intervention, the farmers emphasised the need for such varieties to be high yielding, drought resistant and early maturing. It was also noted that chemical pesticides, where applicable, should have high efficacy and be packaged in small quantities that are affordable to farmers who have limited financial capabilities. The farmers were applying different botanical extracts such as chillies and marigolds and expressed demand for more information on rates and volumes of application that would save them labour costs.

Table 8. Production constraints and options identified by farmers

Season 1	**Constraint**	**Intervention options**
Sweet potatoes	Sweet potato weevil	Apply ash, covering with soil, crop rotation and roguing
	Sweet potato virus	Apply ash, crop rotation, roguing
	Sweet potato butterfly	Use ash, crop rotation, pesticides
	Low yielding varieties and lack of planting material	Use any available or alternative sources of planting materials
	Mole rats	Dig holes and drench with water, use rat poison, use traps
Beans	Root rot	Roguing, crop rotation
	Bean fly	Use of ash and pesticides
	Aphids	Use of ash, pesticides
	Blight	Roguing, crop rotation
	Bean mosaic virus	Roguing, crop rotation, using ash and use of resistant varieties
	Anthracnose	Roguing, use of ash, pesticides
	Low yielding/limited choice of varieties	Use of any available varieties
Season 2		
Maize	Stalk borer	Use ash, roguing
	Maize streak	Roguing
	Striga weed	Roguing
	Lack of quality seeds	Plant any available seeds
	Lack of improved varieties	Use any variety available
	Inadequate capital	Borrow from friends, take loans Use cow dung
	Maize beetle	Use pesticides
	Larger grain borer	Roguing
	Maize blight	
Sorghum	Birds	Scaring
	Striga weed	Roguing, crop rotation, use of farm yard manure
	Head smut	Roguing
	Shoot fly	None
	Midge	None
	Lack of improved varieties	Use any available variety
	Sorghum weevils	Use ash and pesticides
	Husbandry practices	Use own farmer methods
Season 3		
Kales	Aphids	Apply ash and pesticides
	Cut worms	Hand picking, apply ash & pesticides
	Caterpillars	Apply ash and pesticides
	Diamond back moth	Apply ash and pesticides
	Stem rot	Roguing
	Root rot	Roguing
	Poor quality seeds	Use any available seeds
	Marketing	None
Groundnuts	Groundnut aphids	Apply ash and pesticides
	Groundnut hopper	None
	Rosette virus disease	None
	Black leaf spot	None
	Lack of high yielding varieties	Use any available variety
	High labour requirement	Hire labour and family labour
	Wilting	None
	Unfavourable weather condition	None
	Mole rats	Trapping, flooding with water
	Thrips	None
	Squirrels	Scaring
	Marketing	None

Technologies disseminated

For each crop and the identified production constraints, potential options for addressing the constraints were sourced (see Annex 4). The sources of the technological options included CPP funded projects while others were collated from a range of other research work (Table 9). Scientists from KARI, ICIPE, ICRISAT and CABI presented the different technologies to thirty three field school facilitators during three training of trainers courses that were conducted in three seasons (see Annex 2).

The trained FFS facilitators then ran their field schools, and introduced the technologies to the farmers in the usual manner, progressing through the season and debating and discussing each decision, supported by farmer observations in the field. Not all the technologies disseminated were tested by farmers; some are mutually exclusive, and farmers selected those technology options to test that they decided were most appropriate in their circumstances. Thus the technology options tested by the farmers were a sub-set of those disseminated.

Table 9: Summary of technologies disseminated (R number denotes DFID project number – see Annex 4 for further details).

Crop	Problem	Source of technological options
Bean	Bean fly	R7965 Promotion of IPM strategies of major insect pests of Phaseolus beans in hillside systems in eastern and southern Africa
	Aphids	CIAT
	Root -rot	CIAT R7568 Characterisation and epidemiology of root rot diseases caused by *Fusarium* and *Pythium* spp. in beans.
	Anthracnose	R7569 Participatory promotion of disease resistant and farmer acceptable Phaseolus beans in southern highlands of Tanzania
	Bean production constraints (agronomic)	Common food bean production in Western Kenya
Sweet potato	Sweet potato production constraints (agronomic)	R8040 Rapid multiplication and distribution of sweet potato varieties with high yielding and ß-carotene content R8167 Promotion of sustainable sweet potato production and post-harvest management through farmer field schools in East Africa.
	Sweet potato viruses	R7492 Promotion of and technical support for methods of controlling whitefly-borne viruses in sweet potato in East Africa R8243 Working with farmers to control sweet potato virus disease in East Africa
	Sweet potato weevil	CIP
	Sweet potato butterfly	CIP
	Sweet potato Mild Mottle Virus (SPMMV)	R7492 Promotion of and technical support for methods of controlling whitefly-borne viruses in sweet potato in East Africa
	Sweet potato Feathery Mottle Virus (SPFMV)	R7492 Promotion of and technical support for methods of controlling whitefly-borne viruses in sweet potato in East Africa

	Soft Rot. *Rhizopus stolonifer, Mucor* sp.	CIP
Maize	Striga	R6921 Improved methods for the management of Striga: Nitrogen, tolerance, screening and cultural practice R7564 Integrated management of Striga species on cereal crops in E Africa R8212 Integrated pest and soil management to combat Striga, stemborers and declining soil fertility in the Lake Victoria basin R7405 Development of weed management in maize-based cropping systems
	Maize streak virus	R7429 Promotion of the improved maize streak virus tolerant variety Longe 1, to resource poor farmers in Uganda
	Maize grey leaf spot	R7566 Management strategies for maize grey leaf spot *(Cercospora zeae-maydis)* in Kenya and Zimbabwe
	Ear-rot	R6582 Epidemiology, toxicology and management of the maize ear-rot complex in African farming systems. R8220 Improving farmers' access to and management of diseases resistant maize cultivars in the southern highlands of Tanzania
	Stalk borer	R7955 Strategies for feeding smallholder dairy cattle in intensive maize forage production systems and implications for integrated pest management R8212 Integrated pest and soil management to combat Striga, stemborers and declining soil fertility in the Lake Victoria basin
	Maize production constraints (agronomic)	R8219 Improved access to appropriate farm inputs for integrated maize crop management by small-scale farmers in Embu and Kirinyaga districts Kenya
Sorghum	Shoot fly and midges	R7572 Management of key insect pests of sorghum in southern and eastern Africa: developing IPM approaches with expert panels
Kales	Diamond back moth (*Plutella xylostella*)	R6616 Pest management in horticulture; integrating sustainable pesticide use in biocontrol-based peri-urban systems in Kenya R6615 Investigation of biorational methods for control of insect pests of vegetables in Kenya. R7403 Pest management in horticultural crops; an integrated approach to vegetable pest management with the aim of reducing reliance on pesticides in Kenya R7449 Development of biorational brassica IPM in Kenya R7266 Development and evaluation of a pilot field handbook on natural enemies of vegetable pests in Kenya and Zimbabwe
	Cutworms (*Agrotis spp*)	ARF/CSWP/RC-IDA/6012001/1 Pilot project for the implementation of farmer participatory IPM in vegetable/ cash crops in small holder production systems in Kenya R6616 Pest management in horticulture; integrating sustainable pesticide use in biocontrol-based peri-urban systems in Kenya
	Black rot (*Xanthomonas campestris pv campestris*)	R8312 Promotion of quality vegetable seed in Kenya.
	Poor Seed Quality	R8312 Promotion of quality vegetable seed in Kenya.

Groundnuts	Leaf hopper	
	Groundnut aphids	
	Groundnut Rosette Virus Disease	R7445 Development of acceptable groundnut varieties with durable resistance to rosette disease in Uganda R8105 Farmer-led multiplication of rosette resistant groundnut varieties in Eastern Uganda
	Aspergillus flavus fungus	

Output 2: CPP research outputs promoted and disseminated to intermediary institutions

The group discussions on prioritisation of information requirements served to identify the key topics on which farmers most urgently needed information, the preferred sources of this information, channels for disseminating it as well as the preferred formats. The latter included leaflets, handbooks, posters, calendars and video, in descending order of preference. Table 10 below shows the results of the group discussions, which guided selection and preparation of the materials that were disseminated.

Disseminated products

Below is a list of the titles of information materials that were disseminated, based on the farmers' requirements (see above). To obtain the materials, requests were sent to leaders of relevant CPP funded projects in the first instance and then to other relevant projects and institutions. Where the materials were not available, we developed them. In every instance, permission was obtained to use or adopt the materials to the local situation and due acknowledgement was made.

Season 1

- Wadudu na magonjwa yanayoshambulia viazi vitamu, CAB International Africa Regional Centre. (Poster)
- Wadudu na magonjwa yanayoshambulia maharagwe, CAB International Africa Regional Centre. (Poster)
- Bean stem maggot (bean fly) and its management, International Centre for Tropical Agriculture. (Poster)
- Funza wa maharage (inzi wa maharagwe) na namna ya kumdhibiti, International Centre for Tropical Agriculture. (Poster)
- Bruchids/ Bean weevils, International Centre for Tropical Agriculture. (Poster)
- Vipekecha wa maharagwe, International Centre for Tropical Agriculture (Poster)
- Bean foliage beetles (Ootheca spp.) and their management, International Centre for Tropical Agriculture. (Poster)
- Virombosho (Ootheca spp.) na namna ya kuwadhibiti, International Centre for Tropical Agriculture. (Poster)

Table 10. Prioritised dissemination materials - results of group discussions

Crop	Preferred sources/channels	Required information materials (Constraints)
Sweet potato	Extension services Visit to farmer training centres	Management of: Sweet potato Weevil Sweet Potato Virus Sweet Potato Butterfly Control of mole rats Information on high yielding varieties Sources of planting material
Beans	Extension services Visit to farmer training centres	Management of: Root rot Bean fly Aphids Blight Bean mosaic virus Anthracnose Information on high yielding varieties Sources of planting material
Maize	Farmer field schools Radio Extension services	Management of: Stalk borer Maize streak Striga weed Maize beetle Larger grain borer Maize blight Sources of quality seeds / improved varieties
Sorghum	Farmer field schools Radio Extension services	Management of : Birds Striga weed Head smut Shoot fly Midge Sorghum weevils Sources of improved varieties Good husbandry practices
Kale	Farmer field schools Extension services	Management of: Aphids Cut worms Caterpillars Diamond back moth Stem rot Root rot Sources of high quality seeds Markets
Ground nut	Farmer field schools Extension services	Management of: Groundnut aphids Groundnut hopper Rosette virus disease Black leaf spot Wilting Mole rats Thrips Squirrels Sources of high yielding varieties Markets

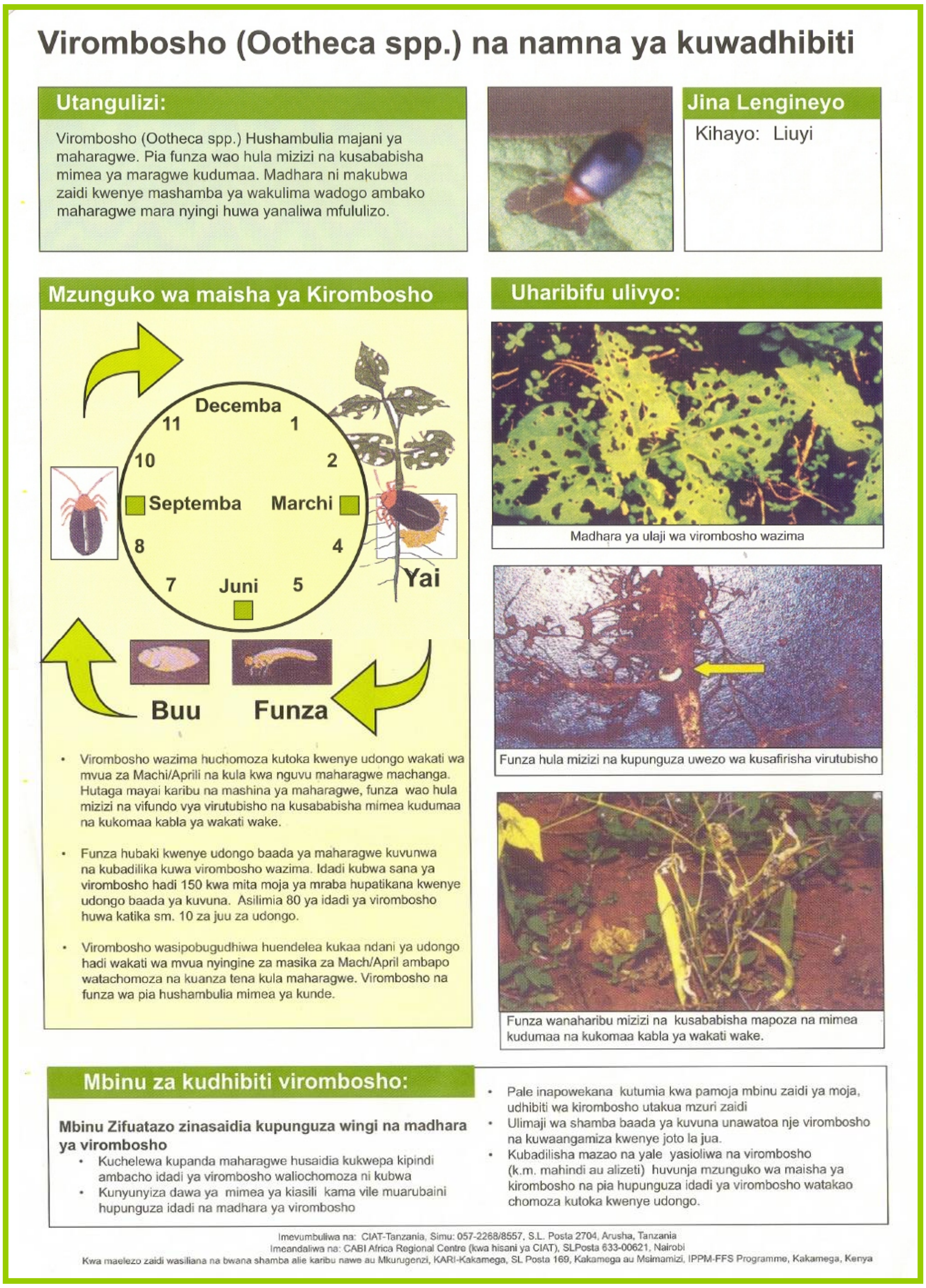

Figure 1. Leaflet on bean foliage beetles and their management.

Figure 2. Poster on sweet potato pests.

Season 2

- Umewahi kuuona huu ugonjwa? Huu ni Ugonjwa wa madoa ya kijivu kwenye majani ya mahindi (Maize Grey Leaf spot (GLS), CAB International Africa Regional Centre. (Poster)
- Have you seen this disease? It is Maize Grey leaf spot?, CAB International Africa Regional Centre. (Poster)
- Striga biology and participatory control approaches: a facilitators/extension guide, Kenya Agricultural Research Institute, International Maize and Wheat Improvement Centre, International Centre for Research in Agroforestry, International Centre for Insect Physiology and Ecology (together with FAO). (Manual).
- Striga biology and control options: a farmer's pamphlet, Kenya Agricultural Research Institute, International Maize and Wheat Improvement Centre, International Centre for Research in Agroforestry, International Centre for Insect Physiology and Ecology. (Manual)
- Control of stalk borers in maize crops, Kenya Agricultural Research Institute. (Leaflet)
- Options for managing maize grey leaf spot, CAB International Africa Regional Centre, Kenya Agricultural Research Institute. (Leaflet)

Season 3

- ROOTS: Cassava Mosaic and cassava brown streak virus diseases in Africa: A comparative guide to symptoms and aetiologies, DFID Crop Protection Programme. (Leaflet)
- Avoiding aflatoxin in groundnuts, DFID Crop Protection Programme, DFID Crop Post Harvest Programme. (Leaflet),
- Trapping rodents that trash crops, DFID Crop Protection Programme, DFID Crop Post Harvest Programme. (Leaflet)
- Production of kales (sukuma wiki) and onions using bucket drip Irrigation, Kenya Agricultural Research Institute. (Manual)
- Farmers' friends: recognition and conservation of natural enemies of vegetable pests in Zimbabwe Biology Department, Imperial College of Science Technology and Medicine, University of London. (Field Guide)
- Farmers' friends, Biology Department, Imperial College of Science Technology and Medicine, University of London. (Poster)
- Pests and diseases of brassicas and tomatoes, NR International. (Poster)
- Information materials on IPM in beans, ground-nuts, cassava, maize, sweet potatoes, sorghum and kale, CAB International Africa Regional Centre. (CD)

Table 11 summaries the information materials disseminated by type and season while table 12 shows the recipients of the materials.

Table 11. Number information materials prepared

Season	Posters	Leaflets	Field manual	CD Rom
1st short season	1880	200	0	
Long rain season	200	300	100	
2nd short season	500	540	100	100
Total	2580	1040	200	100

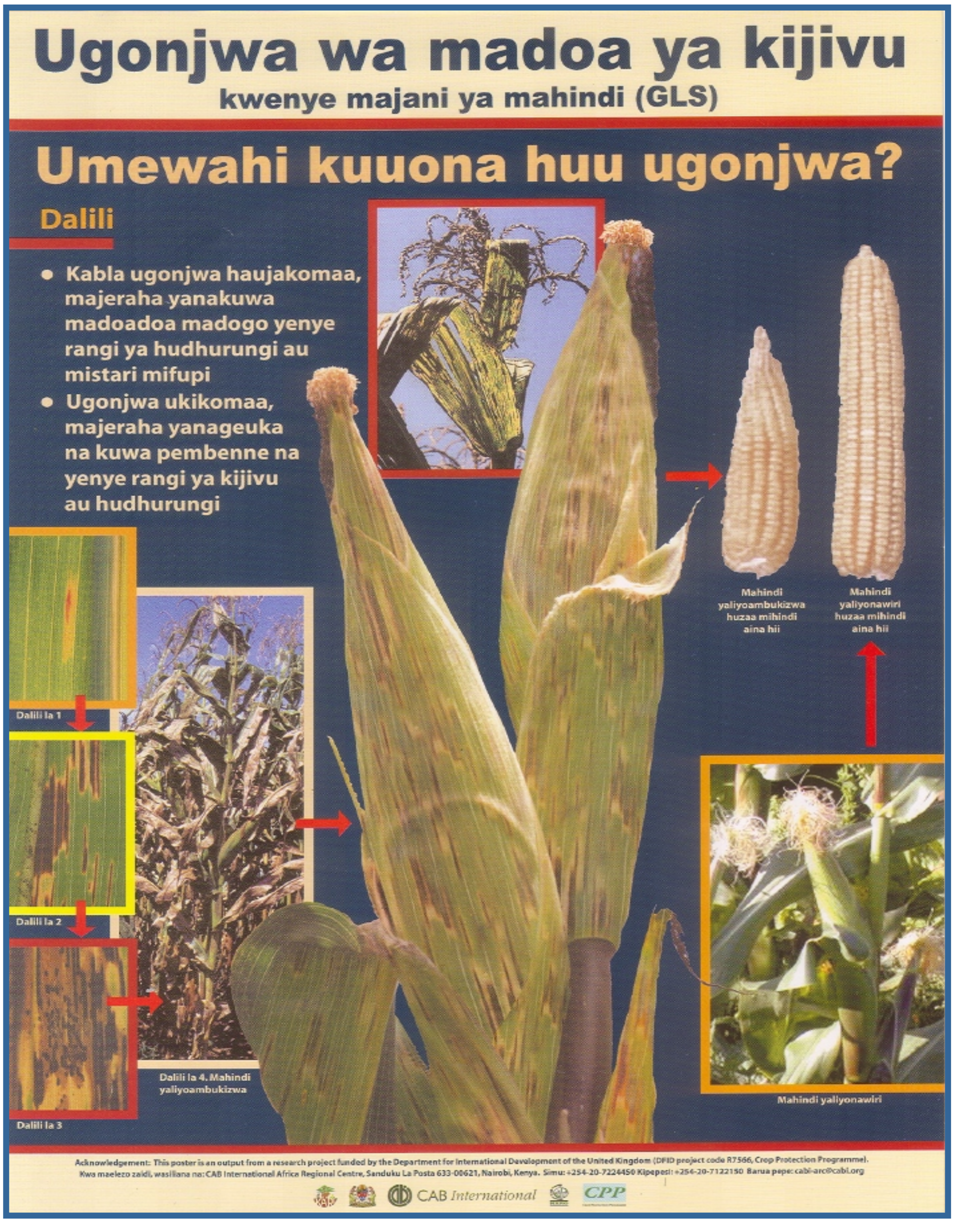

Figure 3. Poster on maize grey leaf spot.

Table 12. Recipients of the dissemination materials

Name of Institution	Type of institution	Town
ACK-Western region Christian community services (WRCCS)	NGO	Kakamega
District FFS Network	CBO	Kakamega
Ministry of Agriculture Kakamega District	Government	Kakamega
CARD	NGO	Kakamega
ABLH	NGO	Kakamega
International Christian support fund (ICS)	NGO	Busia
District FFS Network	CBO	Busia
World Vision	NGO	Busia
Action Aid	NGO	Busia
ACK- Christian Community Services (CCS)	NGO	Busia
REFSO	NGO	Busia
ARDAP	CBO	Busia
FITCA Kenya	Project	Busia
AU/FITCA Kenya	Project	Busia
Farmer Training Centre (FTC Busia)	Government	Busia
FIPS- AFRICA	NGO	Nairobi
District FFS Network	CBO	Bungoma
Cereal Growers association (CGA)	NGO	Nairobi
UPENDO AGROVET	SHOP	Bungoma
Ministry of Agriculture Bungoma District	Government	Bungoma
FIPS- AFRICA	NGO	Bungoma
District FFS Network	CBO	Bungoma
ACE AFRICA	NGO	Bungoma
Kibisi FADC	CBO	Bungoma
Kibabii Youth group	CBO	Bungoma
Mukwano W Group	CBO	Bungoma
Sacred Africa	NGO	Bungoma
CREADIS	NGO	Bungoma
KACE	Private company	Bungoma
KEPHIS	Government	Bungoma
APPROTEC	NGO	Bungoma
Bungoma Farmer run facilitators association	CBO	Bungoma

All the materials were included on the CD, from which additional copies can be produced. Contact addresses of the original authors of the materials are provided to encourage and facilitate reproduction and adaptation as may be required by intermediary organizations in particular situations.

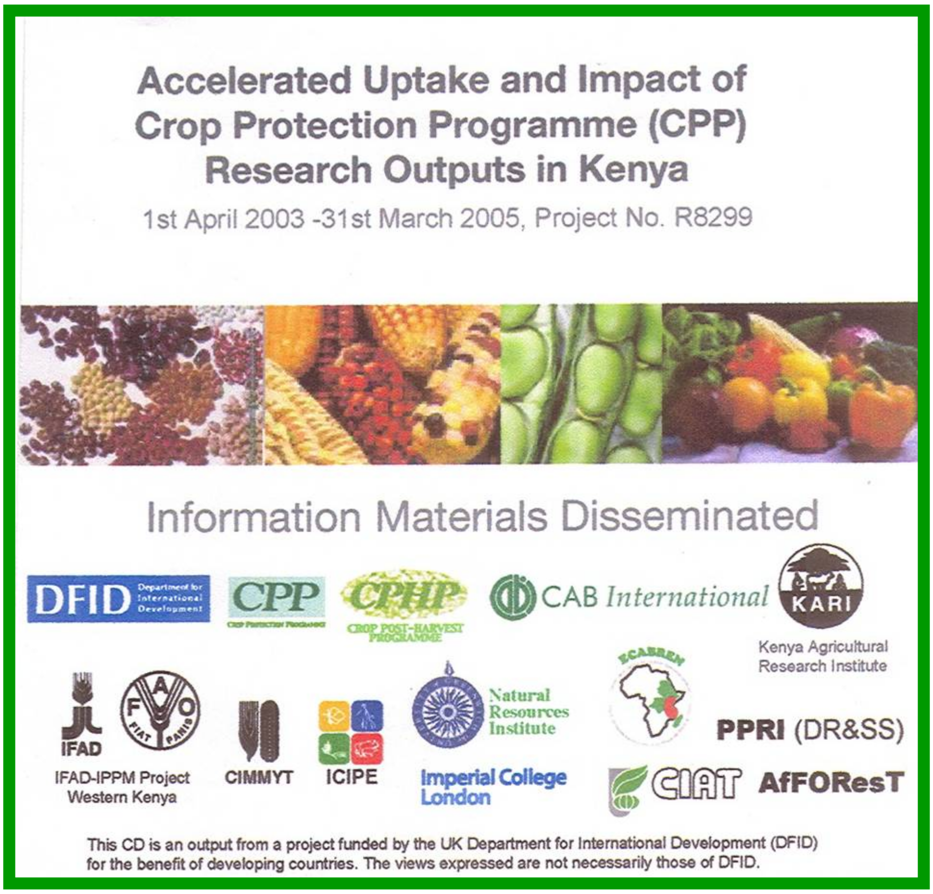

Figure 4. The CD containing the information materials.

Output 3: Farm level impact of adopted CPP research outputs determined

The farm level impact of adopted CPP research outputs was determined through a series of studies that included an assessment of the pre-adoption socio-economic situation and production practices of participating farmers (see Annex 5), a participatory evaluation of new IPPM technologies (see Annex 9) and a post adoption socio-economic survey to assess impact on target farmers (see Annex 6 & 7).

Pre-adoption socio-economic situation and production practices of participating farmers

The crops studied were those selected by the farmers for their study. Input usage, especially fertilizers, was low for all crops compared to the recommended levels. The average family size was 7.5 people for each farm household, while the average land owned was 4.0 acres and the average land cultivated was 3.1 acres (see Annex 7).

This means that a large number of people derive their livelihoods from small land parcels (Table 13).

Table 13. Summary of production characteristics of priority crops in Western Kenya (baseline data)

Production characteristics	Beans	Sweet potato	Maize	Sorghum	Kales
Farmers involved %	89.3	76.4	97.3	42.10	55.3
Average area under crop (acres)	0.66	0.34	1.3	0.71	0.3
Farmers using fertilizers %	27.5	0.0	52.5	3.5	27.7
Average quantity of fertilizer used (kg/acre)	19.2	0.0	64.0	-	10.5
Farmers using hired labour %	25.4	10.7	39.4	8.9	8.5
Yield (Kg/acre)	114	909	470	180	612
Price per Kg (Ksh.)	26.0	4.7	14	15	4.4

The main crop production constraints as reported by the farmers were pests and diseases (Table 14). Pest infestation and disease incidences were reported by more farmers compared to those that reported having attempted to control. The key intervention methods reported were roguing, crop rotation and application of ash. These intervention measures were not as effective as the farmers expected. Roguing reduced the plant population and hence the crop yield. The low intervention rate may be attributed to lack of farmer capacity, lack of the required technology on the pests and diseases not being considered as warranting intervention. Farmers' observations were that the main reason for the low intervention was the non availability of the technologies. Indeed, the farmers who attempted interventions used mainly traditional approaches that had low success rates. This indicated the need for new technologies for addressing the constraints.

Farmers' perceptions of the new technologies

Assessment of farmer perceptions of the technologies indicated preference for the new technologies compared to the indigenous methods of crop production and pest management. Most of the farmers (98%) reported that they approved of the new technologies due to increased yields (51%), less use of pesticides, early maturity, timely, effective and less costly pest and disease management.

The varieties promoted by the project were perceived to produce higher yields and to be more pest and disease resistant. A disadvantage of the varieties is the low availability of the seeds, especially for the sorghum varieties. The push pull technologies are labour intensive and the desmodium seeds are expensive and difficult to obtain. Twenty one percent of the farmers reported that the push pull technologies have high labour requirements, and scarcity of the desmodium seeds was reported by 29% of the farmers.

Farmers reported that their technology requirements for crop production, pest and disease control were being met by the CPP project. Sixty two percent of the farmers reported that there was an increase in access to information. This was particularly with respect to crop production, crop protection, high yielding varieties and market information. There was an increase in timeliness, content, and reach of the information. Access to information was reported to be essential by 98.2% of the farmers. Most of the farmers (85.7%) reported that they were able to produce and sell more due to access to information (see Annex 7).

Impact on input usage by the farmers

There has been an increase in the use of specific inputs indicating more intensive agricultural production. Owned land cultivated increased by 19.5% though it is not clear to what extent this was directly associated with the availability of improved production technologies. The use of pesticides reduced by 25.2% (Table 15) due to the fact that farmers have a wide range of pest control methods, some of which are not based on the use of pesticides. These include improved husbandry practices and resistant varieties.

Table 14. Production constraints and intervention in priority crops

Crop	Constraint	% farmers affected	%Farmers applying different intervention methods
Beans	Bean root rot	73.9	28.1
	Bean blight	58.2	13.2
	Bean mosaic virus	66.8	20.7
	Bean anthracnose	48.2	9.7
	Bean aphids	79.6	32.5
	Bean fly	61.4	12.9
	Lack of planting materials	53.9	44.6
Sweet potato	Sweet potato weevil	82.1	22.7
	Sweet potato butterfly	63.6	8.8
	Lack of planting materials	53.9	43.0
	Sweet potato virus	2.9	1.9
Maize	Maize stalk borer	84.9	40.2
	Maize streak	90.7	52.5
	Maize smut	83.4	53.7
	Maize blight	54.8	8.9
	Maize beetle	65.3	37.1
	Larger grain borer	58.7	39.8
	Striga	20.1	15.1
	Poor quality maize seed	60.2	39.4
	Inadequate capital	81.1	5.2
Sorghum	Sorghum shoot fly	42.5	10.8
	Sorghum midge	43.2	16.2
	Sorghum weevils	44.8	32.8
	Striga weed	48.6	40.9
	Sorghum smut	42.9	27.4
	Limited accessibility to improved varieties	34.7	25.5
Kales	Diamond back moth	71.3	41.5
	Kale aphids	90.4	79.8
	Cut worms	76.6	47.9
	Kale saw fly	19.1	3.2
	Flea beetles	35.1	17.0
	Root rot	71.3	41.5
	Leaf spot	5.3	1.1
	Leaf curl	1.1	1.1
	Poor quality kale seeds	54.3	25.5
	Marketing problem	10.6	7.7
	Inadequate capital	2.1	1.1

Table 15. Average quantities of farm inputs used (per acre)

Type of input	Before	After	% change
Owned land cultivated (acres)	2.86	3.42	19.5
Rented land cultivated (acres)	0.10	0.19	90.00
Fertilizer used (Kg/acre)	63.68	82.42	29.00
Pesticide use (cost in Ksh.))	300.00	224.30	-25.23

Benefits of the new technologies

The technologies promoted by the CPP project concerned husbandry practices, pest and disease control. The effects of the technologies as reported by the farmers were on pest and disease control, yields, income and food self sufficiency. There were significant increases in yield and income of maize and kales (Table 16). Average income is obtained as a product of the average area, yield and price.

Table 16. Impact of the technologies on crops production

	Maize	Kales	Sweet potatoes	Sorghum	Beans
Area (acres)					
Before	1.30	0.30	0.34	0.71	0.66
After	1.68	0.34	0.36	0.71	0.66
% change	29	13	5.88	0.00	0.00
Yield (kg/acre)					
Before	470	612	909	180	114
After	705	674	910	200	114
% change	50	10	0.1	11	0.0
Price (Ksh/kg)					
Before	14.0	4.4	4.7	15.0	26.0
After	14.8	4.2	4.5	13.5	26.5
Income (Ksh)					
Before	13468	808	1453	1917	1956
After	17529	970	1474	1917	1994
% change	30.0	20	1.4	0.0	1.9

The area under cultivation increased for all crops except sorghum and beans. When farmers were asked about the food self sufficiency situation following the adoption of the CPP technologies, 82% indicated that the food self sufficiency had improved. This was attributed mainly to improved maize production. Sixty five percent of the farmers also reported that their incomes had increased due the increased marketed surplus from maize. There were increases in the production of sweet potatoes and sorghum but not of the same magnitude as for maize and kales.

Impact on pest infestation and disease incidence

There was improvement in the pest and disease management by the farmers and efficiency in the use of agricultural resources. Over seventy percent of the farmers reported fewer incidences of pests and diseases. This may be because the project has sensitized the farmers regarding the importance of pest and disease control, as well as provided technologies for reducing pest damage. Eighty eight percent of the kale farmers reported that there was less pest infestation compared to the time before the CPP project. Similarly, 87.2% of the farmers reported that there was less disease incidence (Table 17). Seventy seven percent and 73.3% of the beans and maize farmers reported that there was a reduction in pest infestation while 75.9% and 80.0% respectively reported there was a reduction in disease incidence. However, almost 25% of the farmers reported higher levels of pest infestation and disease incidences. This category of farmers may have had a slow start in application of the new control methods or it could be due to factors beyond their control (see Annex 7).

Table 17. Pest infestation and disease incidence after CPP

Crop	Farmers (%) reporting specified levels					
	Pests			Diseases		
	More	No change	Less	More	No change	Less
Beans	22.4	0.0	77.6	20.7	3.4	75.9
Kales	9.0	2.6	88.4	7.7	5.1	87.2
Maize	24.4	2.3	73.3	17.7	2.3	80.0
Sorghum	9.1	0.0	90.9	9.1	0.0	90.9
Sweet potatoes	25.4	0.0	74.6	20.9	1.5	77.6

Adoption rates of the technologies

The adoption rates were variable for the different technologies. The most preferred were habitat management for the control of stalk borers in maize, pest and disease resistant varieties for beans and sweet potatoes. Early planting for controlling bean fly and bean aphids was also preferred by all the farmers. Cultural practices for the control of pests and diseases in sweet potatoes were not preferred by the farmers and therefore had very low adoption rates. The percentage of farmers attempting control of pests and diseases increased, especially for bean root rot, bean fly, diamondback moth, maize stalk borer and striga weed. Further work would be required to determine actual adoption rates rather than farmers intentions following one season's experimentation.

Impact on information availability

There were improvements in access to information on crop production and protection in terms of timeliness, content and reach (Table 18). The number of farmers using the information increased and similarly the content of information and timeliness improved. Ninety eight percent of the farmers noted that access to information was very important. As a result of access to information which was delivered with the corresponding technologies, farmers were able to obtain more yield and income from the selected crops, as described above.

Table 18. Percentage of farmers reporting change in access to crop protection information

Crop	Change variable	Access improved	Access unchanged	Access essential
Beans	Timeliness	87.9	12.1	98.3
	Content	84.5	15.5	
	Reach	77.6	22.4	
Kales	Timeliness	71.8	28.2	98.7
	Content	51.3	48.7	
	Reach	23.1	76.9	
Maize	Timeliness	74.4	25.6	97.7
	Content	70.9	29.1	
	Reach	73.3	26.7	
Sorghum	Timeliness	81.8	18.2	90.9
	Content	81.8	18.2	
	Reach	63.6	36.4	
Sweet potatoes	Timeliness	73.1	26.9	97.0
	Content	67.2	32.8	
	Reach	68.7	31.3	

Contribution of Outputs to Development Impact

Contribution to DFID's development goals

Achievement of the outputs and thus the project purpose has contributed to the goal of delivering benefits to poor people, by the application of new knowledge in crop protection. In this project the knowledge was new to the thousands of farmers directly reached through farmer field schools, and the many thousands more reached through interaction with the field schools and the intermediary organizations targeted with the dissemination materials.

A number of immediate direct benefits were recognized by the farmers themselves during the project. Through application of new knowledge from outputs of CPP and other projects, farmers were able to obtain average yield increases of 10-15% in sorghum, kale and maize. All three crops are part of the diet of poor rural and peri-urban communities, so by enabling them to produce higher yield, a contribution was made to the goal of food security, and over 80% of farmers felt their food security had indeed been improved.

Farmers also reported increases in marketed surplus. Although the yield increase in kale was modest, 90% of farmers reported an increase in marketed surplus, suggesting that farmers were already producing as much as they wished to consume, allowing most of the additional production could be marketed. A much lower percentage of farmers (16% and 8% respectively) reported increased marketable surplus for maize and sorghum. Interestingly 19% of farmers reported increased marketable surplus of sweet potatoes, despite there being no increase in yield. This may be because other crops were partially replacing sweet potato in the diet. Thus the project also benefited the farmers through increased income from sale of produce.

Farmers were aware that access to crop production and protection information is important for improving productivity and profitability, and felt that through the project, their access had been improved. In all crops farmers reported improvements in the timeliness and content of the information they were provided with through the field schools. Such improvements are not unexpected, because of the way in which farmer field schools provide information to farmers, and because the dissemination materials were prepared in accordance with the needs and preferences they had expressed. Thus there is good evidence that the beneficiaries were using information and knowledge generated by CPP to improve their livelihoods.

The sustainability of the gains cannot be assessed at this stage but some observations can be made. Usage of fertilizer increased in all crops except sweet potatoes, where none is used. The increased use of fertilizer is probably associated with the testing of farmers by improved varieties, though the greatest increase in the proportion of farmers using fertilizer was in beans, where no increase in yield was observed. The cause of this anomaly is not clear, but such a situation could not be sustainable. Conversely, pesticide use did not increase, less than 10% of farmers using them except in kales where 70% of farmers apply pesticide, reflecting the more market driven production. This is a more positive indicator of potential sustainability.

At a broader scale, sustainability of the availability and application of the information and knowledge can be expected on the basis of the approach used. Farmer field schools have been founded elsewhere to be an effective way of improving farmers' decision making and use of information, so those benefits should persist. The wide range of information products disseminated during the project has been made available to many intermediary organizations working in agriculture in Kenya, so we are optimistic that more farmers will be able to use the information in the future. Through the field schools and open days a total of over 5300 farmers have already been reached directly.

Promotion Pathways

The project was directly concerned with promotion, so utilization of the identified pathways was part of the project activities. The CD containing all the dissemination materials also contains the studies under Output 3 of the project, and this has been circulated to intermediary organizations, project partners and providers of the information.

The IFAD funded project under which the farmer field schools used in this project were established is continuing with its second phase, so it is anticipated that further uptake will occur through that pathway. The field school facilitators trained during this project will continue running 66 field schools each season, so there will be ample opportunity for them to introduce the new ideas and technologies to many more farmers.

Publications

The following internal reports have been prepared during the project.

KIMANI, M, NJUKI J and ASABA, JFA (2003) Participatory identification of priority crops. Report of socio-economic activities. Prioritisation of constraints, baseline survey, and identification of dissemination materials. CAB International, Africa Regional Centre, Nairobi, Kenya

KIMANI, M. and NJUKI, J. (2003) IPPM technologies for sweet potato and beans. Report on training workshop 25-29 August 2003. CAB International, Africa Regional Centre, Nairobi, Kenya.

KIMANI, M. and MUSEBE, R. (2004) IPPM technologies for maize and sorghum. Report on training workshop 9-13 February 2004. CAB International, Africa Regional Centre, Nairobi, Kenya.

KIMANI, M. and MUSEBE, R. (2004) IPPM technologies for groundnut and kale. Report on training workshop 16-20 August 2004. CAB International, Africa Regional Centre, Nairobi, Kenya

MUSEBE, R., ODENDO, M., ASABA, J.F., KIMANI, M., KHISA, G and AJANGA, S. (2004). Report of socio-economic activities. Prioritisation of constraints, baseline survey, and identification of dissemination materials.

SIMONS, S. (2003). Project Progress Report. Report on project progress from 3 July to 30 September 2003. CAB International, Africa Regional Centre, Nairobi, Kenya.

SIMONS, S. (2004). Project Progress Report. Report on project progress from 1 October to 31 December 2003. CAB International, Africa Regional Centre, Nairobi, Kenya.

SIMONS, S. (2004). Project Progress Report. Report on project progress from 1 April to 30 September 2004. CAB International, Africa Regional Centre, Nairobi, Kenya.
SIMONS, S. (2005). Project Progress Report. Report on project progress from 1 October to 31 December 2004. CAB International, Africa Regional Centre, Nairobi, Kenya.

The following is a list of the dissemination products produced during the project.

1. Wadudu na magonjwa yanayoshambulia viazi vitamu, CAB International Africa Regional Centre. (Poster)
2. Wadudu na magonjwa yanayoshambulia maharagwe, CAB International Africa Regional Centre. (Poster)
3. Bean stem maggot (bean fly) and its management, International Centre for Tropical Agriculture. (Poster)
4. Funza wa maharage (inzi wa maharagwe) na namna ya kumdhibiti, International Centre for Tropical Agriculture. (Poster)
5. Bruchids/ Bean weevils, International Centre for Tropical Agriculture. (Poster)
6. Vipekecha wa maharagwe, International Centre for Tropical Agriculture (Poster)
7. Bean foliage beetles (Ootheca spp.) and their management, International Centre for Tropical Agriculture. (Poster)
8. Virombosho (Ootheca spp.) na namna ya kuwadhibiti, International Centre for Tropical Agriculture. (Poster)
9. Umewahi kuuona huu ugonjwa? Huu ni Ugonjwa wa madoa ya kijivu kwenye majani ya mahindi (Maize Grey Leaf spot (GLS), CAB International Africa Regional Centre. (Poster)
10. Have you seen this disease? It is Maize Grey leaf spot?, CAB International Africa Regional Centre. (Poster)
11. Striga biology and participatory control approaches: a facilitators/extension guide, Kenya Agricultural Research Institute, International Maize and Wheat Improvement Centre, International Centre for Research in Agroforestry, International Centre for Insect Physiology and Ecology (together with FAO). (Manual).
12. Striga biology and control options: a farmer's pamphlet, Kenya Agricultural Research Institute, International Maize and Wheat Improvement Centre, International Centre for Research in Agroforestry, International Centre for Insect Physiology and Ecology. (Manual)
13. Control of stalk borers in maize crops, Kenya Agricultural Research Institute. (Leaflet)
14. Options for managing maize grey leaf spot, CAB International Africa Regional Centre, Kenya Agricultural Research Institute. (Leaflet)
15. ROOTS: Cassava Mosaic and cassava brown streak virus diseases in Africa: A comparative guide to symptoms and aetiologies, DFID Crop Protection Programme. (Leaflet)
16. Avoiding aflatoxin in groundnuts, DFID Crop Protection Programme, DFID Crop Post Harvest Programme. (Leaflet),
17. Trapping rodents that trash crops, DFID Crop Protection Programme, DFID Crop Post Harvest Programme. (Leaflet)
18. Production of kales (sukuma wiki) and onions using bucket drip Irrigation, Kenya Agricultural Research Institute. (Manual)

19. Farmers’ friends: recognition and conservation of natural enemies of vegetable pests in Zimbabwe Biology Department, Imperial College of Science Technology and Medicine, University of London. (Field Guide)
20. Farmers' friends, Biology Department, Imperial College of Science Technology and Medicine, University of London. (Poster)
21. Pests and diseases of brassicas and tomatoes, NR International. (Poster)
22. Information materials on IPM in beans, ground-nuts, cassava, maize, sweet potatoes, sorghum and kale, CAB International Africa Regional Centre. (CD)

Follow up action

During the crop prioritization exercises, tomato was one of the crops farmers expressed an interest in, as it provides opportunities for income generation. Although not as highly prioritized as kales, tomatoes are popular in peri-urban systems and there has been work funded by CPP and other organization on crop protection in tomatoes. This was the basis for the application for funding for a further season, which CPP approved.

There are opportunities for additional promotion through allowing farmers to ‘tell their story’. Farmers often cite other farmers as their main source of information, partly because they are trusted. FFS open days and exchange visits are one approach to promoting farmer to farmer dissemination, but much larger audiences can be reached through mass media. This radio programmes and videos of farmers’ scientific experience with new information and technologies has already been planned for the one year extension project. The project will add additional materials to the CD, and distribute to a larger number of organizations including through FFS in Tanzania and Uganda.

Where farmers have found a new technology to be beneficial, further action may be required to ensure that any associated inputs are available. For example, the push-pull technology, (being further promoted under R8212) requires desmodium seeds, which are not always available and are considered expensive by farmers. Similarly efforts are required to ensure that the different varieties of the various crops tested by farmers and found to be suitable, are available when they require them. Some work on seed systems is already in progress by ICRISAT and others, including the CABI coordinated ‘Good Seed Initiative’ which has received CPP funding.

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Annexes

Annex 1. Report of Participatory identification of crop production constraints and options for adoption

ACCELERATED UPTAKE AND IMPACT OF CPP RESEARCH OUTPUTS IN KENYA

Activity 1.3: Participatory identification of crop production constraints and options for adoption

R.O. Musebe, M. Kimani, M. Odendo, G. Khisa and S. Ajanga

1.0 Introduction

The purpose of the CPP project is promotion of pro-poor strategies to reduce impact of key pests, improve yield and quality of crops, and reduce pesticide hazards in high potential systems in Western Kenya. Accomplishment of this purpose requires appreciation of the fact that most farmers have extensive, well developed knowledge of their environment, crops and cropping practices. It is also the case that small scale farms are an integration of multiple enterprises that require the management of diverse household resources to meet a range of subsistence, income, and community goals. This project included farmers' criteria and goals when setting the priorities. Farmers who are members of farmer field schools participated in the identification of crops and constraints for each of the three project seasons.

2.0 Objectives of priority setting

Western Kenya has two rain seasons each year suitable for crop production. Therefore the priority setting exercise had to be conducted for each of the seasons to ensure consistency with the production potential and crop production practices. The objectives of participatory identification of constraints and options were:

- To identify priority crops for technology adoption
- To identify constraints and intervention options for selected crops

3.0 Methodology

The participatory identification involved members of farmer field schools. At the start of each crop season all the farmer field schools were visited and those that wished to participate were identified. The crop seasons during which the data were collected were August 2003 for sweet potatoes and beans, April 2004 for maize and sorghum, and August 2004 for kales. A survey questionnaire was administered to all participating farmer field schools. Focus group discussions were conducted with six farmer field schools, two from each district, using a checklist to confirm the prioritization results. These farmers were assembled by the farmer field school facilitators and discussions conducted to identify and agree on priority crops and constraints. Potential options for addressing the constraints were also identified.

Farmers were asked to prioritize crops that they would wish to produce during the subsequent season. The selection of crops was based on importance of the crops to the farmers in terms of meeting their crop production objectives. Among these were food self sufficiency, food security and income generation.

The approach used was a combination of simple group ranking, acclamation and matrix scoring. Farmers were asked to list the criteria that they use to decide the importance of one crop over another. The farmers subsequently provided scores for each of the criteria that they had listed. This was meant to indicate the importance of each of the criteria to the farmers and hence the rank. Using matrix scoring the farmers provided scores for each of the crops on the basis of the criteria. The total score for each crop is an aggregation of the product of criteria ranks and the score for each criteria corresponding to the crop. The crop with the highest score was the one prioritized by the farmers. After selection of priority crops the farmers proceeded to indicate the priority constraints and potential interventions for the selected crops. This involved first listing the constraints and appending a rank for each constraint. The questionnaire and checklist used are provided in the appendix.

4.0. Priority crops and production constraints in Western Kenya

4.1 Selection of crops and constraints for the first season (short rains 2003)

Forty seven farmer field schools participated in the selection exercise. These included 15, 24 and 8 farmer field schools from Bungoma, Busia and Kakamega Districts respectively. The top two crops in the ordered ranking were the same crops as the top two in acclamation- sweet potatoes and beans (Table 1). Beans were high priority in Kakamega District while sweet potatoes were prioritized in Bungoma and Busia Districts. Cassava was prominent in Busia but not in Kakamega and Bungoma. Due to the fact that only two crops could be covered for the short rain season, sweet potatoes and beans were selected. These crops were the same ones that were selected during the focus group discussions.

Table 1: Results of priority setting for the first season (short rains 2003)

Bungoma (15 FFS)	**Ordered ranking**			**Acclamation**		
Crop	Priority 1	Priority 2	Priority 3	Priority 1	Priority 2	Priority 3
Sweet potatoes	**8**	**2**	**1**	**7**	**2**	**1**
Tomatoes	2	0	0	1	1	1
Beans	**1**	**6**	**3**	**5**	**5**	**3**
Groundnuts	1	1	4	1	2	4
Local vegetables	1	2	0	0	0	0
Maize	1	0	0	0	1	2
Sorghum	1	1	2	0	1	0
Busia (24 FFS)	**Ordered ranking**			**Acclamation**		
Crop	Priority 1	Priority 2	Priority 3	Priority 1	Priority 2	Priority 3
Sweet potatoes	**10**	**7**	**2**	**0**	**0**	**5**
Cassava	7	7	3	4	6	3
Beans	**3**	**1**	**10**	**3**	**8**	**2**
Sorghum	2	3	3	3	4	1
Maize	1	0	1	9	3	3
Groundnuts	1	2	0	1	0	4

Tomatoes	0	0	0	0	0	2
Kakamega (8 FFS)	**Ordered ranking**			**Acclamation**		
Crop	Priority 1	Priority 2	Priority 3	Priority 1	Priority 2	Priority 3
Beans	**4**	**3**	**1**	**6**	**1**	**0**
Sweet potatoes	**2**	**1**	**4**	**1**	**1**	**5**
Kales	1	0	0	0	0	0
Local vegetables	1	1	1	0	1	0
Groundnuts	0	2	0	0	4	2
All FFS	**Ordered ranking**			**Acclamation**		
Crop	Priority 1	Priority 2	Priority 3	Priority 1	Priority 2	Priority 3
Sweet potatoes	**20**	**10**	**7**	**8**	**3**	**11**
Beans	**8**	**10**	**14**	**14**	**14**	**5**
Cassava	7	7	3	4	6	3
Maize	2	0	1	9	4	5
Sorghum	3	4	7	3	5	1
Tomatoes	2	0	0	1	1	3
Groundnuts	2	5	4	2	6	10
Local vegetables	2	3	1	0	1	0
Kales	1	0	0	0	0	0

Note: **1**. The table entries show the number of field schools giving a particular priority to the preferred crop. **2**. Total of some entries does not equal the total number of farmer field schools (FFS) because some FFS did not indicate priority 2 and 3 as well as acclamation

The constraints reported for beans and sweet potatoes included sweet potato weevil, sweet potato butterfly, bean root rot and bean fly (Table 2). The reported constraints during priority setting are the same as those identified in the focus group discussions. The options proposed were mainly pest and disease control methods and husbandry practices.

Table 2: Common constraints and intervention options

Crop	**Constraint**	**Intervention options**
Sweet potatoes	Sweet potato weevil Sweet potato virus Sweet potato butterfly Low yielding varieties and lack of planting material Mole rats	Apply ash, covering with soil, crop rotation and roguing Apply ash, crop rotation, roguing Use ash, crop rotation, pesticides Use any available or alternative sources of planting materials Dig holes and drench with water, use rat poison, use traps
Beans	Root rot Bean fly Aphids	Roguing, crop rotation Use of ash and pesticides Use of ash, pesticides

	Blight Bean mosaic virus Anthracnose Low yielding/limited choice of varieties	Roguing, crop rotation Roguing, crop rotation, using ash and use of resistant varieties Roguing, use of ash, pesticides Use of any available varieties

The alternative interventions sought were the use of resistant varieties and chemical control. Pest and disease resistant varieties are supposed to be high yielding, drought resistant and early maturing. The chemicals used should have high efficacy and be packaged in quantities that can be afforded by different categories of farmers having different financial capacities.

4.2 Selection of crops and constraints for the second season (long rains 2004)

The selection exercise was undertaken by 18, 16 and 8 farmer field schools in Busia, Bungoma and Kakamega Districts respectively. Maize and beans were the top two crops in the ordered ranking and acclamation for Bungoma and Kakamega Districts respectively (Table 3). In Busia District sorghum was given priority 1 under ordered ranking, while maize had priority 1 under acclamation. Cassava had the second priority under ordered ranking while maize and sorghum were prioritized as number 2 under acclamation for Busia District. This indicates the importance attached to maize as is the case for the other two districts. The preference for sorghum in Busia District is attributed to agroecological conditions and agricultural potential. Priority rating based on aggregation of all farmer field schools in all the districts vide ordered ranking and acclamation indicated maize as first and sorghum second. Given that only two crops were to be considered, maize and sorghum were selected for the long rain season. Maize was selected for Bungoma and Kakamega Districts, while sorghum was selected for Busia District only.

After selection of priority crops the farmers proceeded to indicate the priority constraints. For maize the key constraints in order of importance were stalk borer, maize streak, striga, lack of quality seeds, maize smut, and maize beetle (Table 4). The constraints for sorghum were birds, striga weed and sorghum smut. Whereas there were other constraints in the production of maize and sorghum farmers reported that they would prefer to have the stated constraints addressed first, then the others thereafter.

Table 3: Results of priority setting for the second season (long rains 2004)

Bungoma (16 FFS)	**Ordered ranking**			**Acclamation**		
Crop	Priority 1	Priority 2	Priority 3	Priority 1	Priority 2	Priority 3
Sweet potatoes	0	1	0	0	0	0
Beans	0	9	2	0	8	0
Groundnuts	1	4	3	0	0	2
Local vegetables	0	1	1	0	1	1
Maize	**15**	**0**	**1**	**9**	**0**	**0**

Kales	0	1	1	0	0	0
Banana	0	0	1	0	0	1
Finger millet	0	0	4	0	0	5
Soya beans	0	0	1	0	0	0
Cassava	0	0	0	0	0	1
Kakamega (8 FFS)	**Ordered ranking**			**Acclamation**		
Crop	Priority 1	Priority 2	Priority 3	Priority 1	Priority 2	Priority 3
Sweet potatoes	1	1	1	1	0	1
Beans	0	7	0	1	3	0
Groundnuts	0	0	2	0	0	2
Local vegetables	0	0	3	1	1	1
Maize	**7**	**0**	**0**	**4**	**0**	**0**
Kales	0	0	1	0	0	0
Busia 18 (FFS)	**Ordered ranking**			**Acclamation**		
Crop	Priority 1	Priority 2	Priority 3	Priority 1	Priority 2	Priority 3
Sweet potatoes	1	4	0	0	1	1
Tomatoes	0	2	0	0	0	0
Beans	1	3	5	2	0	0
Maize	1	0	6	6	4	3
Sorghum	**9**	**2**	**3**	**5**	**4**	**2**
Finger millet	1	1	3	1	0	2
Cassava	3	5	1	1	2	1
Kales	1	0	0	0	0	0
Soya bean	0	1	0	0	0	0
Bambara nut	1	0	0	0	1	0
ALL FFS	**Ordered ranking**			**Acclamation**		
Crop	Priority 1	Priority 2	Priority 3	Priority 1	Priority 2	Priority 3
Sweet potatoes	2	6	1	1	1	2
Tomatoes	0	2	0	0	0	0
Beans	1	19	7	3	11	0
Groundnuts	1	4	5	0	0	4
Local vegetables	0	1	4	1	2	2
Maize	**23**	**0**	**7**	**19**	**4**	**3**
Kales	1	1	2	0	0	0
Sorghum	**9**	**2**	**3**	**5**	**4**	**2**
Finger millet	1	1	7	1	0	7
Cassava	3	5	2	1	2	2
Soya bean	0	1	1	0	0	0
Bambara nut	1	0	0	0	1	0
Banana	0	0	1	0	0	1

Note: **1.** The table entries show the number of field schools giving a particular priority to the preferred crop. **2.** Total of some entries does not equal the total number of farmer field schools (FFS) because some FFS did not indicate priority 2 and 3 as well as acclamation

Table 4: Prioritisation of constraints for maize and sorghum

Crop	Constraint	Intervention options
Maize	Stalk borer Maize streak Striga weed Lack of quality seeds Lack of improved varieties Inadequate capital Maize beetle Larger grain borer Maize blight	Use ash, roguing Roguing Roguing Plant any available seeds Use any variety available Borrow from friends, take loans Use cow dung Use pesticides Roguing
Sorghum	Birds Striga weed Head smut Shoot fly Midge Lack of improved varieties Sorghum weevils Husbandry practices	Scaring Roguing, crop rotation, use of farm yard manure Roguing None None Use any available variety Use ash and pesticides Use own farmer methods

The other constraints that applied to both crops were the marketing problems, storage problems and lack of technical know-how. The interventions suggested for marketing included use of Kenya Agricultural Commodity Exchange (KACE). Local materials were suggested for use during storage. From the available farmer interventions farmers noted that the priority constraints in order of importance were lack of financial resources, lack of technical know how, and pests and diseases.

4.3 Selection of crops and constraints for the third season (short rains 2004)

Prioritization was done on the basis of ordered ranking and acclamation with 29, 14 and 8 farmer field schools in Busia, Bungoma and Kakamega Districts respectively. Groundnuts, kales and cassava were the top crops in the ordered ranking and acclamation for Bungoma, Kakamega and Busia Districts respectively (Table 5). The priority setting exercise thus generated kales for Kakamega District, groundnuts for Bungoma District and cassava for Busia District.

During the training of the facilitators, it was decided that only kales and groundnuts be considered for the short rain season. Cassava was ruled out because its production would extend to the period beyond the end of the project, in which case it would be difficult to obtain information on end of season evaluation. When all the farmer field schools were aggregated, the ordered ranking and acclamation produced kales and groundnuts as the priority crops. Therefore Busia and Bungoma Districts selected groundnuts, while Kakamega District selected kales.

Table 5: Results of priority setting for the third season (short rains 2004)

Bungoma (14 FFS)	**Ordered ranking**			**Acclamation**		
Crop	Priority 1	Priority 2	Priority 3	Priority 1	Priority 2	Priority 3
Beans	6	1	5	5	2	0
Groundnuts	**3**	**2**	**4**	**2**	**2**	**2**
Kales	3	2	0	1	1	1
Tomatoes	0	3	1	0	0	1
Soya beans	0	0	1	0	0	1
Sweet potatoes	1	2	1	0	1	3
Maize	0	1	2	0	0	0
Sorghum	1	1	0	0	1	0
Cassava	0	0	0	0	0	0
Busia (29 FFS)	**Ordered ranking**			**Acclamation**		
Crop	Priority 1	Priority 2	Priority 3	Priority 1	Priority 2	Priority 3
Beans	6	5	6	3	5	1
Groundnuts	0	5	4	0	1	2
Kales	0	3	1	0	1	1
Tomatoes	4	0	2	2	0	0
Soya beans	2	4	4	0	0	2
Sweet potatoes	10	3	2	1	1	3
Maize	3	2	0	8	4	0
Sorghum	1	1	3	0	2	2
Cassava	**3**	**5**	**4**	**3**	**1**	**4**
Kakamega (8 FFS)	**Ordered ranking**			**Acclamation**		
Crop	Priority 1	Priority 2	Priority 3	Priority 1	Priority 2	Priority 3
Beans	1	4	1	0	1	0
Groundnuts	1	1	1	0	1	2
Kales	**3**	**1**	**1**	**0**	**0**	**0**
Tomatoes	0	0	2	0	1	0
Soya beans	1	0	0	-	-	-
Sweet potatoes	1	2	2	0	1	2
Maize	1	0	1	0	0	0
All FFS	**Ordered ranking**			**Acclamation ranking**		
Crop	Priority 1	Priority 2	Priority 3	Priority 1	Priority 2	Priority 3
Beans	13	10	12	8	8	1
Groundnuts	**4**	**8**	**9**	**2**	**4**	**6**
Kales	**6**	**6**	**2**	**1**	**2**	**2**
Tomatoes	4	3	5	2	1	1
Soya beans	3	4	5	0	0	3
Sweet potatoes	12	7	5	1	3	8
Maize	4	3	3	8	4	0
Sorghum	2	2	3	0	3	0
Cassava	**3**	**5**	**4**	**3**	**1**	**4**

Note: **1.** The table entries show the number of field schools giving a particular priority to the preferred crop. **2.** Total of some entries does not equal the total number of farmer field schools (FFS) because some FFS did not indicate priority 2 and 3 as well as acclamation.

The key constraint in kale production in terms of its effect on the crop and availability of intervention measures was the stem rot (Table 6). This was followed by cut worms. The available intervention for stem rot was removal of the affected plant, which lowers the plant population and subsequently the output per unit area. To this end farmers noted that a solution to this problem would improve the output of kales and the corresponding income. Farmers indicated that they would prefer alternative interventions among them being crop rotation and varieties which are pest and diseases resistant.

The main groundnuts constraints as reported by the farmers included the rosette virus disease, cut worms and lack of the preferred varieties (Table 6). The rosette virus disease was considered the most serious in terms of its effect on the crop and available interventions. The farmers did not have any interventions for the disease and indicated that they would want an immediate solution to the disease. Pests, which include cut worms, were considered the second most serious constraint in terms of effect on the crops. Moles and the rosette virus disease were very severe. Only 50% of the farmers reported they attempted control of the insect pests, while up to 60% reported to be controlling moles. The intervention measures and control methods used for the constraints were mainly traditional approaches. The main problems of the intervention measures used were that they were labour intensive and expensive. The farmers indicated that their preference would be to have the constraints addressed in the order in which they had prioritized them.

Table 6: Priority constraints for kales and groundnuts

Crop	**Constraint**	**Intervention option**
Kales	Aphids Cut worms Caterpillars Diamond back moth Stem rot Root rot Poor quality seeds Marketing	Apply ash and pesticides Hand picking, apply ash & pesticides Apply ash and pesticides Apply ash and pesticides Roguing Roguing Use any available seeds None
Groundnuts	Groundnut aphids Groundnut hopper Rosette virus disease Black leaf spot Lack of high yielding varieties High labour requirement Wilting Unfavourable weather condition Mole rats Thrips Squirrels Marketing	Apply ash and pesticides None None None Use any available variety Hire labour and family labour None None Trapping, flooding with water None Scaring None

Farmers reported that the alternative interventions were crop rotation and the use of improved varieties. The desirable characteristics for the alternative interventions would be the availability of suitable crops for the rotations as well as high yielding and disease resistant varieties. In the event that these were provided the farmers would improve production of the groundnuts.

Appendix 1: Questionnaire for priority crops and constraints

Priority Setting of Constraints and Issues in Crop Production
District ---
Name of farmer field school --
Name of facilitator --

A. Farmer objectives on crop production
1…………………………………………………………………..
2…………………………………………………………………..
3…………………………………………………………………..
4…………………………………………………………………..
5…………………………………………………………………..

B. Criteria that farmers use to measure whether any of these objectives are met (put criteria under each objective)
Objective 1………………………………………………………………………………..
………………………………………………………………………………………………
Objective 2………………………………………………………………………………..
………………………………………………………………………………………………..
Objective 3………………………………………………………………………………..
……………………………………………………………………………………………….
Objective 4………………………………………………………………………………..
………………………………………………………………………………………………
Objective 5………………………………………………………………………………..
……………………………………………………………………………………………….

C. Other criteria that farmers use to decide importance of one crop over another
1………………………………….. 2…………………………….3……………………
4…………………………………...5…………………………….6……………………

D. Score of criteria based on importance to farmers (based on a score of 10)

Criteria	Score

E. Priority crops based on criteria above (Rank on a scale of 10 with the highest priority getting 10 and the lowest 1)

Crop	Criteria						
	1…….	2…….	3…….	4…….	5…….	6…….	7……

F. Calculating scores for each crop (To calculate score for each crop, multiply the rank for each crop under each criteria with the score for that criteria)

Crop	Criteria							Overall score	Expected order of rank
	1…	2…	3…	4 …	5…	6…	7…		

G. For the top three crops identify the priority constraints and the reasons why farmers give these priority (rank on a scale of 10 with the highest getting 10 and the lowest 1))

Crop 1……………………………………………………….

Problem/constraint	Rank	Reason

Crop 2……………………………………………………….

Problem/constraint	Rank	Reason

Crop 3………………………………………………….

Problem/constraint	Rank	Reason

Appendix 2: Focus group discussions check for long rains 2004

1. Describing the kale, sorghum, maize, sweet potatoes and groundnuts production system
    - Kale and groundnut production calendars (activity, time, constraints, who does it, agronomic practices, specifications)
    - Input use, pest and disease control
    - Production statistics for kale and groundnuts under different management strategies (monocroped/intercropped, with/without manure or fertilizer, different varieties etc)
    - Resource endowment (what they consider a rich, medium or poor person should have)
2. Constraints and current interventions
    - Confirming the priority constraints and their rank in importance –in terms of effect on crop, available interventions etc
    - Interventions currently being carried out to solve these constraints
    - Proportions of farmers using interventions
    - Evaluation of interventions
        - ✓ Determine evaluation criteria
        - ✓ Evaluate current interventions based on these criteria (*** high **medium * low score)
3. Current information sources
    - Identify current information sources
    - Determine evaluation criteria
    - Evaluate information sources based on criteria ((*** high **medium * low score)
4. Alternative interventions (technologies, information etc)
    - Which constraints still require alternative interventions?
    - Possible alternative interventions (resistant varieties, chemical control, IPM, biological control, cultural control etc)
    - Key considerations for adoption of these potential alternatives
    - Key information requirements
    - How to measure success of the interventions-how will we know whether it has worked or not?

Intervention	Possible constraints to use/adoption	Key information requirements	Indicators for success

5. Key information requirements (content, format, channels)
    - Identify possible channels/formats
    - Identify possible constraints in using information channels/formats
    - Evaluation of channels/formats

Channel/format	Possible constraints to use/adoption	Indicators for success

Annex 2. Report of training courses

First short season training course August 2003

Venue and date

The training course took place at the Paradise Hotel, Busia between 25 and 29 August 2003.

Participation

Thirty-three participants attended the training course. These included farmer Field School facilitators from Kakamega, Busia and Bungoma districts. Resource persons included scientists and socio-economists from KARI, CABI and IPPM FFS Western Kenya project.

Course objectives

The objectives of the IPPM training course were to:

- Train field school facilitators on the agronomy, pest and disease management in beans and sweet potato
- Evaluate dissemination materials for beans and sweet potato pest and disease management
- Train facilitators on participatory budgeting and evaluation of IPPM technologies

Course program and content

The course ran for one week and the program is attached in annex 1 (course programs)

Course content

The course had 3 themes:

Theme 1: Sweet potato and beans IPPM

- Common diseases of beans and their management
- Sweet potato agronomy
- Common insect pests of beans and their management
- Beans agronomy
- Common insect pests of sweet potato and their management
- Common diseases of sweet potato and their management
- Bean post harvest management and utilization
- Sweet potato post harvest and utilization

Theme 2: Evaluation of IPPM technologies

- Collection of baseline data for impact assessment
- Participatory partial budgeting
- Scoring methods

Theme 3: IPPM dissemination

- Evaluation of sample sweet potato and bean pest and disease dissemination materials

Course presentations

The following technical papers were presented during the workshop. Every presentation was followed by a session of questions, plenary discussions or group work as appropriate.

- Common diseases of sweet potatoes and their management by Margaret Makello (KARI)
- Pests of sweet potatoes (*ipomea batatas)* in Kenya and their control by Margaret Mulaa (KARI)
- Sweet potato agronomy by Ndolo P.J. (KARI)
- Sweet potato post harvest management and utilization by Rhoda Nungo (KARI)
- Common diseases of beans and their management by Sammy Ajanga (KARI)
- Common pests of beans and their management by G.Oduor and W. Ogutu (CABI)
- Common food bean production in Western Kenya by Rachier G.O. (KARI)
- Methods for technology evaluation by Jemimah Njuki (CABI)
- Collection of baseline data for impact assessment by J. Njuki (CABI) and M. Odendo (KARI)

Work plans

The facilitators grouped themselves according to their districts and prepared work plans for the short season. Each facilitator planned to work with two field schools. The season would start with planting of beans and sweet potato vines. KARI would supply the planting materials for both beans and sweet potato. The facilitators would include the learnt technologies in the FFS curriculum. Some would be handled as special topics while others would become treatments in the field school study plots for comparing with farmers practice. In the middle of the season, each field school would hold a field day to evaluate the performance of the various technologies and also to share experiences and results with the wider community and intermediaries such as NGOs and church based agricultural organisations. During the field school season, the facilitators would distribute information and dissemination materials to farmers and intermediaries. The facilitators would at the same time collect baseline IPPM data as well as carry out participatory partial budgeting exercises using the methodology received from the training.

First long season training course February 2004-09-14

Venue and date

The training course took place at Bishop Nicholas Stam Pastoral Centre, Kakamega from 9 to 13 February 2004

Participation

Thirty-three participants attended the training course. These included farmer Field School facilitators from Kakamega, Busia and Bungoma districts. Resource persons included scientists and socio-economists from KARI, ICIPE, ICRISAT, CABI and IPPM FFS Western Kenya project.

Course objectives

The objectives of the IPPM training course were to:

- Train field school facilitators on the agronomy, pest and disease management in maize and sorghum
- Evaluate dissemination materials for maize and sorghum pest and disease management
- Train facilitators on participatory budgeting and evaluation of IPPM technologies

Course program and content

The course ran for one week and the program is attached in annex 1 (course programs)

Course content

The course had 3 themes:

Theme 1: Maize and sorghum IPPM

- Introduction to maize varieties and maize agronomy
- Common diseases of maize and their management
- Common insect pests of maize and their management
- Sorghum agronomy
- Common diseases of sorghum and their management
- Striga management in maize and sorghum

Theme 2: Evaluation of IPPM technologies

- Collection of baseline data for impact assessment
- Methods for technology evaluation

Theme 3: IPPM dissemination

- Evaluation of sample maize and sorghum pest and disease management dissemination materials

Course presentations

The following technical papers were presented during the workshop. Every presentation was followed by a session of questions, plenary discussions or group work as appropriate.

- Sorghum production by J.G. Kibuka, ICRISAT
- Maize production in Western Kenya by John Achieng, KARI Kakamega
- Maize pests and their management by G.N. Kibata, J.N. Mbugua, C.M. Ngatia, K. Mutambuki and P.W. Lihhayo, KARI-NARL
- Sorghum production in the lake region by C. Mburu, KARI Kakamega
- Important maize diseases in Western Kenya by S. Ajanga, KARI Kakamega
- Striga management in maize and sorghum by O.M. Odongo, KARI Kakamega
- Habitat management for Striga and maize stem borer control (Push-pull) by Z. Khan, ICIPE
- Methods for technology evaluation by R. Musebe, CABI and M. Odendo, KARI Kakamega
- Collection of baseline data for impact assessment by R. Musebe, CABI and M. Odendo, KARI Kakamega

Work plans

Facilitators from Kakamega and Bungoma districts planned to run maize field schools while those from Busia district planned to run both maize and sorghum field schools. In all the districts 80% of the field schools would be new i.e. those that did not participate in the short season crops (beans and sweet potato) while 20% would be old schools. KARI Kakamega planned to provide maize and sorghum seeds according to the varieties identified in the course to have better agronomic qualities and resistance to various diseases. The facilitators would include the learnt technologies in the FFS curriculum. Some would be handled as special topics and others as treatments in the field school study plots for comparing with farmers practice. In the middle of the season, each field school planned to hold a field day to evaluate the performance of the various technologies and also to share experiences and results with the wider community and intermediaries such as NGOs and church based agricultural organisations. During the field school season, the facilitators would distribute information and dissemination materials to farmers and intermediaries. The facilitators would also collect baseline IPPM data as well as carry out participatory partial budgeting exercises using the methodology received from the training.

Second short season training course

Venue and date

The training course took place at Bishop Nicholas Stam Pastoral Centre, Kakamega from 16 to 20 August 2004

Participation

Thirty-three Farmer Field School facilitators from Kakamega, Busia and Bungoma districts attended the training course. Resource persons included scientists and socio-economists from KARI, CABI and IPPM FFS Western Kenya project.

Course objectives

The objectives of the IPPM training course were to:

- Train field school facilitators on the agronomy, pest and disease management in ground nuts, kales and cassava
- Evaluate dissemination materials for groundnuts, kales and cassava pest and disease management
- Train facilitators on participatory budgeting and evaluation of IPPM technologies

Course program and content

The course ran for four days and the program is attached in annex 1 (course programs)

Course content

The course had 3 themes:

Theme 1: Groundnuts, kales and cassava IPPM

- Introduction to groundnuts varieties and ground nuts agronomy
- Common diseases of groundnuts and their management
- Common insect pests of groundnuts and their management
- Cassava agronomy and cassava varieties
- Common diseases of groundnuts and their management
- Common insects of cassava and their management
- Kale agronomy and kale varieties
- Common diseases of kales and their management
- Common insect pests of kales and their management

Theme 2: Evaluation of IPPM technologies

- Collection of baseline data for impact assessment
- Methods for technology evaluation

Theme 3: IPPM dissemination

- Evaluation of sample groundnuts, kales and cassava pest and disease management dissemination materials

Course presentations

The following technical papers were presented during the workshop. Every presentation was followed by a session of questions, plenary discussions or group work as appropriate.

- Cassava management practices by R.O. Odero, KARI Kakamega
- Common pests of kales and their management by G.N. Kibata, KARI NARL
- Agronomic practices and varieties of kales by Inzaule S.S.S KARI Kakamega
- Common pests of groundnuts and their management by W. Ogutu CABI
- Common diseases of groundnuts and their management by G.O. Rachier, KARI Kakamega
- Common pests of cassava and their management by W. Ogutu CABI.
- Disease of kales and collards and their control by Inzaule S.S.S. KARI Kakamega
- Introduction to groundnut varieties and agronomy by G.O. Rachier, KARI Kakamega
- Collection of baseline data for impact assessment by R. Musebe, CABI and M. Odendo, KARI Kakamega

Work plans

Facilitators from Kakamega and Bungoma districts planned to run ground nuts and kales field schools while those from Busia district planned to run kale field schools. Cassava was dropped at the planning stage as it would take more than six months to mature and the FFS activities within the project would end in four months time from the training course. KARI Kakamega planned to source and provide groundnut and kale seeds according to the varieties identified in the course to have better agronomic qualities and resistance to various diseases. The facilitators would include the learnt technologies in the FFS curriculum. Some would be handled as special topics and others as treatments in the field school study plots for comparing with farmers practice. In the middle of the season, each field school planned to hold a field day to evaluate the performance of the various technologies and also to share experiences and results with the wider community and intermediaries such as NGOs and church based agricultural organisations. During the field school season, the facilitators would distribute information and dissemination materials to farmers and intermediaries. The facilitators would also collect baseline IPPM data as well as carry out participatory partial budgeting exercises using the methodology received from the training.

Course programs

1st short season (Sweet potato and beans), 25-29 August 2003

	8.30 – 10.30	**10.30-11.00**	**11.00-1.00**	**1.00-2.00**	**2.00-3.30**	**3.30-4.00**	**4.00-5.30**
Monday	Welcome address, Introduction to workshop objectives (M. Kimani/G. Khisa)	Tea	Results of the priority setting and Focus Group Discussions (J Njuki /M.Odendo	Lunch	Introduction to bean varieties, and bean agronomy (Gideon Rachier)	Tea	Bean agronomy (Gideon Rachier)
Tuesday	Common diseases of beans and their management (Sammy Ajanga)		Common pests of beans and their management (George Oduor/Walter Ogutu		Bean post harvest management and utilization (George Oduor/Walter Ogutu)		Introduction to SP varieties and agronomy (P. Ndolo)
Wednesday	Sweet potato agronomy (P.Ndolo)		Common diseases of sweet potatoes and their management (Margaret MaKello)		Common pests of sweet potatoes and their management (Margaret Mulaa)		Sweet potato post harvest management and utilization (Rhoda Nungo)
Thursday	Collection of baseline data for impact assessment (J.Njuki/M Odendo)		Methods for technology evaluation (J.Njuki/M.Odendo)		Methods for technology evaluation (J. Njuki/M.odendo)		Methods for technology evaluation (J. Njuki/M.odendo)
Friday	Planning session (M. Kimani/G. Khisa)		Planning and wrap up (M. Kimani/G. Khisa)				
Overall facilitation: Martin Kimani and Godrick Khisa							

1st long season (Maize and sorghum), 19-13 February 2004

	8.30-10.30	**10.30-11.00**	**11.00-1.00**	**1.00-2.00**	**2.00-3.30**	**3.30-4.00**	**4.00-5.30**
Monday	Registration Introduction to workshop objectives (M.Kimani and S. Ajanga)	Tea	Results of the priority setting and Focus Group Discussions (R. Musebe/M.Odendo)	Lunch	Results of baseline survey for the short season crop (R. Musebe/M.Odendo)	Tea	Introduction to maize varieties, and maize agronomy (John Achieng)
Tuesday	Common diseases of maize and their management (Sammy Ajanga)		Common diseases of maize and their management (Sammy Ajanga)		Common pests of maize and their management (John Mbugua)		Common pests of maize and their management (John Mbugua)
Wednesday	Sorghum agronomy (Alowodi)		Common diseases of sorghum and their management (Christopher Mburu)		Common pests of sorghum and their management (W. Ogutu)		Striga management in maize and sorghum (O.M. Odongo)
Thursday	Collection of baseline data for impact assesment (R. Musebe/M Odendo)		Methods for technology evaluation (R. Musebe/M.Odendo)		Methods for technology evaluation (R. Musebe/M.odendo)		Methods for technology evaluation (R. Musebe/M.odendo)
Friday	Planning session (M. Kimani)		Planning and wrap up				

2nd short season (Kales, groundnuts and cassava), 16-20 August 2004

	8.30-10.30	**10.30-11.00**	**11.00-1.00**	**1.00-2.00**	**2.00-3.30**	**3.30-4.00**	**4.00-5.30**
Monday 16/8/04	Registration Introduction to workshop objectives (M.Kimani and S. Ajanga)	Tea	Results of priority setting and FGD. Results of baseline survey for the long rain season (R. Musebe and M. Odendo	Lunch	Introduction to ground nut varieties and agronomy(Rachier)	Tea	Common diseases of groundnuts and their management (Ajanga/Rachier)
Tuesday 17/8/04	Common diseases of ground nuts and their management (Ajanga/Rachier)		Common pests of groundnuts and their management (Ogutu)		Cassava agronomy varieties and disease management (Obiero)		Common pests of cassava and their management (Ogutu)
Wednesday 18/8/04	Kale agronomy and varieties(Inzaule)		Common diseases of kale and their management (Inzaule)		Common pests of kales and their management (Kibata)		Common pests of kales and their management (Kibata)
Thursday 19/8/04	Methods for technology evaluation (Musebe/Odendo)		Evaluation of information dissemination materials (Asaba/Nkonu)		Planning session (Kimani/Khisa)		Wrap up and close (Kimani)
Friday 20/8/04	Protocls for end of project evaluation (Musebe/Odendo)		Protocls for end of project evaluation (Musebe/Odendo				

Annex 3. List of training course participants

The following participated in the three training courses.

Name	District
1. Francis were	Busia
2. Charles Chweya	Busia
3. Patrick Odunga	Busia
4. Rose Ngoya	Busia
5. George Otando	Busia
6. Godfrey Ooko	Busia
7. George Gare	Busia
8. Rev. Jotham Were	Busia
9. Polycarp Ndubi	Busia
10. Mark Mungania	Busia
11. Simon Mwombe	Busia
12. Joseph Netia	Busia
13. Josephat Bwire	Busia
14. Mafundo Ambrose	Busia
15. Antonina Oggema	Busia
16. Buluma Edward	Busia
17. Kizito Chweya	Busia
18. Charles Oduori	Busia
19. Wilson Odouri	Busia
20. Lillian J Onkware	Bungoma
21. Gregory Nalianya	Bungoma
22. Jared Wandete	Bungoma
23. Clement Waswa	Bungoma
24. Richard Situma	Bungoma
25. Henry Mukongolo	Bungoma
26. Joseph Welela	Bungoma
27. Churchil Amatha	Bungoma
28. Orwa Dan	Bungoma
29. Arnest Maina	Kakamega
30. Ruth Apondi	Kakamega
31. John Inganga	Kakamega
32. Pius Koko	Kakamega
33. Anne Chegugu	Kakamega

Annex 4. List of technologies disseminated to field school facilitators

Crop	Problem	Technologies disseminated	Source
Bean	Common pests of bean and their management		
	Bean fly	Cultural Control ▪ Avoiding overlapping or successive bean cropping ▪ Crop rotation with non-host plants ▪ Proper sanitation which include removal of volunteer plants, destruction of crop residues ▪ Early planting to avoid peak infestation periods ▪ Mulching to cover the cotyledons making them inaccessible for oviposition. ▪ Ridging/hilling or soil mounding of the crop 2-3 weeks after germination Chemical Control ▪ Pre-sowing application of commonly used systemic insecticides, such as carbofuran, aldicarb and phorate, to the soil alongside the seeds helps protect young seedlings when they are most vulnerable to bean fly infestation ▪ Seed coating of systemic chemicals, such as carbofuran and carbosulfan before sowing. ▪ Foliar application or spraying of chemical insecticide at weekly intervals starting soon after germination through the first four weeks	R7965 Promotion of IPM strategies of major insect pests of Phaseolus beans in hillside systems in eastern and southern Africa
	Aphids	Cultural Control ▪ Localized aphid infestations can be handpicked or pruned out ▪ Always remove all crop residues immediately after harvest. ▪ Remove any aphids discovered on transplants before planting. Organic/Biological Control ▪ Insecticidal soap, horticultural oil, or Neem oil ▪ Predators, such as lady beetles, damsel bugs, lacewing larvae, and flower fly larvae, and parasitic wasps help keep aphid populations in check. ▪ Spray the plants with Neem oil. Chemical control ▪ Apply a registered insecticide when insects are first noticed such as	CIAT

		Diazinon, Rhodocide, Brigade, Talaster, Orthene, Metasystox, Folimat and Dimethoate when insects are first noticed. ▪ Dress seeds with gaucho before planting	
	Root -rot	▪ Resistant cultivars (KK8, KK15, KK22, GLP 585,GLP X 92) ▪ Filed sanitation ▪ Intercropping with cereals ▪ Seed dressing with Benomyl and Dithane or Mancozeb ▪ Rotation ▪ Hilling up	CIAT R7568 Characterisation and epidemiology of root rot diseases caused by *Fusarium* and *Pythium* spp. in beans.
	Anthracnose	▪ Plant seeds that are free of anthracnose ▪ Treat seeds with recommended fungicide (diazinon, captan, thiophermate-methyl	R7569 Participatory promotion of disease resistant and farmer acceptable Phaseolus beans in southern highlands of Tanzania
	Bean production constraints (agronomic)	▪ In high soil fertility areas plant GLP 2, GLP 24 ▪ In low soil fertility areas plant GLP 585, GLP X92 ▪ Early preparation: one month before planting ▪ Deep plough: hand hoe, oxen plough or tractor. ▪ Organic material rots down, remove weeds and big clods. ▪ Improves ▪ High quality seed: Certified or own seed ▪ Certified seed: check germination ▪ Own seed: ▪ Clean and unbroken - emergence, growth vigour & disease pest control ▪ Maize beans inter crop predominates. Common intercropping patterns are: ▪ Maize: planted in rows spaced at 75 x 30 cm ▪ Beans: randomly planted within ▪ maize rows ▪ Double rows of beans within maize ▪ rows ▪ Same row/hill as maize ▪ Same row/hill as maize and within maize rows Fertiiser ▪ Apply 100 kg ha-1 DAP /TSP fertilizer + 5 tons ha-1 farmyard manure (FYM) or compost. ▪ FYM spread in field before ploughing or put in the planting hole as DAP.	Common food bean production in Western Kenya

		▪ Good quality manure is desirable. ▪ Green manures: Mucuna and canavalia also increase soil productivity. ▪ GM are planted the season before and left on the soil surface.	
Sweet potato			
	Sweet potato production constraints (agronomic)	Land preparation ▪ Deep cultivation is essential for ideal root growth and expansion, higher yields ▪ Land must be well prepared early in advance for planting ▪ Avoid stony soils as they limit root expansion ▪ Ridges and mounds are important for root expansion, high Planting ▪ Plant any time there is sufficient moisture in the soil ▪ Early planting gives better yield, reduces weevil infection ▪ Late planting exposes crop to drought and weevil damage ▪ Cuttings should be free from diseases or pests ▪ Plant the top 25-30cm of the vine. Middle or basal portions may be used if there is shortages of tip portions ▪ Insert 2/3 of cutting into the soil ▪ Spacing: 70-100 cm x 30-50 cm Varieties ▪ Choice depends on maturity period, yields, underground storability, taste of cooked roots, resistance to diseases, market demand ▪ Widely grown local varieties (Mar Ooko, Kalamb Nyerere, Bungoma, Nyandere, Jayalo) ▪ Released varieties (Kemb 10, SPK004, SPK013, KSP20 and Mugande) ▪ New varieties: 91/92, Mwavuli, 566682/02, Salyboro Weeding, hilling up, vine lifting ▪ The plant gives an early ground cover hence two or three weedings may be enough. ▪ The crop should be kept clean during the first two months after planting. ▪ Hilling up to reduce weevil damage when storage roots are exposed or when the soil is dry or cracked. ▪ Vine lifting increases yields where one time harvest is practicedIntercropping or rotation	R8040 Rapid multiplication and distribution of sweet potato varieties with high yielding and ß-carotene content R8167 Promotion of sustainable sweet potato production and post-harvest management through farmer field schools in E. Africa

		▪ Sweetpotato is mainly grown in pure stands ▪ Intercropping is done where population pressure on land is high. ▪ Intercropping with short crops or legumes is recommended. ▪ Sweetpotato is commonly relayed with maize ▪ Sweetpotato does well following either cereals such as maize, sorghum, finger millet, or legumes such as beans Harvesting ▪ Piecemeal harvesting is common as roots may not be stored fresh for more than a few days ▪ Maturity of crop is detected by the cracks in the ground ▪ Large roots are harvested first ▪ First roots are ready 3-5 months after planting	
	Sweet potato viruses		R7492 Promotion of and technical support for methods of controlling whitefly-borne viruses in sweet potato in East Africa R8243 Working with farmers to control sweet potato virus disease in East Africa
	Sweet potato weevil	Cultural control ▪ Sanitation which include destruction of infested crop material and crop residues to lower pest populations, ▪ Early planting ▪ Crop rotation, ▪ Selection of clean planting material, and ▪ Timely harvesting to avoid dry period ▪ Plant away from weevil infested fields ▪ These Chemical Control ▪ Chemicals can be used at both pre-plant and post-plant applications.	CIP
	Sweet potato butterfly	Cultural methods ▪ Hand pick and destroy nests of young caterpillars. It is very effective when started early, before the caterpillars have dispersed. Once the caterpillars have dispersed, more drastic measures are needed. For	CIP

		effective control, hand picking should cover large areas, including neighbouring fields, to avoid rapid re-infestations ▪ Use of clean planting materials - Select planting material from clean fields to avoid carrying the pest larvae and/or eggs to new fields. ▪ Proper sanitation - Completely remove older sweet potato fields after harvesting and check volunteer plants which may encourage pest population build-up. ▪ Keeping distance between plots - New sweet potato fields should not be planted next to older infested fields. This discourages adult sweet potato butterflies flying over to the new fields and ▪ Early planting and harvesting of sweet potato - Early planting and harvesting of sweet potato enables the crop to escape heavy attacks since the pest commonly attains pest status during the dry season Chemical control Recommended chemicals include the following: ▪ Fenitrothion or fenvalerate ▪ Permethrin ▪ Dimethoate ▪ Carbaryl and ▪ Pyrethroids	
	Sweetpotato Mild Mottle Virus ((SPMMV)	▪ Planting virus-free propagating materials and sanitation should be used for control	
	Sweetpotato Feathery Mottle Virus (SPFMV)	▪ Use of virus-free planting material and sanitation. Resistant clones have been reported.	
	Soft Rot *Rhizopus stolonifer, Mucor* sp.	▪ Washing storage roots is especially conducive to rot.	
Maize	Striga	▪ Use of tolerant varieties, KSTP 94 - maize variety, Seredo and SRN 39 - Sorghum (1525403, 1525395) ▪ Hand pulling and weeding before and just after flowering. Striga forms mature seeds 2 weeks after flowering so weeded striga must be collected and burned ▪ Crop rotation with trap crops which stimulate striga germplasm but do not support striga plants (e.g. soyabeans, cowpeas, groundnuts,	R6921 Improved methods for the management of Striga: Nitrogen, tolerance, screening and cultural practice. R7564 Integrated management of Striga species on cereal crops in Tanzania

		desmodium) resulting in death of the striga seedlings ▪ Use of fertilizer - organic (FYM), - Organic nitrogen fertilizer ▪ Use of certified seed or striga free seed especially local planting material ▪ Intercropping with non host crops e.g. legumes which shade striga plants and their growth is reduced so no seeds are produced e.g. maize/cowpea/groundnuts ▪ Use of green manure e.g. the velvet bean and sunhemp ▪ Planting of catch crops (e.g. maize, sorghum) and trap crops in alternate rows then incorporate, catch crop in soil or use as fodder before striga flowers and seeds	R8212 Integrated pest and soil management to combat Striga, stemborers and declining soil fertility in the Lake Victoria basin R7405 Development of weed management in maize-based cropping systems
	Maize streak virus		R7429 Promotion of the improved maize streak virus tolerant variety Longe 1, to resource poor farmers in Uganda
	Maize grey leaf spot	▪ Rotation ▪ Deep ploughing	R7566 Management strategies for maize grey leaf spot *(Cercospora zeae-maydis)* in Kenya and Zimbabwe
	Ear-rot	▪ Early planting ▪ Early harvesting ▪ Sorting out ▪ Good storage management ▪ Variety ▪ Crop management	R6582 Epidemiology, toxicology and management of the maize ear-rot complex in African farming systems. R8220 Improving farmers' access to and management of diseases resistant maize cultivars in the southern highlands of Tanzania
	Stalk borer	Cultural practices ▪ Destruction of crop residues ▪ Early planting Biological control ▪ Use of parasitoids and predators ▪ Augmentative releases of parasitoids effective against C. partellus in Coast province Habitat management (push & pull strategy)	R7955 Strategies for feeding smallholder dairy cattle in intensive maize forage production system and implications for integrated pest management R8212 Integrated pest and soil

		▪ Uses pull plants (napier and sudan grass) as trap crops and molasses or desmodium grass as repellent plants Indigenous technical knowledge (ITK) ▪ Ash or soil applied to plant funnels Chemical insecticide (applied as dilute or foliar spray applied at 7 - 8 leaf stage) ▪ Endosulfan (Thiodan) ▪ Trichlorphon (Dipterex) ▪ Pyrethroids (Ambush) ▪ Pyethrins(Pye marc or Pye dust) Disadvantage include user safety and effect to environment and non-targets	management to combat Striga, stemborers and declining soil fertility in the Lake Victoria basin.
	Maize production constraints (agronomic)	Planting ▪ Start with on-set of rains ▪ Long season March ▪ Short season early-mid September Spacing ▪ 75x30cm in wet parts of the region ▪ 90x30cm in the drier parts of the region ▪ Plant 3 seeds per hole and thin Fertiliser ▪ 54 kg of N and 57 Kg of P205 (DAP at planting, CAN and urea at knee high and FYM –handful per hole) Weeding ▪ 1^{st} weeding 3-4 weeks after emergency ▪ 2^{nd} weeding 4 weeks later Varieties ▪ Long rains H614, 625, 626, 628, KH 637A, KH634A, KSTP94 ▪ Short rains H511,512,513	R8219 Improved access to appropriate inputs for integrated maize crop management by small-scale farmers in Embu and Kirinyaga districts, Kenya
Sorghum			
	Shoot fly and midges	▪ Date of sowing - Synchronous and timely sowing of cultivars with similar maturity over large areas ▪ Planting density and thinning - Use a high seeding rate helps to maintain optimum plant stands ▪ Removal of alternative hosts ▪ Crop rotations and cropping systems - Rotate sorghum with cotton, groundnuts, sunflowers or sugarcane. selected cropping system ▪ Field sanitation – ▪ Fallowing and close season ▪ Host-Plant Resistance	R7572 Management of key insect pests of sorghum in southern and eastern Africa: developing IPM approaches with expert panels

		▪ Local lines, Seredo and ICRISAT IS 15107 ▪ Chemical Control - chlorpyriphos, deltamethrin, dichlorvos, endosulfan, fenvalerate, malathion, monocrotophos, - ▪ Integrated Pest Management	
	Smut	▪ Removal by uprooting the infected plants/ heads from the field and preferably destroys them by burning. The uprooted material should be dried away from livestock. Avoid leaving the infected sorghum/ maize plants in the field or feeding them to livestock. ▪ Harvesting and threshing are the most likely time for the grains to be contaminated with smut spores when the heads are shaken about. Seed collection should therefore be made before these operations take place. ▪ The collected seed should be kept away from the rest of the harvest, especially during harvesting and threshing when the smut spores are being released.	R7518 An investigation into the epidemiology and control of fungal pathogens of sorghum in semi-arid production systems in East Africa.
Kales			
	Diamond back moth (*Plutella xylostella*)	▪ Pesticides (Use of pesticides namely Bifenthrin (Brigade 25 Ec) Deltamethrin (Decis 2.5 Ec) Chlorfenapyr (Secure 36% SC) Fipronil (Regent 50 SC) Thiomethoxan (Actara 25 WG) Methoxyfenozide (Runner 240 SC) Lufenuron (Match 500 Ec) Novaluron (Rimon 10 Ec) Spinosad (Tracer 480 SP) Bacillus thuringiensis (Thuricide HP 16,000 iu/mg, Xentari WDG 15,000 iu/mg) Carbofuran (Furadab 5G) Azadirachtin (neemroc 0.03% Ec) ▪ use of baculoviruses (*Plutella xylostella* granulosis virus) *Pxl*GV Use of insect infecting fungi (*Zoophthora radicans*) ▪ Improved targetting of pesticides (V-lance) ▪ Natural enemies *Cotesia plutellae* (larval parasitoid) *Diadegma sp*. (larval-pupal parasites) *Brachymeria sp* (pupal parasites) Predators – spiders, birds, lacewings, ants ▪ Hand picking	R6616 Pest Management in horticulture; integrating sustainable pesticide use in biocontrol-based peri-urban systems in Kenya. R7403 Pest management in horticultural crops; an integrated approach to vegetable pest management with the aim of reducing reliance on pesticides in Kenya R6615. Investigation of biorational methods for control of insect pests of vegetables in Kenya R7449 Development of biorational brassica IPM in Kenya

			R7266 Development and evaluation of a pilot field handbook on natural enemies of vegetable pests in Kenya and Zimbabwe
	Cutworms (*Agrotis spp*)	▪ Application of dilute insecticidal dusts. ▪ Application of abrasives such as diatomite or fine ash ▪ Use of vertical sticks (pegs) driven into the ground at base of seedlings ▪ Use of Entomopathogenic nematodes (EPNs e.g. *Steinernema karii*.	Pilot project for the implementation of farmer participatory IPM in vegetable/ cash crops in small holder production systems in Kenya. ARF/CSWP/RC-IDA/6012001/1 R6616 Pest Management in horticulture; integrating sustainable pesticide use in biocontrol-based peri-urban systems in Kenya.
	Black rot (*Xanthomonas campestris pv campestris*)	▪ Cultural e.g. crop rotation but use of clean seeds is recommended. ▪ Seed treatment with hot water (50^{o} C for 30 minutes) provides disinfection of seeds	R8312.Promotion of quality vegetable seed in Kenya.
	Poor Seed Quality	▪ Farmer seed selection	R8312.Promotion of quality vegetable seed in Kenya.
Groundnuts			
	Leaf hopper	▪ Intercrop with sunflower or millet ▪ Use resistant varieties ▪ Aphid chemicals	
	Groundnut aphids	▪ Handpick or prune out localized aphid infestations. Before planting groundnuts check surrounding weeds and other plants for aphids and destroy where found. Remove all crop residues immediately after harvest. Plant early Closely space plants ▪ Use tolerant /resistant varieties (especially the bunch types) ICG-VSM 89749/88710 and Uganda Stripe	
	Groundnut Rosette Virus Disease	▪ Early planting ▪ Close spacingPartial tolerant varieties: Mani pintar & Makulu Red ▪ Tolerant lines: ICG -VSM 88710, ICG -VSM 897490 & Uganda Stripe	R7445 Development of acceptable groundnut varieties with durable resistance to rosette disease in Uganda

			R8105 Farmer-led multiplication of rosette –resistant groundnut varieties for eastern Uganda
	Aspergillus flavus fungus	▪ Rapid drying of harvested pods to a moisture content of about 10% ▪ Minimum damage to pods during weeding and harvesting to avoid entry of fungus in to broken pods ▪ Control of damage caused by other pests e.g. termites ▪ Timely harvesting so as not to leave the nuts from the field ▪ Tolerance against Aflatoxin contamination reported	
Cassava			
	Aphid	▪ Early detection is the key to reducing aphid infestations. ▪ Grow resistant varieties such as EACMV-Ug ▪ Small numbers of individual colonies on small plants can be crushed by hand or removed by pruning to prevent spreadMarigold plants can be used to attract beneficial insects such as ladybugs, lacewings, assassin bugs, syrphid fly larvae, adult wasps and spiders ▪ Shake infested plant, once aphids are down they will be predators upon ▪ Fill yellow pan traps with soapy water and place the trap close to the host plantSpray neem oil and soaps ▪ Use contact insecticides such as pyrethrum directed at growing points and under foliage	
	Mealy bug	▪ Spray Basudin 600EW (Diazinon), ▪ Synthetic pyrethroids have been used for many years, and although resistance to some of these chemicals has developed in mealybugs, the newer synthetic pyrethroids are still quite effective if not overused. ▪ Dimethoate and omethoate can be used on mealybugs, but being organophosphate pesticides, their regular use is strongly discouraged. ▪ Good control of mealybugs has been achieved by releasing parasitic wasps such as *Apoanagyrus lopezi* and *Leptomastix*	

Annex 5. Report of pre-adoption socio-economic situation and production practices of participating farmers

ACCELERATED UPTAKE AND IMPACT OF CPP RESEARCH OUTPUTS IN KENYA

Activity 3.1: Assessment of pre-adoption socio-economic situation and production practices of participating farmers

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1. Introduction

Crop production constraints, particularly pests and diseases, result in smallholder farmers achieving yields well below potential. CPP research on pests has, in recent years, produced an array of new knowledge concerning weeds, diseases, insects and rodents. It is the case, however, that the farmers do not have the information and knowledge they need to reduce the effects of pests and diseases in order to improve crop production and yield. Improving farmer accessibility to appropriate technologies is therefore crucial. It is also important to quantify the effects of efforts aimed at improving farmer access to technology for improving crop production.

Two approaches used to quantify the impact of technologies are the 'with and without' analysis or the 'before and after analysis'. The present study uses a before and after analysis to assess the impact of the technologies that farmers tried. As a first step in this direction a survey of the pre-adoption situation was conducted.

2. Objectives

1. Examine the characteristics of farmers involved in crop production
2. Assess crop production in terms of resource use and output
3. Identify the crop production constraints and interventions

3. Methodology

Five farmers were selected from each of the farmer field schools (FFS). The facilitators ensured diversity, in terms of gender, age and farm size, when picking the farmers. The selection of farmer field schools (FFS) was based on the willingness of farmers to participate. At the start of each crop season all the farmer field schools were visited and those that wished to participate were identified. The crop seasons during which the data were collected were August 2003 for sweet potatoes and beans, April 2004 for maize and sorghum, and August 2004 for kales.

A survey questionnaire was administered to participating farmers in the selected field schools by trained farmer field school facilitators. The data collected include the socio-economic situation of the participating farmers, production statistics and constraints, what farmers feel needs to be improved within the systems, prices of the crops during the previous season, resource endowment, pest and disease management. The questionnaire used in data collection is provided in the appendix. These data relate to the conditions before the promotion of the integrated pest and disease management strategies and provide the basis for a before and after analysis of the impact of the technologies.

4.0 Socio-economic conditions in production of sweet potatoes and beans

4.1 Household characteristics of sweet potatoes and beans farmers

The number of farmers interviewed was 75, 120 and 40 for Bungoma, Busia and Kakamega Districts respectively. The average age of the farmers interviewed was 45.7 years, while the average land cultivated was 3.1 acres. Only 37.2% of the farmers had above primary level of education (Table 1).

Table1: Household characteristics of sweet potatoes and beans farmers

Characteristic	**Bungoma District**	**Busia District**	**Kakamega District**	**All Districts**
Average age (years)	47.5	44.0	48.6	45.7
Sex: Male (%)	78.8	59.4	70.0	66.4
Female (%)	21.2	40.6	30.0	33.6
Family size:				
Adult male (> 14 yrs)	2.1	2.0	2.7	2.1
Adult female (>14 years)	2.1	1.8	2.9	2.0
Children (≤ 14 years)	3.6	3.4	2.9	3.4
Average land (acres):				
Owned land cultivated	3.4	2.8	2.8	2.6
Rented land cultivated	0.4	0. 5	0.6	0.5
Non cultivated land	1.0	1.4	1.2	1.2
Education level (%)				
None	11.2	18.1	5.0	14.2
Non-formal	2.5	2.5	7.5	3.2
Primary	33.8	48.2	57.5	45.4
Secondary	50.0	30.6	30.0	36.1
Tertiary	2.5	0.6	0.0	1.1

Land cultivated was highest in Bungoma District and lowest in Busia District, while rented land cultivated was highest in Kakamega District and lowest in Bungoma District.

4.2 Beans production in Western Kenya (FFS)

Beans are grown by most of the farmers (89.3%) (Table 2). The average area under beans is 0.7 acres. Overall 27.5% of the farmers use fertilizers on beans. Bungoma District has the highest percentage (46.3%) of farmers that use fertilizers on beans, while Busia has the lowest percentage (15.0%). The average amount of fertilizers used in beans production is 19.2 kg per hectare.

Table 2: Bean production and input usage in Western Kenya

Production characteristics	Bungoma District	Busia District	Kakamega District	All Districts
Farmers growing beans (%)	88.8	88.1	95.0	89.3
Average area under beans (acres)	0.5	0.8	0. 6	0.7
Farmers using fertilizers (%)	46.3	15.0	40.0	27.5
Average quantity of fertilizer used (kg/acre)	19.8	16.9	23.2	19.2
Farmers using hired labour (%)	8.9	29.4	42.5	25.4
Yield of beans (Kg/acre)	127.0	118.5	79.6	114
Price per kg (Ksh.)	23.7	25.0	33.8	26.0

4.3 Sweet potatoes production in Western Kenya (FFS)

Sweet potatoes are grown by overall 76.4% of the farmers. Bungoma District had the highest average area of 0.4 acres under sweet potatoes (Table 3). The yield of sweet potatoes is highest in Bungoma District and lowest in Kakamega District. This means that the highest production of sweet potatoes is by farmers in Bungoma District. Sweet potato production is undertaken without fertilizers in all the districts in Western Kenya. Sweet potatoes are produced for subsistence purposes mainly.

Table 3: Sweet potato production and input usage in Western Kenya

Production characteristics	Bungoma District	Busia District	Kakamega District	All Districts
Farmers growing sweet potatoes (%)	81.3	73.1	80.0	76.4
Average area under sweet potatoes (acres)	0.4	0.3	0.4	0.3
Farmers using fertilizer (%)	0.0	0.0	0.0	0.0
Average quantity of fertilizer used (kg/acre)	0.0	0.0	0.0	0.0
Farmers using hired labour (%)	11.3	8.1	20.0	10.7
Yield of sweet potatoes (Kg/acre)	1404.1	774.3	459.4	909.7
Price per kg (Ksh)	2.8	6.0	4.1	4.7

4.4 Beans production constraints and interventions

The major insect pests of beans are the bean aphids and the bean fly, while the major diseases are the bean root rot and the bean mosaic virus (Table 4).

Table 4: Farmers affected by specified beans constraints in Western Kenya (%)

Constraint	Bungoma District	Busia District	Kakamega District	All Districts
Bean root rot	81.3	66.3	90.0	73.9
Bean blight	63.8	60.6	37.5	58.2
Bean mosaic virus	71.3	65.0	65.0	66.8
Bean anthracnose	43.8	51.3	45.0	48.2
Bean aphids	75.0	80.0	87.5	79.6
Bean fly	63.8	66.3	37.5	61.4
Lack of planting materials	48.8	56.9	52.5	53.9

In spite of the high incidences of pests and diseases there are limited interventions by the farmers. The highest percentage of farmers (32.5%) attempting control was observed for bean aphids (Table 5). The lowest percentage of farmers (9.7) attempting interventions was reported for bean anthracnose.

Table 5: Farmers attempting interventions for beans constraints (%)

Constraint	Bungoma District	Busia District	Kakamega District	All Districts
Bean root rot	35.9	21.3	40.0	28.1
Bean blight	12.5	17.0	0.0	13.2
Bean mosaic virus	26.3	16.9	25.0	20.7
Bean anthracnose	10.0	9.4	10.0	9.7
Bean aphids	42.5	26.9	32.5	32.5
Bean fly	18.8	12.7	2.5	12.9
Lack of planting materials	43.8	48.1	32.5	44.6

The main intervention methods for the diseases were roguing and crop rotation (Table 6). Roguing has serious repercussions for the farmers as it reduces the plant population and hence the yield. The intervention measures for the insect pests were application of ash and pesticides. The problem with application of ash is that it has limited efficacy. The overall impression is that farmers require affordable technologies for the control of both diseases and pests.

Table 6: Main intervention methods for beans production constraints

Constraint	Intervention method
Bean root rot	Roguing (12.8%), crop rotation (8.0%), apply ash (2.7%), apply pesticides (0.8%), plant resistant varieties (2.3%), frequent weeding (1.5%)
Bean blight	Roguing (5.2%), crop rotation (4.8%), apply pesticides (3.2%)
Bean mosaic virus	Roguing (7.0%), crop rotation (6.5%), seed selection (2.5%), apply ash (1.6%), early planting (1.1%), repeated weeding (0.4%), apply pesticides (0.8%), plant with manure (0.8%)
Bean anthracnose	Crop rotation (4.1%), Roguing (1.4%), apply ash (0.8%), repeated weeding (0.4%), apply pesticides (1.4%), seed selection (1.6%)
Bean aphids	Apply ash (20.1%), apply pesticides (8.6%), roguing (0.4%), crop rotation (2.4%), early planting (1.0%)
Bean fly	Apply ash (3.6%), apply pesticides (2.0%), spray pawpaw leaf solution (1.8%), crop rotation (1.1%), roguing (2.9%), and early planting (1.5%)
Lack of planting materials	Borrow from friends and relatives, buy from local market, plant local varieties, plant many varieties

4.5 Sweet potato production constraints and interventions

The main constraints in sweet potato production reported by the farmers were insect pests, especially the sweet potato weevil and the sweet potato butterfly (Table 8). A few instances of diseases were reported for the sweet potato virus. This may be because there are few diseases in sweet potatoes, or it may be because the farmers' understanding of diseases is limited.

Table 7: Farmers affected by specified constraints in sweet potato production (%)

Constraint	Bungoma District	Busia District	Kakamega District	All Districts
Sweet potato weevil	86.3	82.5	72.5	82.1
Sweet potato butterfly	63.8	70.6	35.0	63.6
Lack of planting materials	58.8	51.3	55.0	53.9
Sweet potato virus	8.8	0.0	2.5	2.9

Despite the high incidence of the sweet potato weevil very few farmers (22.7%) were attempting to control them. A relatively smaller percentage (8.8%) was controlling the sweet potato butterfly.

Table 8: Farmers attempting intervention in sweet potato production constraints (%)

Constraint	Bungoma District	Busia District	Kakamega District	All Districts
Sweet potato weevil	31.3	15.6	27.5	22.7
Sweet potato butterfly	3.8	13.8	2.5	8.8
Lack of planting materials	48.8	42.0	35.0	43.0
Sweet potato virus	5.0	0.0	2.5	1.9

The main intervention methods used by the farmers were application of ash, roguing and crop rotation (Table 9). These methods were noted to have very low efficacy. This is a clear indication of the need for appropriate control measures for sweet potato pests.

Table 9: Main intervention methods for sweet potato production constraints

Constraint	Intervention method
Sweet potato weevil	Apply ash (1.6%), crop rotation (7.2%), seed selection (1.6%), roguing (1.6%), early harvesting (5.5%), and regular hilling (5.2%)
Sweet potato butterfly	Ash (1.1%), crop rotation (2.1%), seed selection (0.4%), roguing (1.2%), apply pesticides (1.1%), kill larvae manually (1.8%), apply pawpaw leaf or tea leaf solution (1.1%)
Lack of planting materials	Use local varieties, buy from neighbours and friends
Sweet potato virus	Roguing (1.5%), using uninfected vines (0.4%)

5.0 Socio-economic conditions in production of maize and sorghum

5.1 Household characteristics maize and sorghum farmers

The number of farmers interviewed was 80, 90 and 40 for Bungoma, Busia and Kakamega Districts respectively. The average age of the farmers interviewed was 46.3 years, while the average land cultivated was about 2.9 acres. Most of the farmers (75.0%) had no more than primary level of education (Table 10).

Table 10: Household characteristics of maize and sorghum farmers

Characteristic	Bungoma District	Busia District	Kakamega District	All Districts
Average age (years)	46.1	44.5	54.2	46.3
Sex: Male (%)	70.0	50.9	72.5	58.7
Female (%)	30.0	49.1	27.5	41.3
Family size:				
Adult male (> 14 yrs)	2.6	2.0	2.7	2.2
Adult female (>14 years)	2.0	1.8	2.8	2.0
Children (≤ 14 years)	3.0	3.0	2.6	3.0
Average land (acres):				
Owned land cultivated	3.4	2.7	2.8	2.9
Rented land cultivated	0.4	0.3	0.4	0.4
Non cultivated land	1.3	1.3	0.9	1.2
Education level (%)				
None	3.3	18.2	12.5	13.9
Non-formal	0.0	2.5	0.0	1.5
Primary	50.0	61.0	67.5	59.5
Secondary	46.7	16.4	17.5	23.6
Tertiary	0.0	1.9	2.5	1.5

5.2 Maize Production in Western Kenya (FFS)

Maize is produced by all the farmer field schools in Western Kenya. This is because it is a staple food crop, which is also produced for commercial purposes. All the farmers in Bungoma were involved, while over 96% were involved in Busia and Kakamega Districts. Average area under maize is highest in Bungoma and lowest in Busia (Table 11). This is as expected because Bungoma District has high agricultural potential with regard to maize production. Use of fertilizers on maize was highest in Bungoma and lowest in Busia District. Maize yield was highest in Bungoma District and lowest in Busia District.

Table 11: Maize production and input usage in Western Kenya

Production characteristics	Bungoma District	Busia District	Kakamega District	All Districts
Farmers growing maize (%)	100.0	96.2	97.5	97.3
Average area under maize (acres)	2.1	1.0	1.2	1.3
Farmers using fertilizers (%)	96.7	32.1	67.5	52.5
Average quantity of fertilizer used (kg/acre)	74.5	33.0	66.0	64.0
Farmers using hired labour (%)	40.1	34.0	60.0	39.4
Yield of maize (Kg/acre)	830.0	323.5	485.0	470.2
Price per Kg (Ksh.)	13.5	15.4	10.9	14.3

5.3 Sorghum Production in Western Kenya (FFS)

For the long rain season in 2004, sorghum was produced in Busia District only. The average area under sorghum was only 0.7 acres (Table 12). Sorghum is produced mainly for subsistence purposes. Farmers are interested in producing it on a larger scale for commercial purposes. This is because there is high demand for sorghum. Indeed, sorghum is imported from Uganda to Kenya through Busia to meet extra demand. There is very limited use of improved inputs in sorghum, possibly because it is a subsistence crop in the district. Fertilizer is applied by only 5.6% of the farmers.

Table 12: Sorghum production and input usage in Western Kenya

Production characteristics	Bungoma District	Busia District	Kakamega District
Farmers growing sorghum (%)	-	68.6	-
Average area under sorghum (acres)	-	0.7	-
Farmers using fertilizer (%)	-	0.0	-
Average quantity of fertilizer used (kg/acre)	-	0.0	-
Farmers using hired labour (%)	-	14.5	-
Yield of sorghum (Kg/acre)	-	179.7	-
Price per Kg (Ksh)	-	15.2	-

5.4 Maize production constraints and interventions

The major maize production constraints reported included maize stalk borer, maize smut and inadequate capital (Table 13). Maize streak was reported to be the most widespread disease of maize.

Table 13: Farmers affected by specified maize constraints in Western Kenya (%)

Constraint	Bungoma District	Busia District	Kakamega District	All Districts
Maize stalk borer	90.0	83.6	82.5	84.9
Maize streak	100.0	88.1	87.5	90.7
Maize smut	83.3	84.3	80.0	83.4
Maize blight	53.3	50.3	75.0	54.8
Maize beetle	83.3	53.5	85.0	65.3
Larger grain borer	73.3	48.4	77.5	58.7
Striga	6.7	21.4	35.0	20.1
Poor quality maize seed	38.3	63.5	80.0	60.2
Inadequate capital	86.7	81.8	70.0	81.1
High cost of				

improved varieties	31.7	50.6	32.5	43.4

The percentage of farmers attempting some form of intervention for the constraints varied across districts and constraints (Table 14). The main intervention measures were only traditional approaches, which included roguing and application of ash.

Table 14: Farmers attempting interventions for maize constraints (%)

Constraint	**Bungoma District**	**Busia District**	**Kakamega District**	**All Districts**
Maize stalk borer	48.3	36.5	42.5	40.2
Maize streak	63.3	50.9	42.5	52.9
Maize smut	55.0	56.6	40.0	54.1
Maize blight	6.7	8.2	15.0	9.7
Maize beetle	76.7	20.1	45.0	36.3
Larger grain borer	65.0	31.4	35.0	38.6
Striga	6.7	15.1	27.5	15.1
Poor quality maize seed	21.7	44.7	45.0	39.8
Inadequate capital	75.0	51.6	40.0	55.2
High cost of improved varieties	26.7	26.6	25.0	26.6

The intervention methods used by farmers were varied (Table 15). They were mainly traditional methods, which included application of ash and roguing (Table 34). Farmers reported that in most cases success was very low.

Table 15: Main intervention methods for maize production constraints

Constraint	**Intervention method**
Maize stalk borer	Apply ash (10.5), apply pesticides (6.0), roguing (19.8), killing using hands (3.9)
Maize streak	Roguing (51.7), change seeds (0.8), use manure (0.4)
Maize smut	Roguing (53.3), apply ash (0.4), change seeds (0.4)
Maize blight	Roguing (8.1), apply ash (0.4), crop rotation (0.4), apply cow dung (0.8)
Maize beetle	Use of cow dung (23.8), apply pesticides (9.0), kill using hands (3.5)
Larger grain borer	Use pesticides e.g. actellic (21.1), apply ash (15.1), use cow dung (1.6), hand pick and crush (0.4), early harvesting (0.4)
Striga	Uproot the striga (12.7), crop rotation (1.2), apply manure (0.8), plant resistant varieties (0.4)
Poor quality maize seed	Seed selection (2.7), use own seed (2.4), plant any other available seed (34.7)
Inadequate	Borrow from friends (55.2)

capital	
High cost of improved varieties	Plant local and any other available varieties (26.6)

5.5 Sorghum production constraints and interventions

The main constraints reported in sorghum production included shoot flies, midge, weevils and striga (Table 16). Sixty seven percent of the farmers interviewed attempted intervention for striga, while 44.7 attempted control for sorghum smut (Table 17). The interventions included early planting and uprooting (Table 18).

Table 16: Farmers affected by specified constraints in sorghum production (%)

Constraint	Bungoma District	Busia District	Kakamega District
Sorghum shoot fly	-	69.0	-
Sorghum midge	-	70.4	-
Sorghum weevils	-	73.0	-
Striga weed	-	79.2	-
Sorghum smut	-	69.8	-
Limited accessibility to improved varieties	-	56.6	-

Table 17: Farmers attempting intervention in sorghum production constraints (%)

Constraint	Bungoma District	Busia District	Kakamega District
Sorghum shoot fly	-	17.6	-
Sorghum midge	-	26.4	-
Sorghum weevils	-	53.4	-
Striga weed	-	66.7	-
Sorghum smut	-	44.7	-
Limited accessibility to improved varieties	-	41.5	-

Table 18: Main intervention methods for sorghum production constraints

Constraint	Intervention method
Sorghum shoot fly	Roguing (16.0), early planting (0.8), apply ash (0.8)
Sorghum midge	Early planting (17.0), apply ash (5.0), apply pesticides (4.4)
Sorghum weevils	Apply pesticides (10.0), apply ash (43.4)
Striga weed	Uproot the striga (66.7)
Sorghum smut	Roguing (44.7)
Limited accessibility to improved varieties	Plant local varieties (41.5)

6.0 Socio-economic conditions in production of kales

6.1 Household characteristics of kale farmers

The number of farmers interviewed was 70, 145 and 40 for Bungoma, Busia and Kakamega Districts respectively. The average age of the farmers interviewed was 46.5 years, while the average land cultivated was about 3.3 acres. The highest level of education for sixty eight percent of the farmers was primary education (Table 19).

Table 19: Household characteristics of kale farmers

Characteristic	Bungoma District	Busia District	Kakamega District	All Districts
Average age (years)	44.8	48.6	45.3	46.5
Sex: Male (%)	65.7	53.8	75.0	62.8
Female (%)	34.3	46.2	25.0	37.2
Family size:				
Adult male (> 14 yrs)	1.9	1.7	1.7	1.8
Adult female (>14 years)	1.7	1.8	2.1	1.8
Children (≤ 14 years)	2.5	2.8	2.5	2.6
Average land (acres):				
Owned land cultivated	2.7	3.4	2.8	3.0
Rented land cultivated	0.6	0.2	0.1	0.3
Non cultivated land	0.9	1.5	1.0	1.2
Education level (%)				
None	8.6	12.8	10.0	10.6
Primary	40.0	69.2	65.0	57.4
Secondary	51.4	17.9	20.0	30.9
Tertiary	0.0	0.0	5.0	1.1

6.2 Kale production in Western Kenya

Seventy percent of the farmers in Kakamega District were involved in kale production, while half of the farmers were involved in both Bungoma and Busia Districts (Table 20). The average area under kales was the same in Bungoma and Kakamega Districts. Busia District had the least area under kales. The kale varieties grown are 1000 headed, collards and sukuma siku. There was very limited use of fertilizers on kales in all the districts.

Table 20: Kales production and input usage in Western Kenya

Production characteristics	Bungoma District	Busia District	Kakamega District	All Districts
Farmers growing kales (%)	51.4	51.3	70.0	55.3
Average area under kales (acres)	0.4	0.2	0.4	0.3
Farmers using				

fertilizers (%)	34.3	12.8	45.0	27.7
Average quantity of fertilizer used (kg/acre)	12.3	4.4	11.3	10.5
Farmers using hired labour	8.6	2.6	20.0	8.5
Yield of kales (Kg/acre)	414.2	765.5	240.1	612.4
Price per Kg (Ksh.)	4.6	4.4	4.4	4.4

6.3 Kale production constraints and interventions

The major kale production constraints reported included diamond back moth, kale aphids, cut worms and root rot (Table 21).

Table 21: Farmers affected by specified kales constraints in Western Kenya (%)

Constraint	Bungoma District	Busia District	Kakamega District	All Districts
Diamond back moth	74.3	71.8	65.0	71.3
Kale aphids	85.7	94.9	90.0	90.4
Cut worms	80.0	82.1	60.0	76.6
Kale saw fly	31.4	5.1	25.0	19.1
Flea beetles	60.0	25.6	10.0	35.1
Root rot	68.6	74.4	70.0	71.3
Leaf spot	14.3	0.0	0.0	5.3
Stem rot	70.1	78.0	67.0	72.0
Leaf curl	0.0	0.0	5.0	1.1
Poor quality kale seeds	62.9	48.7	50.0	54.3
Marketing problem	14.3	10.3	5.0	10.6
Inadequate capital	0.0	2.6	5.0	2.1

Farmers attempting some form of intervention for the constraints varied across districts and constraints (Table 22). The main intervention measures were only traditional approaches, which included roguing and application of ash.

Table 22: Farmers attempting interventions for kale constraints (%)

Constraint	Bungoma District	Busia District	Kakamega District	All Districts
Diamond back moth	65.7	17.9	45.0	41.5
Kale aphids	82.9	74.4	85.0	84.0
Cut worms	68.6	28.2	50.0	47.9
Kale saw fly	0.0	0.0	15.0	3.2
Flea beetles	42.9	0.0	5.0	16.0
Root rot	54.3	30.8	40.0	41.7

Leaf spot	0.0	0.0	0.0	0.0
Stem rot	38.1	26.3	37.8	34.1
Leaf curl	0.0	0.0	5.0	1.1
Poor quality kale seeds	31.4	15.4	35.0	25.5
Marketing problem	11.4	7.7	0.0	7.4

The intervention methods used by farmers were varied (Table 23). They included application of conventional pesticides and traditional methods, which included application of ash and roguing. The success rate for the traditional intervention measures was very low. This underscores the need for promotion of approaches developed by CPP research.

Table 23: Intervention methods for kale production constraints

Constraint	Intervention method and % of farmers involved
Diamond back moth	Application of ash (12.8), hand picking (3.2), roguing (3.2), use of pesticides (22.3)
Kale aphids	Application of ash (44.7), use of pesticides e.g. karate (34.0), mixture of ash , pepper and tithonia (3.2), roguing (2.1)
Cut worms	Application of ash (16.0), application of pesticides (17.0), hand picking and killing with sticks (14.9)
Kale saw fly	Application of ash (3.2)
Flea beetles	Application of ash (3.2), application of pesticides (12.8)
Root rot	Roguing (35.2), crop rotation (6.5)
Leaf curl	Roguing (1.1)
Stem rot	Roguing (31.5)
Poor quality kale seeds	Select own seed, change the source of the seeds (15.9), mix varieties (3.2)
Marketing problem	Sell at low price (2.1), give to neighbours (1.1), sell in distant markets (2.1), sell locally (2.1)

7.0 Conclusions

The average age of the farmers was 46.1 years, indicating that older people are the ones involved in crop production. This may be because young people migrate to the cities in search for non-farm employment. The average family size was 7.0 people for each farm household, while the average land owned was 4.0 acres and the average land cultivated was 3.1 acres. This means that a large number of people derive their livelihoods from very small land parcels. Production practices that increase the productivity of land are needed to improve the welfare of the farmers. Overall 68.6% of the farmers had no more than primary level of education. Thus, any measures to improve productivity have to be disseminated in a participatory manner to enhance adoption.

The crops prioritized were beans, maize, sweet potatoes, sorghum and kales. The selection of crops was based on agricultural potential of the areas and the climatic conditions during specific seasons. The input usage, especially fertilizers was low compared to the recommended levels. The crop yields were also low as rated against the agricultural potential of the districts.

The main crop production constraints as reported by the farmers were pests and diseases. Pest infestation and disease incidences were reported by more farmers compared to those that reported having attempted to control. The key intervention methods reported were roguing, crop rotation and application of ash. These intervention measures were not as effective as the farmers expected. Roguing reduced the plant population and hence the crop yield. The low intervention rate may be attributed to lack of farmer capacity, lack of the required technology and the pests and diseases not being considered as serious. Farmers' observations were that the main reason for the low intervention was the non availability of the technologies. Indeed, the farmers who attempted interventions used mainly traditional approaches that had low success rates. This means that there is need for new technologies for addressing the constraints. The new technologies would reduce the damage caused by pests and diseases and hence lead to an increase in crop yields.

Appendix: Questionnaire for baseline data collection

BASELINE DATA COLLECTION
(Please interview each farmer separately)

Name of field school………………………………
District…………………………………………
Division………………………..Location……………………………..Village……………
Name of facilitator…………………..……….………
Farmer Name…………………………………….
Date of interview……………………………………….

A. Background information

1. Age of household head…………………Years
2. Sex: a) Male …….. b) Female……………
3. Education level of farmer
   a) None b) Primary c) Secondary d) Tertiary e) Non-formal

3. For those with no or non formal education, what is the literacy level (circle appropriately-may have multiple answers)
   a) Can read Kiswahili b) Can understand Kiswahili c) Can write Kiswahili

4. Household size: Adult male (>14 yrs)……………….
   Adult female (>14 yrs)…………………..….
   Children (14 yrs and below)……………………….

5. Total land under cultivation
   a) Owned……………….…….acres b) Rented…………………..……acres

6. Total land not cultivated…………………..…..acres
7. Sources of income other than farming………………………………………

B. Crop Production

8. Crop production statistics (starting with the most important)

Crop	Land area (acres)	Variety commonly grown	Use of inorganic fertilizer (Yes/No)	If yes, state type and quantity	Use of pesticides (Yes/No)	Use of manure (Yes/No)	Use of hired labour (Yes/No)	Yield estimates (specify units)	Unit price

C. Pest and disease management in selected crops

9a. Pest and disease management in maize

Did you have any of these problems	Yes or No	If yes, what interventions did you take?
1.Stalk Borer		
2.Maize streak		
3.Maize smut		
4. Maize beetle		
5.Larger grain Borer		
6. Maize Blight		
7. Maize weevil		
Other problems		
1. Lack of quality seeds		
2. Inadequate capital		
3. Lack of improved varieties		
4		

9**b.** Pest and disease management in sorghum

Did you have any of these problems	Yes or No	If yes, what interventions did you take?
1. Smut		
2. Shoot fly		
3. Weevils		
4. Midge		
5.		
Other problems		
1. Birds		
2. Striga weed		
3. Lack of improved variety		
4.		
5.		
6.		

NB: Interventions do not necessarily have to be control methods. They can be practices aimed at reducing the pest or disease such as selection of planting material, rotation etc

9c. Pest and disease management in kales

Did you have any of these problems	**Yes or No**	**If yes, what interventions did you take?**
1.Aphids		
2.Cut worms		
3.Flea beetles		
4. Diamond back moth		
5.		
6.		
7.		
Other problems		
1. Poor quality seeds		
2. Inadequate capital		
3.		
4		

9d. Pest and disease management in beans

Did you have any of these problems	**Yes or No**	**If yes, what interventions did you take?**
1. Bean root rot		
2. Blight		
3. Bean Mosaic virus		
4. Anthracnose		
5. Aphids		
6. Bean fly		
7. Lack of planting material		
Other		
1		
2		
3		
4		

9e. Pest and disease management in Sweet Potato

Did you have any of these problems	**Yes or No**	**If yes, what interventions did you take?**
1. Sweet potato weevil		
2. Sweet potato butterfly		
3. Lack of planting material		
Other		
1		
2		
3		
4		
5		
6		

NB: Interventions do not necessarily have to be control methods. They can be practices aimed at reducing the pest or disease such as selection of planting material, rotation etc

Annex 6. Report of Participatory evaluation of new IPPM technologies

ACCELERATED UPTAKE AND IMPACT OF CPP RESEARCH OUTPUTS IN KENYA

Activity 3.2: Participatory evaluation of new IPPM technologies

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1.0 Introduction

Participatory evaluation of the IPPM technologies was conducted in three districts in Western Kenya, to gauge farmers' views about the technologies. Farmer evaluation criteria were determined at the onset of the farmer field schools. The farmer field school facilitators for the sampled schools were trained on participatory budgeting, cost-benefit analysis, focus group discussions, scoring and ranking, and evaluation of IPPM technologies based on farmer criteria. The participatory evaluation methods used were scoring and ranking. This was in order to explore farmers' perceptions, elicit criteria, understand their choices, and decision making. They were also meant to provide means for obtaining information on farmers' preferences, priorities, and criteria for evaluating changes to their farming systems.

The objectives of the evaluation were to:

1. Identify farmer characteristics for technology evaluation
2. Rate each of the identified characteristics based on relative importance
3. Rate the performance of each of the technologies based on farmer criteria

2.0 Methodology

Six participating farmer field schools, two from each district (Bungoma, Busia and Kakamega), were randomly sampled and focus group discussions conducted. The discussions focused on the crops selected by the farmers for the short and long rain seasons. The crops were beans and sweet potatoes for short rains in 2003, maize and sorghum for long rains in 2004 and kales for short rains in 2004. The technologies evaluated are those selected by the farmers. A combination of simple ranking, matrix scoring and weighting were used for the evaluation.

During the focus group discussions farmers were asked to provide and rate the criteria/characteristics for technology evaluation. Discussions were conducted in an open and free environment that encouraged total participation of all farmers present. Scoring was followed by ranking to determine the relative importance of each of the characteristics. The highest score, which was taken to be equivalent to the total number of characteristics, was given to the most important characteristic and the next highest score to the next most important characteristic until all the characteristics were finished. The scores from each farmer were then picked and tallied on a master sheet. The total scores for each characteristic were used to develop a ranked list of characteristics, indicating order of importance.

Matrix scoring of the technologies was undertaken by asking all the farmers to assign a score for each technology with respect to each characteristic. The highest score, which was taken to be equivalent to the total number of technologies, was given to the technology that had the best capacity to supply the specified characteristic. The next highest score was given to the next best technology in terms of supplying the characteristic until all the technologies were finished. Scores for the technologies were tallied on a master sheet. The exercise was repeated for all characteristics for all technologies. The scores reported in the results tables are averages for all the sampled farmer field schools. The total scores are obtained as a summation of the product of the score of criteria/characteristic importance and the individual technology scores. The technology with the highest score was then considered to be the best.

3.0 Evaluation of the beans technologies

The technologies disseminated in the case of beans included cultural control and insecticides to control bean fly and aphids (R7965[1]). The cultural practices included destruction of crop residues, mulching and early planting to avoid peak infestation periods of bean fly, and hand picking of the bean aphids. Chemical control involved the application of insecticides. Root-rot control methods were also disseminated, which involved the use of root-rot resistant cultivars namely KK 22, KK 15, GLP 585 and KK 8 (R7568[2]). Farmer evaluation of the two technologies against their normal practice (use of ash) revealed that the use of insecticides was more effective in the control of the bean aphids and the bean fly, and consequently led to high yields. However the cost involved were prohibitive (Table 1).

Table 1: Evaluation of farmer practice, insecticides and cultural control of the bean fly and aphids

Criteria	Score of criteria importance	Normal farmer practice	Cultural control (early planting)	Use of insecticides
Crop yield	5	1	2	3
Input costs	3	2.5	2.5	1
Pest control	4	1	2	3
Labour requirement	1	2.5	2.5	1
Availability	2	3	2	1
Total scores	-	25	32	33

The farmers planted two root-rot resistant cultivars namely KK 8 and KK 22. The farmer evaluation criteria for the bean cultivars included yield, market demand, pest resistance and maturity period (Table 2).

[1] CPP project: IPM of Phaseolus bean pests in hillsides
[2] CPP project: Root-rot diseases of Phaseolus beans in Uganda

Table 2: Farmer evaluation of the root-rot resistant cultivars of beans

Criteria	Score of criteria importance	KK 22	KK 8	Local varieties
Yield	11	3	2	1
Disease resistance	7	3	2	1
Pest resistance	8	3	2	1
Drought resistance	5	3	2	1
Price	10	3	2	1
Market demand	9	3	1	2
Adaptation to local conditions	3	3	2	1
Maturity period	6	3	2	1
Labour requirement	1	1	2	3
Uniform maturity	2	3	2	1
Seed availability	4	1	2	3
Total score	-	188	123	85

Note: The total scores are obtained as the summation of product of the score of criteria importance and the individual technology score

The bean variety KK 22 was preferred due to its high yields, high pest and disease resistance, uniform maturity and high market prices. Farmer evaluation clearly indicated that they would prefer to plant the root-rot resistant varieties instead of the local varieties.

4.0 Evaluation of sweet potato technologies

The technologies disseminated for sweet potatoes were cultural control of sweet potato weevil and sweet potato butterfly. The cultural control involved use of clean planting materials, early planting and early harvesting, and planting in lines on ridges (R8167[3]). Hilling up reduces weevil damage. Farmers were also advised on chemical control. During the season the farmers tried the cultural method and resistant varieties. Evaluation of the cultural control (new planting regime) indicated that planting in lines on ridges was better than the farmer practice of planting on mounds (Table 3). Farmers however, indicated that planting in lines on ridges was labour intensive and required more potato vines.

Table 3: Evaluation of cultural control methods for sweet potato weevil and butterfly

Criteria	Score of criteria importance	New cultural control (planting regime)	Farmer control (old regime)
Yield	6	1.5	1.5
Ease of planting	3	1	2
Spacing	2	2	1
Plant population	5	2	1
Pest control	4	2	1
Use of land	1	2	1
Total score	-	36	27

[3] CPP Project: Promotion of sustainable sweet potato production and post harvest management through farmer field schools in East Africa

Farmers also tried varieties that were high yielding, had high market demand, and resistance to pests and diseases. These varieties included SPK 004, SPK 013, Kemb 10 and Mugande. The assessment of the varieties indicated that Kemb 10 is the best variety (Table 4).

Table 4: Evaluation of sweet potato varieties

Criteria	Score of criteria importance	Kemb 10	SPK 004	SPK 013	Mugande	Local varieties
Yield	8	5	2	1	3	4
Price	4	5	4	3	1	2
Early maturing	2	1	3	4	2	5
Drought resistance	7	5	1	2	4	3
Marketability (consumer preference)	5	5	4	2	1	3
Pest and diseases resistance	6	4	3	1	2	5
Food self sufficiency (food security)	1	2	5	3	1	4
Length of harvesting	3	5	2	1	4	3
Total score	-	163	94	64	90	129

Note: The total scores are obtained as the summation of product of the score of criteria importance and the individual technology score

5.0 Evaluation of the maize technologies

The disseminated technologies include: i) striga tolerant varieties such as KSTP 94 (R6921[4]), ii) crop rotation with trap crops which stimulate striga germplasm but do not support striga plants (R8212[5]), iii) certified seeds (high yielding and disease resistant varieties) or striga free seed (R7405[6]), iv) husbandry practices especially early planting for the control of ear-rot (R6582[7]) and stalk borer (R7955[8]) insecticides for the control of stalk borer and vi) habitat management (push and pull strategy) for the control of stalk borer. Early planting and destruction of crop residues as cultural techniques for control of stalk borer and ear-rot were not considered in the evaluation. It was noted that these cultural practices were already regular exercises by the farmers and therefore there was no need to evaluate them though they are useful. Farmers tried the improved maize varieties (H505, H614, KSTP 94 and H513) and habitat management. The resulting farmer evaluation of the varieties based on their criteria is as in Table 5.

[4] CPP project: Improved methods for the management of striga
[5] CPP project: Integrated pest and soil fertility management to combat striga, stem borers and declining soil fertility in the Lake Victoria region
[6] CPP project: Development of weed management in maize-based cropping systems
[7] CPP project: Management of the maize ear-rot complex in African farming systems
[8] CPP project: Strategies for feeding smallholder dairy cattle in intensive maize forage production system and implications for integrated pest management

Table 5: Evaluation of maize varieties

Criteria	Score of criteria importance	H614	H513	H505	Local varieties	KSTP 94
Yield	8	4	2	5	1	3
Market demand	2	5	3	4	1	2
Maturity period	5	1	3	4	2	5
Pest resistance	7	5	2	4	1	4
Disease resistance	4	4	3	5	1	2
Germination rate	1	4	3	5	1	2
Striga resistance	6	1	3	4	2	5
Seed availability	3	5	4	3	2	1
Total scores	-	123	88	154	50	124

Note: The total scores are obtained as the summation of product of the score of criteria importance and the individual technology score

The improved maize varieties have the advantage of high yields compared to the local varieties. The high yields lead to increased food self sufficiency. According to the farmer evaluation H505 was the best variety followed by KSTP 94. The variety KSTP 94 was preferred by farmers because of its resistance to striga.

The other technologies besides the varieties were habitat management (push-pull plants) (R8212[9]), use of insecticides and the indigenous technical knowledge (ITK). The push-pull plants include Napier and Sudan grass as trap crops and Desmodium grass as repellants. The ITK involved use of ash or soil applied to the plant funnels. The push-pull plants technology was considered the best in this category (Table 6). The specific advantages of the push-pull technology are that the technique controls stalk borers effectively and the Napier grass is also used as animal feed. The disadvantages of the push pull are high labour requirement, non availability and high price of desmodium seed, and slow growth of the desmodium that delays weeding of maize.

Table 6: Evaluation of habitat management, use of insecticides and ITK in maize

Criteria	Score of criteria importance	Push pull	Insecticides	ITK
Yield	5	3	2	1
Input costs	4	2	1	3
Pest control	3	2	3	1
Other uses	2	3	1	2
Labour requirement	1	1	3	2
Total score	-	36	28	26

Note: The total scores are obtained as the summation of product of the score of criteria importance and the individual technology score

[9] CPP project: Integrated pest and soil fertility management to combat striga, stem borers and declining soil fertility in the Lake Victoria region

The farmers felt that there is need to improve (increase) the availability of seeds for selected maize varieties, provide control methods or measures for the maize streak disease, have proper seed treatment and increase the multiplication of desmodium seeds

6.0 Evaluation of the sorghum technologies

The technologies disseminated in the case of sorghum were for the control of shoot fly, midges and sorghum smut. Shoot fly and midges were controlled by the use of high seeding rate, removal of alternate hosts, crop rotation, field sanitation, use of resistant varieties and chemical control (R7572[10]). Sorghum smut was controlled by uprooting of infected plants. Farmers tried the three resistant varieties namely Seredo, IS 8613, and IS 8193 during the season. Farmer evaluation of the varieties revealed that Seredo was the best variety followed by IS 8613 and IS 8193 respectively (Table 7). Seredo is preferred because of its fast growth and high yielding characteristics.

Table 7: Evaluation of sorghum technologies

Criteria	Score of criteria importance	Local varieties	Seredo	IS 8613	IS 8193
Fast maturing	11	2	4	3	1
Birds attack	9	2	1	3	4
Resistance to drought	7	4	2	2.5	1
Yield	10	3	4	1	2
Disease resistance (Smut)	5	1	2	3	4
Resistance to pests	6	1	4	3	2
Seed availability	8	4	3	1.5	1.5
Shelf life (storage)	4	4	3	1	2
Requirement for additives	3	2	1	4	3
Ease of marketing	1	3	4	1	2
Viability of seeds	12	2	4	3	1
Colour	2	3.5	3.5	2	1
Total score	-	197	242.5	189.5	151

Note: The total scores are obtained as the summation of product of the score of criteria importance and the individual technology score

7.0 Evaluation of kale technologies

The technologies disseminated to the farmers included control of diamond backmoth using pesticides (R6616[11]), hand picking and improved targeting of pesticides. For cutworms, the control methods were application of insecticides and use of vertical sticks (pegs) driven into the ground at the base of the seedlings. Cultural methods

[10] CPP project: Management of key insect pests of sorghum in Southern and Eastern Africa

[11] CPP project: Pest management in horticulture, integrating sustainable pesticide use in biocontrol-based peri-urban systems in Kenya

such as crop rotation and using clean seeds for the control of stem rot were disseminated. Farmers were also trained on seed selection to address the problem of poor seed quality (R8312[12]). Farmers reported that they would prefer to purchase certified seed instead of the high labour demanding activity of seed selection. Farmers tried the recommended pesticides in the control of diamondback moth and cutworms using the recommended application regimes and had various observations (Table 8).

Table 8: Evaluation of pesticides for control of diamond back moth and cutworms

Criteria	Score of criteria importance	Farmer control	Pesticide control using recommended regimes
Crop yield	5	1	2
Pesticide cost	3	2	1
Pesticide required	2	2	1
Pest control	4	1	2
Labour required	2	1.5	1.5
Total score	-	22	26

Farmers' evaluation revealed that the method of controlling diamond backmoth using pesticides such as bifenthrin and deltamethrin using the recommended application rates and timings was more effective in the control of the pest. The method was however reported to be more costly. The extra pesticide costs could be covered by the resultant high yields; given that the other recommended husbandry practices are followed. Farmers observed that cultural methods for the control of diseases required more time for impact to be noticed.

8.0 Farmers perceptions of the technologies

Assessment of the farmer perception of the technologies indicated preference for the CPP technologies compared to the indigenous farmer methods of crop production and pest management. Most of the farmers (98.1%) reported that they preferred the new technologies due to increased yields (51.0%), less use of pesticides, early maturity, timely, effective and less costly pest and disease management. There was therefore improvement in pest and disease management. There was also effective use of resources due to good planning.

The varieties promoted by the CPP project produce higher yields and are more pest and disease resistant. The disadvantages of the varieties are low availability of the seeds especially for the sorghum varieties. Habitat management (push-pull plants) technologies are labour intensive and the desmodium seeds are very expensive and difficult to find. Twenty one percent of the farmers reported that habitat management technologies have high labour requirements. Scarcity of the desmodium seeds was reported by 29% of the farmers.

[12] CPP project: Promotion of quality vegetable seed in Kenya

9.0 Conclusions

A diverse range of technologies were disseminated for addressing the priority constraints in crop production at the farm household level. These technologies were disseminated to the farmers by trained farmer field school facilitators. Farmers tried some of the technologies during the crop seasons.

Farmer evaluation of the technologies indicated a clear appreciation of the need for improved methods for production, pest and disease control. Farmers are aware of the causes of low farm output and the attributes of technologies required to mitigate the situation. The farmers are able to provide a preference ranking of the characteristics they consider crucial in technology evaluation. The main characteristics considered for technology evaluation include yield, pest and disease resistance and labour requirement. Yield was the most important characteristic and was used in evaluation of all technologies. The technologies promoted by the project were supplying the characteristics considered essential by the farmers. Farmers preferred the technologies mainly because they effectively control pests and diseases, and as a consequence improve the yields of crops. Some technologies such as habitat management were rated high, but farmers indicated that for continuity it would be necessary for desmodium seeds to be made more readily available. In cases where costs were considered high the inherent assumption is that the high crop yields accruing to the use of the technologies, given that the other crop production practices are optimal, would outweigh the costs.

Annex 7. Report of Post adoption socio-economic survey to assess impact on target farmers

Accelerated uptake and impact of CPP research outputs in Kenya

Activity 3.3: Post adoption socio-economic survey to assess impact on target farmers

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1.0 Introduction

Impact assessment was conducted in three districts in Western Kenya that were involved in the project entitled “Accelerated uptake and impact of CPP research outputs in Kenya”; Bungoma, Busia and Kakamega. The impact assessed in this study relates to changes that farmers perceive to have occurred as a result of the project. Impact is meant to show the value of research benefits to the individual farmers, communities and the country at large.

There are three main types of impact studies that are related to time. These are ex-ante, on-going evaluation and ex-post impact studies. The present study is an ex-post impact study meant to show how farmers have used research outputs, provide measures of the adoption and indicate benefits accruing from the technology. This study was also meant to assess the farmers’ access to the information and knowledge they need.

In order to assess the farm level impact of adopting the new technologies a before-and-after analysis was carried out. The impact assessed was that occurring over the short life of this project, but it is noted that longer impacts could be different. The impact was assessed through examining changes in levels of input use, yield, and extent of adoption and the benefits of the new technologies.

2.0 Objectives

The broad objective of the study was to assess the impact of the CPP research outputs that the participating farmers had been introduced to and opted to experiment with. The specific objectives were:

1. To examine the changes in levels of input use
2. To assess the adoption rates of the new CPP technologies
3. To determine the farmers’ access to information on CPP technologies
4. To determine the benefits from the CPP technologies

3.0 Methodology

Individual interviews were conducted with selected farmers in the participating farmer field schools by trained farmer field school facilitators. The interviews were conducted using a structured questionnaire (Appendix 1). Five farmers were selected from each of the farmer field schools (FFS) for the interviews. The facilitators ensured diversity in terms of gender, age and farm size, when picking the farmers. At the end of each crop season all the participating farmer field schools were visited for individual interviews. The same farmers were interviewed before and after the introduction of the CPP technologies. The crop seasons for which the data were collected were those beginning in August 2003 for sweet potatoes and beans, April 2004 for maize and sorghum, and August 2004 for kales. The data collected include resource endowment, usage of farm inputs, production statistics, output prices and changes in livelihoods.

Focus group discussions were also conducted with farmers in two farmer field schools from each district. A total of six farmer field schools were involved in the focus group discussions. The focus group discussions were conducted on a range of issues that included positive and negative changes that occurred in relation to yield, income, area, pest and diseases control. The situation before the CPP project was compared to that after to gauge the impact of the technologies. 'Before' refers to the period preceding the introduction of the CPP technologies; while 'after' refers to the time the farmers were trying the CPP technologies but assessed at the end of the crop season.

4.0 Input usage by the farmers

There has been an increase in the use of most inputs except pesticides though the pattern is different for the different crops. The percentages of farmers reporting the use of specific inputs for the prioritized crops are depicted in figures 1 through 5. Fertilizers were not used by the sweet potato farmers (Figure 2), and the sorghum farmers did not use pesticides (Figure 4).

The percentage of farmers using fertilizers increased for all the crops except sweet potatoes. Overall, the quantity of diamonium phosphate fertilizers used increased by 22.2 kg/acre for beans, 21.2 kg/acre for maize, 20.1 kg/acre for kales and 17.8 kg/acre for sorghum (Table 1). There was increased use of fertilizers possibly because of the likelihood of obtaining more output from the improved varieties. There was also an increase in the percentage of farmers using hired labour and manure for some crops.

The percentage of farmers using pesticides was unchanged for all the crops. This is due to the fact that farmers were offered a wide range of pest and diseases control methods some of which are not based on the use of pesticides. These include improved husbandry practices, indigenous technical knowledge, habitat management and pest and disease control methods that do not involve pesticides.

There was also an increase in the size of owned land cultivated by the maize and sweet potato farmers (Table 1). The owned land cultivated may have been used for various crops although key crops for the respective seasons were those prioritized by the farmers. Given that there was a corresponding increase in area under maize and sweet potatoes (Table 2), it is possible that the increase in area of owned land cultivated is attributed at least in part to use of the improved technologies. The farmer desire to try some of the technologies is one of the factors responsible for the change in area under the crops. Indeed, some farmers reported that there were increases in area of specific crops due to the use of new technologies (Table 3).

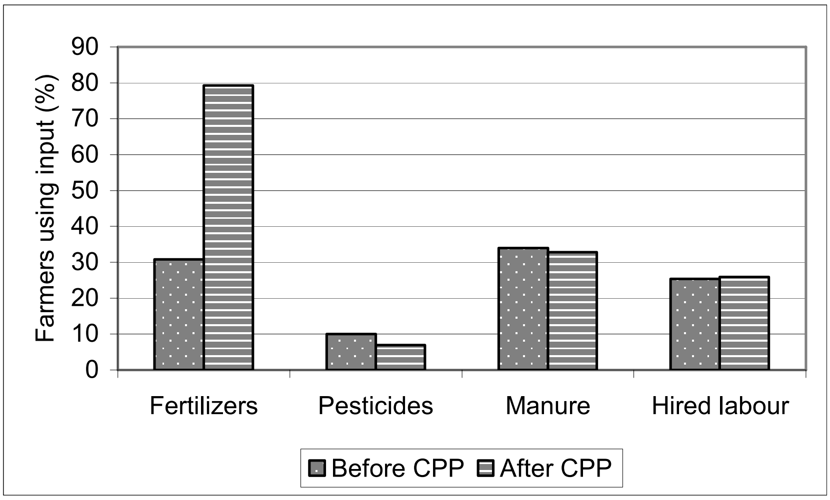

Figure 1: Use of farm inputs by beans farmers

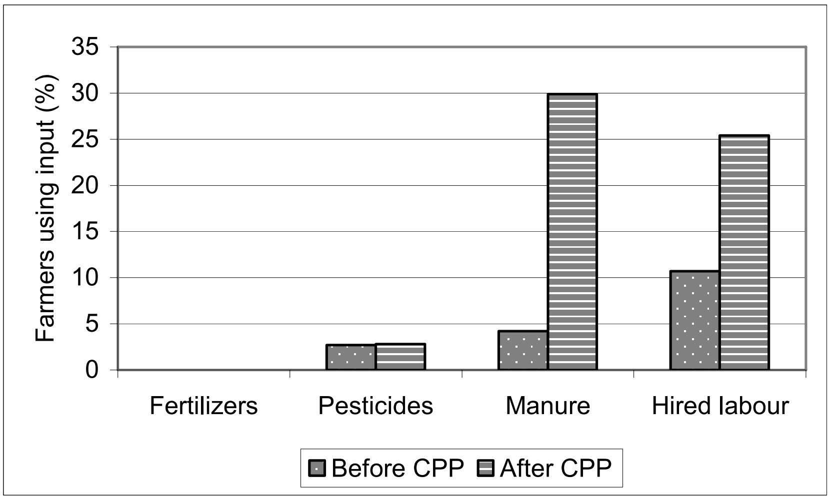

Figure 2: Use of farm inputs by sweet potato farmers

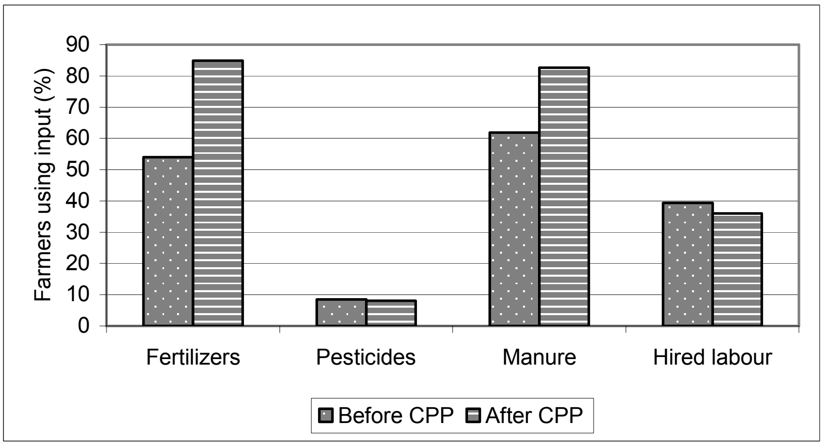

Figure 3: Use of farm inputs by the maize farmers

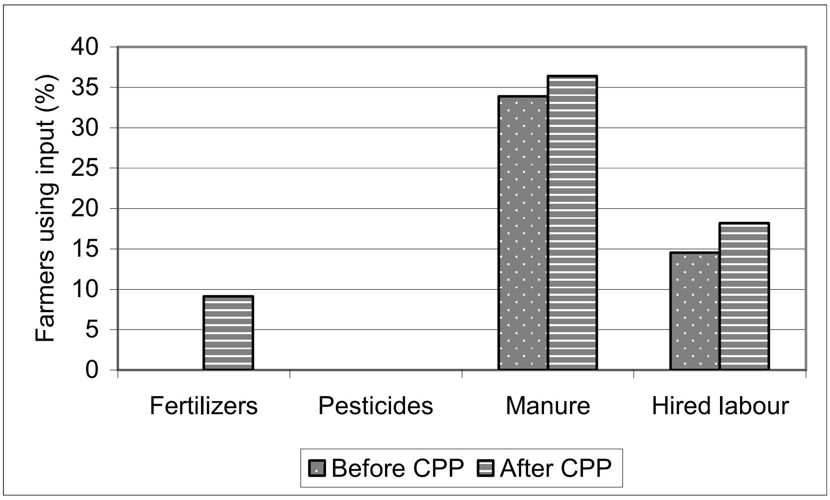

Figure 4: Use of farm inputs by sorghum farmers

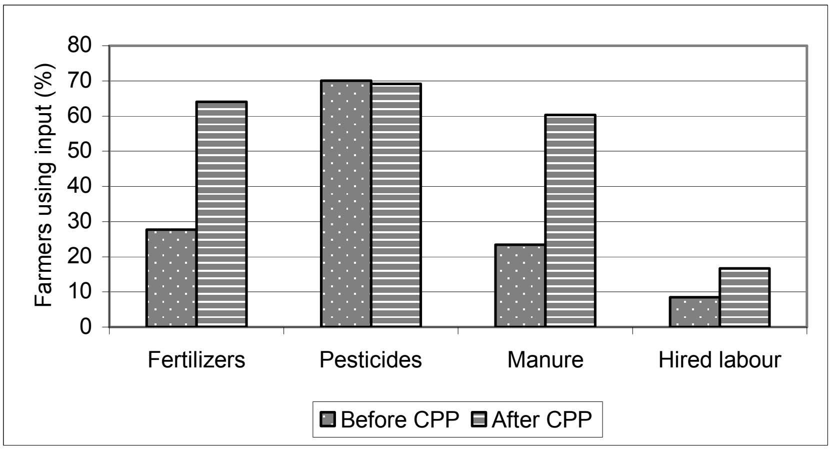

Figure 5: Use of farm inputs by kales farmers

Table 1: Use of land and fertilizers by the farmers during the various crop seasons

Crop	Period	Owned land cultivated (acres)	Rented land cultivated (acres)	Fertilizer use (Kg/acre)
Beans	Before	2.9	0.5	19.2
	After	2.9	0.2	41.4
Kales	Before	3.0	0.1	10.5
	After	3.0	0.2	30.6
Maize	Before	2.9	0.3	64.0
	After	3.5	0.2	85.2
Sorghum	Before	3.3	0.3	0.0
	After	3.3	0.3	17.8
Sweet potatoes	Before	3.0	0.3	0.0
	After	3.8	0.3	0.0

5.0 Benefits of the new technologies

The technologies promoted by the CPP project were husbandry practices, varieties, pests and diseases control. The effects of the technologies as reported by the farmers were on pest and disease control, yields, income and food self sufficiency. The technologies promoted were with respect to the crops prioritized by the farmers as key to their livelihoods. There were increases in yield and income of maize and kales (Table 2). Average income is obtained as a product of the average area, yield and price. It is important to indicate that the value of the crops is used as a proxy for income because the farmers reported that they obtained more marketed surpluses due to the use of CPP technologies. The farmers were however unable to indicate the exact marketed surpluses for specific crops. Farmers were categorical that there were clear increases in income due to the CPP technologies. Eighty six per cent of the farmers interviewed reported that there were increases in income due to the use of CPP technologies.

Table 2: Impact of the technologies on crops and farm income per acre

	Maize	Kales	Sweet potatoes	Sorghum	Beans
Area (acres)					
Before	1.30	0.30	0.34	0.71	0.66
After	1.68	0.34	0.36	0.71	0.66
% change	29.00	13.00	5.88	0.00	0.00
Yield (kg/acre)					
Before	613.0	612.0	909.0	180.0	114.0
After	705.0	674.0	910.0	200.0	114.0
% change	15.0	10.0	0.1	11.0	0.0
Price (Ksh/kg)					
Before	14.8	4.4	4.7	15.0	26.0
After	14.8	4.2	4.5	13.5	26.5
Income (Ksh)					
Before	11794.1	808.0	1453.0	1917.0	1956.0
After	17529.0	970.0	1474.0	1917.0	1994.0
% change	48.6	20.0	1.4	0.0	1.9

The area under cultivation increased for all the prioritized crops except sorghum and beans. The area under maize increased by 29.0%, while the corresponding yield increased by 15.0%. Income received from maize production increased by 48.6%. Since maize is a staple food crop it is the case that food self sufficiency and food security increased due to adoption of the maize production technologies. Kales production and the corresponding income also increased. There were some changes in the production of sweet potatoes, sorghum and beans, which were not as high as those from maize and kales. The increases in production of kales can also be explained by the fact that farmers are devising mechanisms for the production of the crop throughout the year possibly because of the increasing demand from government institutions and schools. Maize is also in high demand from these institutions. The disparity in increase in yield for sorghum without a corresponding increase in income and an increase in income for beans without a corresponding increase in yield is due to the decrease in the price of sorghum and an increase in the price of beans.

Farmers were also asked to indicate whether there were any increases in area, output and marketed surplus of the prioritized crops without stating the actual values. This was for purposes of cross checking. None of the farmers interviewed reported an increase in area of sorghum or output of beans (Table 3). About 73.1% of the farmers reported an increase in area under kales, while all the farmers (100%) reported increases in the output of kales.

Table 3: Percentage of farmers reporting increase in area, output and marketed surplus

Crop	Area	Output	Marketed surplus
Beans	0.0	0.0	0.0
Kales	73.1	100.0	90.0
Maize	19.6	25.0	16.0
Sorghum	0.0	10.0	8.0
Sweet potatoes	28.6	26.7	18.7

The percentage of farmers reporting increases in marketed surplus was less than the percentage reporting increase in output. This indicates that some of the crop output was used for increasing food self sufficiency at household level. When farmers were asked about the food self sufficiency situation following the adoption of the CPP technologies, 82% indicated that food self sufficiency had improved. This was attributed mainly to maize production. Sixty five percent of the farmers also reported that their incomes had increased due to the increased marketed surplus from maize. There were increases in the production of sweet potatoes and sorghum but not with the same magnitude as for maize and kales. Given the unpredictable nature of the farming environment and the need for diversification, these crops are also going to improve in production. The technologies promoted are therefore useful in this regard. Increase in the yield of sorghum was noted but the corresponding income was reduced by the low price. Farmers reported that they were having improvements in their livelihoods, which they could attribute in part to the use of improved crop protection practices that lead to high crop yield.

6.0 Pest and disease management

There was improvement in the pest and disease management by the farmers and efficiency in the use of agricultural resources. There was an increase in the percentage of farmers attempting control of different pests and diseases for some crops. Notable increases in the numbers of farmers attempting control were reported for bean root rot, bean fly, diamondback moth on kales, maize stalk borer and striga weed. This indicates farmer appreciation of the new technologies and by implication their demand for the new technologies. No significant changes with respect to the percentage of farmers attempting intervention for other pests and diseases were reported. The lack of a change in percentage of farmers attempting interventions does not mean that they do not use the new technologies. It is possible that the farmers use the new technologies instead of their indigenous methods such as ash. The percentages of farmers attempting interventions for pests and diseases in specific crops are depicted in figures 6 through 10.

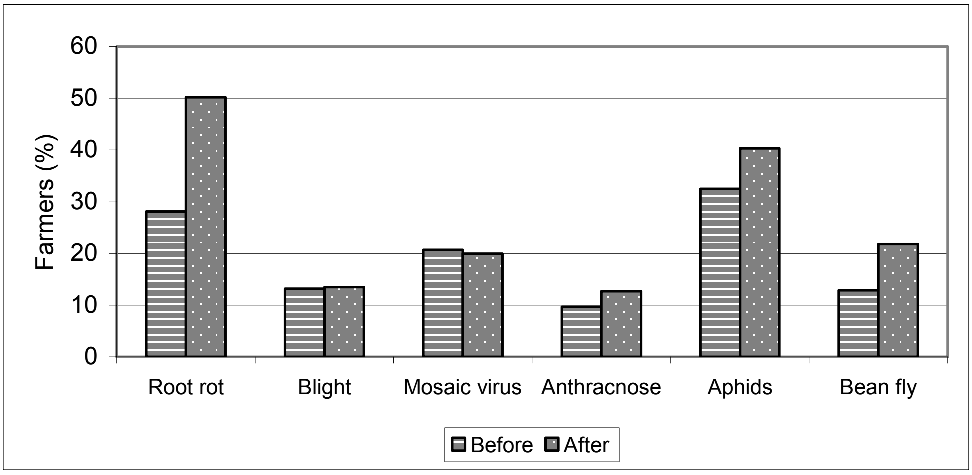

Figure 6: Farmers attempting interventions in beans constraints

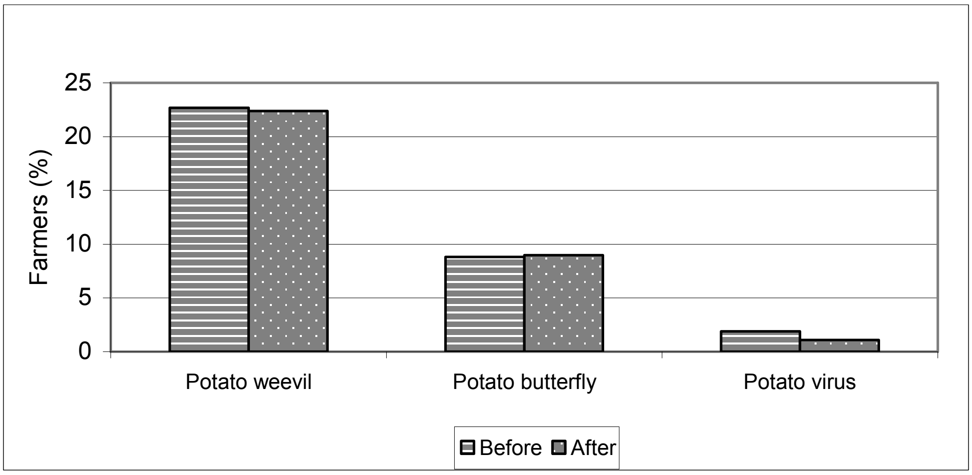

Figure 7: Farmers attempting interventions in sweet potato constraints

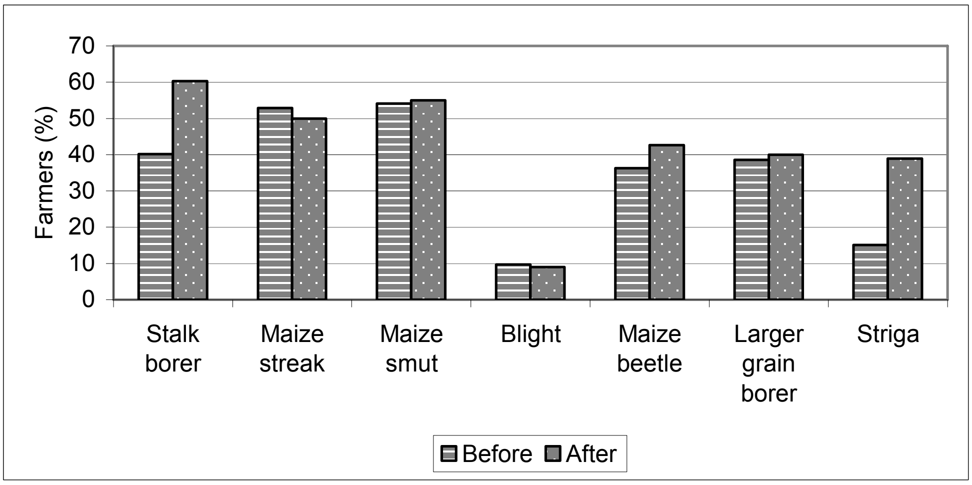

Figure 8: Farmers attempting interventions in maize constraints

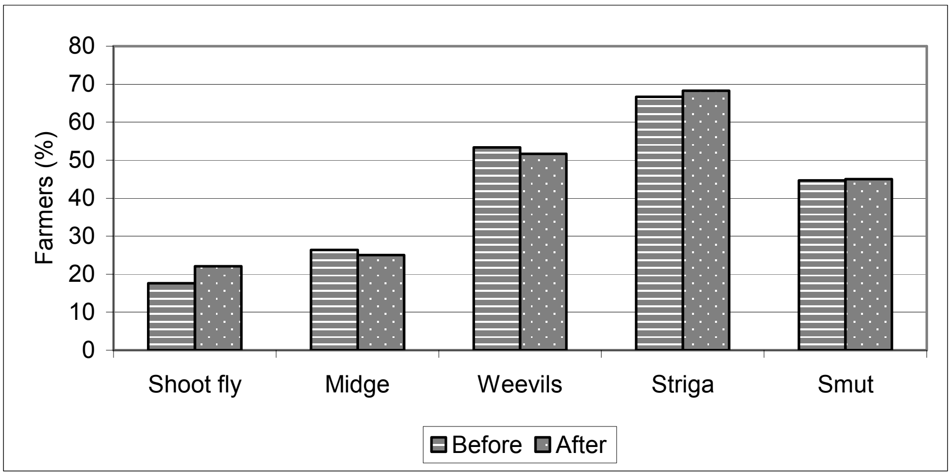

Figure 9: Farmers attempting interventions in sorghum constraints

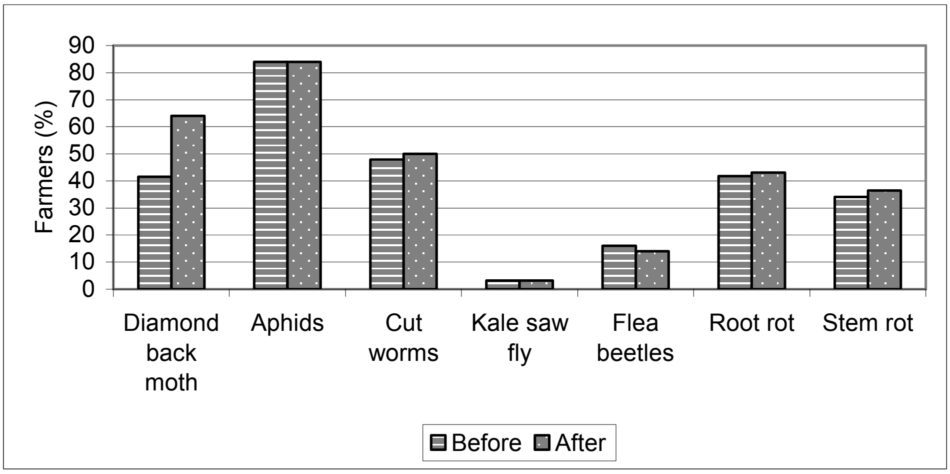

Figure 10: Farmers attempting interventions in kales constraints

Over seventy percent of the farmers reported fewer incidences of pests and diseases. This may be because the project has sensitized the farmers regarding the importance of pests and disease control. Eighty eight percent of the kale farmers reported that there was less pest infestation compared to the time before the CPP project. Similarly, 87.2% of the farmers reported that there was less disease incidence (Table 4). Seventy seven percent and 73.3% of the beans and maize farmers reported that there was a reduction in pest infestation while 75.9% and 80.0% respectively reported there was a reduction in disease incidence. However, almost 25% of the farmers reported higher levels of pest infestation and disease incidences. This category of farmers may have had a slow start in application of the new control methods or it could be due to factors beyond their control.

Table 4: Pest infestation and disease incidence after CPP

Crop	Farmers (%) reporting specified levels					
	Pests			Diseases		
	More	No change	Less	More	No change	Less
Beans	22.4	0.0	77.6	20.7	3.4	75.9
Kales	9.0	2.6	88.4	7.7	5.1	87.2
Maize	24.4	2.3	73.3	17.7	2.3	80.0
Sorghum	9.1	0.0	90.9	9.1	0.0	90.9
Sweet potatoes	25.4	0.0	74.6	20.9	1.5	77.6

7.0 Adoption rates of the technologies

The technologies promoted included improved varieties, pest and disease resistant varieties and habitat management method (push-pull plants). At the end of the crop seasons farmers were asked to indicate whether or not they would wish to use the new technologies. The reported intention to adopt is used as a proxy for adoption.

The improved varieties for maize were noted to have higher yields compared to the local varieties. The disadvantages of the improved maize varieties were high susceptibility to maize streak. The adoption rates for the maize varieties varied. The most preferred maize variety was H505 which had an adoption rate of 96%. H614 was adopted by 25% of the farmers, while H513 and H623 had adoption rates of 23% and 0% respectively. H623 was less preferred because of susceptibility to maize streak and maize smut.

Habitat management (push-pull plants) involved the use of desmodium and napier grass in the control of stalk borer. Desmodium serve as repellants while the napier grass serves as a trap crop. This technology performed better in the control of stalk borer in maize compared to the local methods. The specific advantages of the push-pull plants were that napier grass was also used as animal feed. The disadvantages of the push-pull plants were high labour requirements, limited availability of desmodium seeds, high price of desmodium seeds, and the slow growth of the desmodium seeds which delays the weeding of maize. The habitat management technology was adopted by all the farmers.

The pest and disease resistant varieties for beans (KK22 and KK8) had adoption rates of 85% and 95% respectively. Farmers reported that these varieties were high yielding, had high pest resistance, uniform maturity, are easy to cook and fetched high prices in the markets. The only disadvantage reported for these varieties was low seed availability. The use of pesticides in the control of pests in kale was adopted by 57% of the farmers. Early planting for controlling bean fly and aphids was adopted by all the beans farmers.

The technologies promoted with respect to sorghum were planting in rows, use of high seed rate, pest resistant and high yielding varieties. The varieties included Seredo, IS 8193 and IS 8613. The corresponding adoption rates were 50%, 23% and 47% for Seredo, IS 8193 and IS 8613 respectively. Seredo had the highest adoption rate because of being fast growing and high yielding. However, the Seredo variety is susceptible to bird attack and creates a lot of left over during processing. IS 8193 is not attacked by birds but has a problem of lodging since it is a tall variety; it is also late maturing, has a bad taste and is easily attacked by midge. IS 8613 is fast growing and is not attacked by birds. The farmers reported that they did not like the colour of IS 8613.

Sweet potato technologies promoted included treatment of the potato vines, planting of the potatoes in lines on ridges and use of pest and disease resistant varieties. Farmers reported appreciation of the need to select potato vines that are free from pests and diseases. Only 27% of the farmers used the new technique of planting potatoes in lines on ridges. The remainder of the farmers used the old method of planting potatoes on mounds that are not in lines. The pest and disease resistant varieties, namely Kemb 10, SPK 004, SPK 013 and Mugande, were tried by all the farmers practicing sweet potato production. The sweet potato varieties promoted were reported to be high yielding, thereby increasing production for both local consumption and marketing. Farmers noted that planting in lines on ridges is labour intensive and requires a lot of vines.

8.0 Access to information

Changes in access to crop protection information are reported in Table 5. There were improvements in access to crop protection information in terms of timeliness, content and reach of the information. Timeliness means provision of information at the time that it is needed; content refers to the message communicated; reach refers to the number of people that have access to the information. Reach was obtained by asking the farmers to indicate whether or not they thought many people had access to information because of the project activities. The number of farmers using the information increased and similarly the content of information and timeliness improved. The increase in number of farmers using the information indicates appreciation of the CPP technologies in terms of their effects on crop production. Farmers reported that their information requirements for crop production, pest and disease control were being met by the CPP project. Over seventy percent of the farmers growing the prioritized crops reported that there were increases in timeliness of the information. Over ninety percent of the farmers noted that access to information was important. As a result of access to information which was delivered with the corresponding technologies farmers were able to obtain more yield and income from the selected crops.

Table 5: Percentage of farmers reporting change in access to crop protection information

Crop	Change variable	Access improved	Access unchanged	Access essential
Beans	Timeliness	87.9	12.1	98.3
	Content	84.5	15.5	
	Reach	77.6	22.4	
Kales	Timeliness	71.8	28.2	98.7
	Content	51.3	48.7	
	Reach	23.1	76.9	
Maize	Timeliness	74.4	25.6	97.7
	Content	70.9	29.1	
	Reach	73.3	26.7	
Sorghum	Timeliness	81.8	18.2	90.9
	Content	81.8	18.2	
	Reach	63.6	36.4	
Sweet potatoes	Timeliness	73.1	26.9	97.0
	Content	67.2	32.8	
	Reach	68.7	31.3	

9.0 Conclusions

Farmers appreciated the capacity of the technologies to improve production, reduce pest infestation and disease incidences. The level of input use increased especially fertilizers; manure and hired labour, meaning improvements in crop husbandry practices and also disease and pest management. Farmers now have access to a diverse range of pest and disease control methods. The adoption rates were variable for the different technologies. The most preferred were habitat management for the control of stalk borers in maize, pest and disease resistant varieties for beans and sweet potatoes. Early planting for controlling bean fly and bean aphids was also preferred by all the farmers. Cultural practices for the control of pests and diseases in sweet potatoes were not preferred by the farmers and therefore had very low adoption rates. The percentage of farmers attempting control of pests and diseases increased, especially for bean root rot, bean fly, diamondback moth, maize stalk borer and striga weed.

Timeliness, content and reach of crop protection information for the priority crops increased. This indicates that dissemination of research outputs using the farmer field schools is effective for the prioritized crops. The technologies promoted by the CPP project enabled some farmers to obtain better yields and earn more farm income. The increased yields at small scale farm level mean an improvement in the food self sufficiency status. These technologies were preferred by the farmers because they could allow more diversification of the crop production practices, which is crucial given the high risks of agricultural production. Farmers' technical know-how and information needs for crop production were also improved.

Appendix 1: questionnaire for impact data

IMPACT DATA COLLECTION

Name of field school…………………………..………
District……………………………………...………
Division……………………………………….…......
Location……………………………………….…….
Village……………………………………………….
Name of facilitator………………...……...……......
Farmer Name…………………………………………..
Date of interview………………………………………

A. Background information

1. Age of household head…………………Years
2. Sex: a) Male …….. b) Female……………
3. Education level of farmer
a) None b) Primary c) Secondary d) Tertiary e) Non-formal
4. For those with none or non-formal education, what is the literacy level (circle appropriately-may have multiple answers)
a) Can understand Kiswahili b) Can read Kiswahili c) Can write Kiswahili
5. Household size (total number of household members) ……………………
6. Total land under cultivation
a) Owned…………….……acres b) Rented…………………..……acres
7. Total land not cultivated…………………..acres
8. Sources of income other than farming (rank the sources in order of importance)
………………………………………………………………………………………

B. Crop production: changes farmers have observed since inception of the project

9. Crop production statistics

Crops grown	Maize	Beans	Sorghum	Sweet potatoes	Kales
Variety					
Acreage					
Output (Kgs)					
Yield (Kg/acre)					
Price (Ksh/kg)					

10. Input usage statistics

Type of input	**Used (yes or no)**	**Quantity**	**Price (Ksh. per kg or lt.)**
Seeds (Kgs)			
Fertilizers (Kgs.)			

DAP			
CAN			
Manure (Kgs.)			
Pesticides (Lts.)			
Hired labour (Man days)			
Other (specify)			

11. Pest and disease management

Pest or disease	Present (yes or no)	Intervention (yes or no)	Type of intervention

How do you rate the following situations compared to the time before the CPP project?
Pest infestation (less or more or unchanged) ---
Disease incidence (less or more or unchanged) --

12. Access to Agricultural Information

Please specify the type of information you consider most important and the changes that have occurred to its access due to the project

Type of information	Preferred source	Preferred format	Timeliness*	Content*	Reach*	Help from information?
Crop production						
Pest & disease control						
Suitable varieties						
Post harvest mgt.						
Marketing						
Other (specify)						

Note * 1=improved, 2=No change, 3=worsened. Timeliness means provision of information at the time that it is needed; content refers to the message communicated and reach refers to the number of farmers that have access to (use) the information .Source of information include: research, extension, FFS/ fellow farmers. Preferred format include: printed and non printed, audio, visual and audio-visual. Help received from access to information: Yes=1, No=2

13. Change in livelihoods (welfare indicators)
Have you experienced changes that can be attributed to this project? (use table below)

Livelihood Change	**Improved**	**No improvement**	**Deteriorated**
Feeding/nutrition			
Food security			
Food self sufficiency			
Income status (wealth)			
Other (specify)			

14. Farmer perceptions about project services
Are there improvements in your management of pests and diseases? Yes/No ---------

What are the present levels of pests and diseases? (more or less or unchanged) -----

Has there been an increase in acreage of prioritized crops due to CPP technologies? Yes/no -------

Has there been an increase in output of the crops due to the new technologies? Yes/no ------------

Do you sell more or less or same now? ---

Are there any increases in your farm income due to CPP technologies? Yes/no -------