FINAL TECHNICAL REPORT

CROP PROTECTION PROGRAMME

Project Title: Promotion of integrated pest management strategies of major insect pests of *Phaseolus* beans in hillsides systems in eastern and southern Africa

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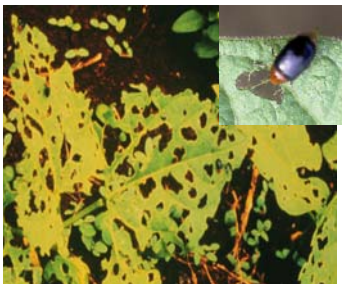

FINAL TECHNICAL REPORT

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Acronyms and Abbreviations

ADP	Agricultural Development Programme
ADRA	Adventist Development and Relief Agency
AHI	African Highlands Intitiative
AMSDP	Agricultural Market Systems Development Project
BFB	Bean Foliage Beetle
BSM	Bean Stem Maggot
CABI	Center for Applied Biosciences International
CBOs	Community Based Organisations
CIAT	International Centre for Tropical Agriculture
CMAD	Community Mobilisation Against Desertification
CPP	DFID Crop Protection Programme
DALDO	District Agriculture and Livestock Development Officer
DC	District Commissioner
DED	District Executive Director
DFID	Department for International Development of The United Kingdom
ECABREN	Eastern and Central African Bean Research Network
ERI	Enabling Rural Innovation
INM	Integrated Nutrient Management
IPM	Integrated Pest Management
IPDM	Integrated Pest and Disease Management
KARI	Kenya Agricultural Research Institute
NGOs	Non-Governmental Organisations
PABRA	Pan African Bean Research Alliance
PADEP	Participatory Agricultural Development and Empowerment Project
SABRN	Southern African Bean Research Network
SARI	Selian Agricultural Research Institute
SUA	Sokoine University of Agriculture
VEOs	Village Extension Officers
VIC	Village information Centre
WAFC	World Agroferestry Centre
WVI	World Vision International

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1. Executive Summary

The project aimed at increasing the rate of IPM technology uptake through improved dissemination strategies to reduce losses caused by major bean pests in smallholder farming systems. This was achieved through surveys to better understand socio-economic characteristics that influence technology uptake in smallholder farmer communities and increased our understanding of local knowledge systems and traditional IPM strategies. The project adopted a participatory group approach (modified farmer field school) that helped to create IPM awareness among local community members and policy makers to solicit their support and participation in project activities, and actually disseminating available IPM strategies for key insect pests and diseases of beans particularly bean stem maggots, bean foliage beetles, root rots, etc. at target locations.

The project's aim was achieved by adopting a participatory group approach and processes where sessions of group training for innovative farmers, extension officers, local leaders and other service providers in target locations were conducted. These were followed by on-farm participatory learning/demonstration trials where innovative farmers, researchers and extension officers studied the biology and ecology of the major bean pests, diseases, soil nutrients, etc. and farmer groups experimented with both traditional (wood ash, crude extracts from different botanical plants, soap and kerosene, cow urine and cowshed slurry, soil amendments, etc.) and improved crop and pest (cultural/agronomic practices, tolerant/resistant crop varieties, soil and water conservation practices, neem powder, etc.) management technologies. Different traditional and improved dissemination channels were selected by farmers and active stakeholders and were used to share and promote the results to target community members, extension agents, service providers, policy makers, donors and other audiences. These channels included formal and informal training, setting up wide scale field demonstrations/learning plots, organizing farmer field days and visits/tours, drama, songs, poems, radio messages, TV captions, preparation and distribution of promotional/extension materials, setting up village information centres (VICs) or small village libraries, etc.

Robust and dynamic farmer groups (over 250 groups with more than 60,000 members in Malawi, Tanzania, Kenya and Uganda) with spill over through partners in Rwanda and DR Congo were formed at project sites. Farmer group members at project sites have sensitised their local village leaders to set aside premises for setting up village information centres to enhance the retention of promotional materials (leaflets, posters, reports, field guides and manuals, etc.) prepared with partners on their activities and stock other relevant materials that could easily be accessed by community members. Currently there are 45 VICs in Uganda (1), Malawi (1), Kenya (3), Tanzania (8) and Rwanda (32). Innovative farmers have been training and catalysing the formation of new farmer groups at different sites in each season. The awareness creation has resulted in the diversification of constraints that farmers have experimented on (e.g. up to 11 constraints have been researched on by some farmer groups in Hai district, northern Tanzania, 5 each in Malawi, Kenya and Uganda) and obtained solutions to address them. The processes used in implementing project activities have attracted an increasing number of active partners (government ministries, NGOs, CBOs, other projects, etc.) who are now using the farmer groups for planning and implementing development programmes in target communities.

Participating farmers have accessed high yielding pest tolerant bean and other crop types as well as improved cultural/agronomic practices that have helped them raise their bean and other crop production levels. Farmers in target areas have been able to increase bean production for food security and sold the excess for improved household

income. These farmers have been linked to different partners that have enhanced their access to various services and information (on markets, farm inputs, savings and credits, farm enterprises, etc.) that helped them to address other farm production constraints. The participatory approach, its processes and the blending of indigenous and improved technologies have restored farmers' confidence and empowered them in decision making as well as raising awareness among other community members and policy makers. Partnerships in project activities have enabled participating farmers to increase farm production and contributed to improved food security and household income despite shortcomings such as frequent droughts and the increasingly high incidences of HIV/AIDS at project sites. Project activities have catalysed the creation of an enabling community environment for access by different partners and policy makers involved in different development programmes making the target communities to become models for development planning and implementation.

2. Background

Importance of beans in eastern, central and southern Africa

The common bean (*Phaseolus vulgaris* L.) is an important food and cash crop in eastern, central and southern Africa. The region has the second highest bean production after Latin America and contributes to over 25% of the global production (Pachico, 1993). The region has also the highest per capita bean consumption, i.e. 50 kg/cap/yr on the average, but in parts of western Kenya this may exceed 66 kg/cap/yr (Kirkby 1987). The crop contributes as much as 60% of the dietary protein in countries like Rwanda and Burundi and about 30% in parts of eastern and southern Africa. Common beans are highly valued by the poor because all parts of the plant are consumed: the leaves are used as spinach and the grains are eaten fresh or dried while the haulm (stems and pod shells) is a high quality livestock feed. Although beans are grown largely for subsistence and mainly by women farmers, about 40% of the total production in eastern, central and southern Africa is marketed at an average annual value of USD 452 million (Wortmann *et al* 1998). Incomes from such sales are used to cater for household needs, pay children's school fees and re-investment in farm and commercial enterprises. National research directors in eastern and central Africa (ASARECA region) have rated beans as the second most important food crop after maize in the region (ASARECA 1995).

Bean production intensity is greatest in highly populated hillsides, where farms are small and few other significant sources of dietary protein are available (Wortmann *et al* 1998). The intensification of production in such areas has resulted in the elimination of fallow periods, increased incidences of soil fertility decline and enhanced the surge of other production constraints including high population levels of insect pests and diseases. These together with periodic water stress resulting from frequent droughts are considered to be the principal agronomic constraints limiting bean productivity in the region (Allen and Edje 1990).

Bean production constraints

Beans originated in the highlands of central and South America and were introduced into Africa about 400 years ago. The crop arrived without many of its original field pests and hence, the pest spectrum in Africa differ markedly from those attacking the crop in its ancestral region. However, many indigenous pests of the other legumes, especially cowpea, *Vigna* spp. and its close relatives have adapted to beans (Abate and Ampofo 1996). Two of the principal pre-harvest pests of beans, bean stem maggots and bean foliage beetles, belong to this group. With snap bean production the high pesticide use

to protect the crop against these constraints threatens the export market as the importing countries enforce regulations on minimum pesticide residue levels (Nderitu *et al* 1997).

Bean stem maggots (BSM) *Ophiomyia* spp., Diptera: Agromyzidae)

Bean stem maggots (BSM) also known as bean flies are often described as the most important field pest of beans in Africa. Three species: *O*. *phaseoli*, *O*. *spencerella* and *O*. *centrosematis* attack the crop wherever it is grown. *O*. *phaseoli* and *O*. *centrosematis* have also been reported from Asia (Talekar and Chen 1985). *O*. *phaseoli* is the most widely distributed among the three species and is also reported in Asia (Ruhendi and Litsinger 1982, Ho 1967, Kamijo 1981, Talekar and Chen 1985, Tryon 1894, Cook 1982, Greathead 1975, Fischer 1971, CIE Map no 130). *O*. *spencerella* appears to be restricted to continental Africa. BSM is also reported to attack cowpea (*Vigna unguiculata*), mung beans (*Vigna radiata*) (Talekar and Chen 1985), Hyacinth bean (*Dolichos lablab*), *Crotolaria mucronata* (Jackai and Singh 1983), *C*. *laburnifolia* (Abate 1990), several *Phaseolus* spp. and other members of Papilinaceae.

The severity of BSM attack is often associated with poor crop growing conditions (Allen *et al* 1997, Davis 1998, Songa and Ampofo 1998) and the problem is further aggravated by the presence of soil borne pathogens such as *Fusarium* spp., *Pythium* spp., etc. (Nderitu *et al* 1997) that use wounds created by the pest to gain access into the plant. BSM oviposits directly in the plant tissue and the emerging maggots feed in the stem and disrupt nutrient transport. The leaves of attacked plants turn yellow, wilt and the plant dies. Older plants attempt to compensate for the damage by producing adventitious roots but sometimes this result in the swelling and cracking of the lower part of the stem. Surviving plants are often stunted and grain yield is reduced. BSM attack is most severe in late planted crops. Significant synergistic interactions between BSM and root rots attack on beans have been reported (Nderitu *et al* 1997). The estimated annual bean production losses due to BSM attack is 194,000 and 96,000 tons in eastern and southern Africa respectively (Wortmann *et al* 1998).

Bean foliage beetles (BFB) (*Ootheca* spp., Coleoptera: Chrysomelidae)

Bean foliage beetles (BFB) are restricted to tropical Africa, where they attack beans, cowpea and various other legumes. Two species: *O*. *bennigseni* and *O*. *mutabilis* are reported from eastern and southern Africa. *O*. *bennigseni* appears to be restricted to eastern Africa while *O*. *mutabilis* is more widespread (CIE Map nos. 487 and 488). Specimens held at the Kenya National Museum suggest that *O*. *bennigseni* is more prevalent in the highlands while *M*. *mutabilis* is mostly found in lowlands. The adult insects feed on leaves of beans and other host plants and often cause total defoliation in outbreak populations. Eggs are laid through cracks in the soil at the root zone and the emerging larvae feed on the bean roots, poaching nodules and removing lateral roots. Larval feeding activity disrupts nutrient transport and the potential for nitrogen fixation. Attacks by early instars may go unnoticed but the older larvae remove lateral roots and cause wilting and premature senescence in affected bean plants (Ampofo and Massomo 1998). Bean foliage beetles are associated with the transmission of viral diseases on cowpea in West Africa (Allen *et al*. 1987) but this has not yet been established for beans.

Until recently, BFB was perceived as a sporadic pest for beans (Ampofo and Massomo, 1998) and cowpea as the causes of population outbreaks were not fully understood. The pest was considered important in localised areas only (Wortmann *et al*. 1998). Intensive and extensive observations have revealed the pest to cause severe attacks in

many parts of the eastern (Uganda: Tumwesigye 1999, Kasharu 1999, Tanzania: Slumpa 1999), central (Rwanda and DR Congo) and southern Africa (Malawi: Ross 1998). Intensified studies of the pest life history in Tanzania (Ampofo and Massomo 1998) have shown patterns of adult emergence in relation to rainfall regime and the planting of beans and other host plants. The studies suggested that BFB population outbreaks are the result of intensification (continuous planting of beans on the same parcel of land without rotation or fallowing) and this is likely to spread further as intensification expands due to human population growth.

Existing management strategies

Farmer management strategies before the onset of the project were not adequately suppressing the pest populations. Sometimes farmers could not understand the problem or they were not aware of the pest and attributed the damage symptoms to other causes such as drought ("burning of the plants" in the case of BSM), onset of first seasonal heavy rainfall incidences (in the case of BFB, "beetles are brought by the rains and disappear with the rains"), continuous rains ("rotting and death of plants due to too much water", in the case of root rots), or "tiredness of the soil" in the case of infertile soils, etc. In some areas, problem awareness had been raised through the extension and other service agents' (e.g. NGOs, etc.) intervention and participatory research had raised farmers' consciousness of their indigenous technical knowledge. However, management strategies promoted by the national extension services have been heavily dependent on conventional commercial pesticides that are often costly, unavailable to the smallholder farmers and environmentally unfriendly. In the case of BFB, farmers appeared to have no solution: in parts of northern Tanzania they delayed planting of beans to avoid high invading beetle populations, but such delays predisposed the crop to high BSM attacks and terminal drought. Some farmers stopped cultivating beans altogether in those areas where the problem was most severe (Farmers in Hai district, Kisaka and Ulicky, pers comm.).

A summary of research already conducted

Collaborative research work by national research and extension systems in eastern, central and southern Africa, CIAT, regional bean research network- ECABREN and the African Highlands Initiative (AHI) focused on developing and disseminating sustainable strategies for the management of the these pests. Management strategies have included genetic resistance, chemical seed dressing, cultural practices to reduce population build ups, and integrated soil/water and crop management strategies to enhance plant vigour and tolerance to the pests. Dissemination of some of these management strategies was in progress in pilot areas of northern Tanzania in collaboration with the extension service and through AHI.

Bean stem maggots:

<u>Host plant tolerance/resistance</u>

Host plant tolerance/resistance offers an easy and sustainable approach to the management of this pest by smallholder farmers who are often unable to purchase agricultural inputs. CIAT and the Bean research Networks have invested considerable efforts in this area of research. Through various sub-projects and other research activities, scientists have identified tolerant/resistant bean genotypes (Abate 1990, Ampofo 1995, Ampofo and Massomo, 1998). In cases where the resistance is available in acceptable seed types, they have been disseminated to farmers through on-farm and other farmer participatory trials or else they have been used in breeding programmes to transfer the resistance. The Multiple Constraint Breeding Project supported by the Pan African Bean Research Alliance (PABRA), is designed to incorporate resistance to key

pest constraints in market acceptable varieties for the network countries. The Participatory Plant Breeding Programme, with sites in Ethiopia and Tanzania, had among its objectives, breeding for BSM tolerance with farmers. The support to such breeding activities has resulted in the release of two varieties (Beshbesh and Melkie) bred at CIAT and selected by the Ethiopian National Programme for cultivation by farmers. These varieties have been taken up by CONCERN- Ethiopia (an NGO) for multiplication and dissemination to farmers in affected areas of Ethiopia. Other lines from the CIAT breeding programme have been selected for dissemination in Kenya, Malawi, Tanzania, DR Congo and Uganda through their respective NARS. The levels of resistance currently available, however, do not give complete protection against high pest populations but they perform better when used in combination with other strategies.

Biological control

Studies on the biology of various BSM species in Taiwan (Talekar and Chen, 1985) and in Uganda (Greathead 1968) revealed that most parasites attack the larvae (maggots) and emerge from the pupae. A large number of parasites have been reared from BSM puparia. In Africa, these include *Opius liogaster* (Taylor 1958), *O. melanagromyza* and *Eucoilidea* sp. (Greathead 1968, Autrique 1989, Sithanantham 1989), *Opius phaseoli* (Songa and Ampofo 1998, Sithanantham 1989), *Sphegigaster stepicola* and *S. brunneicolis* (Abate 1990). In Burundi, Autrique (1989) observed a high level of parasitism during the early infestation period but in northern Mozambique, Davies (1998) found parasitism to peak towards the end of the growing season when the damage was already done. Davies (1998) suggested avoidance of pesticide use to maintain parasitoid populations at acceptable levels through the season. In general, parasites are unable to exert adequate control for BSM in Africa but *Opius* spp. imported from Uganda to Hawaii established and exerted control over *Ophiomyia phaseoli* (Fischer 1971, Greathead 1975). The role of pathogens in BSM mortality and population dynamics is not adequately understood. It is anticipated that since the entire developmental stages occur within the plant tissue, it is unlikely that the application of fungal pathogens will be effective, but this needs investigation.

Chemical seed dressing

Several national programmes have identified chemicals (e.g. endosulfan, diazinon or lindane) that can be applied at low doses as seed dressing to provide protection to germinating plants at a time when they are most vulnerable to BSM attacks (Abate 1991, Trutmann *et al*. 1992). Other pesticides such as dimethoate can be applied as foliar sprays when early symptoms of attack (e.g. leaf punctures) are observed. Chemical seed dressings have a good potential in BSM management but often they are unavailable to farmers and in some cases they have been promoted without adequate information about their proper use or safety precautions. Farmers tend to prefer chemical approach as it is very easy and is more dramatic in their effects. CIAT and the networks see commercial pesticides as a last resort to pest control and focus on other environment friendly approaches. Chemical seed dressing is especially useful when used in combination with other approaches such as organic amendments to enhance soil fertility (Autrique 1989, Ampofo and Massomo 1998).

Bean foliage beetles:

Cultural practices

The majority of smallholder farmers often intercrop beans with other crops including maize, bananas, coffee, vegetables, etc., while a few would rotate beans with maize,

vegetables and other crops if land is not a limiting factor. Farmers claim that chemical pesticides are not very effective because the pest emerges in waves from the soil and feed voraciously on the foliage and when sprayed they fly away or drop off the plants to the ground. In a participatory study of the biology of the bean foliage beetles (BFB) with farmers in northern Tanzania, Ampofo and Massomo (1998) observed that the adults emerge from diapause in response to the planting of beans or other hosts such as cowpea. The adults feed on leaves and lay eggs in the soil near the roots of bean plants. The emerging larvae feed on the roots of beans or other host plants. The development of the pest (from egg to adult) takes about 100 days (March to July) in northern Tanzania and the teneral adult goes on diapause until the next long rainy season. High levels of mortality occur during diapause and delayed rains or planting of beans or other hosts cause further mortality with a resultant low residual population to attack the emerging crop. Timely (delayed) sowing is identified as a pest avoidance method for BFB management. In a related study, Ampofo and Massomo (1998) observed that BFB adults only emerged in the presence of beans or other host (e.g. cowpea) seedlings in the field. The beetles did not emerge in plots planted to non-host plants such as maize or soybean or in fallow plots although they were present in the soil. The two authors hypothesised that the adults are stimulated to emerge from teneral diapause by exudates from the roots of the host plant. Trials in the laboratory showed the larvae to survive on bean and cowpea roots but failed on soybean and maize roots. Crop rotation was recommended as an approach to BFB management as it breaks the pest's development cycle and reduces population levels significantly. This method however, requires a community approach to synchronized planting, rotation and other strategies.

Host plant resistance

In Tanzania, Karel and Rweyemamu (1985) evaluated 20 bean genotype accessions and found 6 resistant (non-preference for foliar feeding) while others appeared to be tolerant to foliar damage. Screening work at CIAT Arusha on a set of core collections comprising 1500 germplasm accessions revealed no resistance. However, several accessions showed moderate damage levels and they recovered and produced reasonable grain yields. It appears that if the growing tip of the bean plant is not damaged and other growing conditions are favourable, the recovery rate is generally good.

Botanical pesticides

Botanical pesticides such as neem (*Azadirachta indica*) seed powder and seed oil were tested for their effect on BFB attack (Ampofo and Massomo 1998). Both formulations were found to have a repellent/anti -feedant effect on the adult beetles. The effect lasted for 3-5 days and 2 applications were enough to protect the bean seedlings at the most vulnerable stages of plant growth. The above strategies are from among various other possible options for BFM management. However, farmers selected them because they were more compatible with their production systems and could be established with little or no extra costs.

Interactions between BSM, BFB, root rots and other constraints

Research from PABRA and the Bean Networks indicate synergistic interactions between BSM and root rots such as caused by *Fusarium* spp. and *Pythium* spp. Both problems are aggravated by the decline in soil fertility associated with high human populations and intensification of production. The mode of interaction is not very well understood, but it is hypothesized that BSM feeding and oviposition (piercing of seedling hypocotyl) creates avenues for entry by the pathogenic organisms (Ampofo

1993, Davies 1995). Plant mortality is higher when BSM and root rots occur together. A model developed by Wortmann *et al* (1998) suggests that yield reductions caused by this interaction in smallholder farmers' fields is underestimated and predicts an increase in severity and spread unless appropriate management strategies are developed and widely disseminated.

BFB is most severe in the early planted crop and in some areas farmers delay planting to avoid this pest. However, delayed planting also predisposes the crop to BSM infestations and damage. This phenomenon leaves farmers in dilemma and hence, the availability of strategies for the management of the two pests would enable them to make the best of the prevailing environmental conditions to produce their beans efficiently. Furthermore, BFB larvae feed on bean (and cowpea) roots and poach the nodules, resulting in reduced nitrogen fixation by beans and loss of soil fertility improvement.

Identification of the demand for the project

The demand for the project work had been expressed through various routes including stakeholders meetings, surveys and project development and planning workshops. A participatory planning workshop of National Research and Extension Systems from the SADC countries identified bean stem maggots (BSM) and bean foliage beetles (BFB) among the top ten priority constraints to bean productivity in the region. The CIAT and the Bean Entomology Working Group (entomologists from eastern, central and southern Africa) of the Bean Networks, also identified BSM and BFB among the three top insect pests that constrain bean productivity in the region. In Tanzania, a national bean research planning workshop also identified BSM as the first priority constraint to productivity nationally.

Individual farming communities have identified BSM and BFB as key pests and have conducted activities to address them (e.g. Ampofo and Massomo 1998). In a PRA in Malawi, aphids, BSM and BFB were identified as the three most important pre-harvest pests (Ross 1998). Ross observed that usually farmers do not control these pests, as appropriate methods are not available to them. She concluded that there is an "urgent need for the development of cheap and effective control measures for the pre-harvest pests of beans, particularly aphids, BSM and BFB".

The African Highlands Initiative (AHI) identified BSM as priority pest associated with systems degradation and selected it as one of its priority areas of research. In northern Tanzania, farmers and various district governments identified BSM and BFB as key pests in smallholder production systems and approached the research division for assistance in addressing them. The Bean Research Networks (ASARECA and SADC) have been supporting a number of sub-projects emerging out of this demand.

3. Project Purpose

The purpose of the project was to contribute to the reduction of losses caused by bean pests in particular bean stem maggots and bean foliage beetles through effective targeting, dissemination and adoption of IPM strategies that are acceptable to smallholder farmers in the highlands of eastern, central and southern Africa.

Several pest management strategies have been developed through various NARS, the regional bean research networks, NGOs and other stakeholders. However, uptake of these outputs has been slow because of inadequate promotional strategies. The

purpose of the project was to increase community awareness of pest constraints and increase the uptake of IPM technology through the promotion of sustainable control methods for bean pests in smallholder production systems. The project aimed at increasing IPM awareness at the community level and among policy makers to support IPM as a sustainable pest control strategy. The project has been promoting IPM strategies for bean pests through various channels such as extension information materials; training of innovative farmers, extension personnel and other service agents involved in technology dissemination; catalysing the formation of farmer research groups; participatory on-farm field demonstrations at different sites, farmer meetings/conferences; farmer field days and tours/cross visits; traditional drama/songs/poems; setting up village information centres/libraries, radio messages and TV captions; exchange of improved bean seed and other farm inputs using small packs.

The achievement of the project outputs has contributed to an increased adoption and use of appropriate IPM strategies in bean production systems. This has enhanced the promotion of sustainable systems and natural resources management. The project has created IPM awareness among farming communities at target areas and promoted acceptable and effective IPM strategies for the major bean pests, particularly BSM, BFB and root rots. Participation in project activities has helped to enhance the formation of farmer research groups and increased farmers' capacity to understand factors that lead to pest problem development and provided them with available options for pest management. Similarly, researchers and extension agents have gained a better understanding of farmers' behaviour and preferences in technology development and dissemination. The participatory approach in development, monitoring, evaluation and promotion of IPM strategies has contributed to enhancing the empowerment process for target communities. It has helped farmer research groups to gain links to policy makers and partners who assist with planning and management of their natural resources in a more sustainable manner compared to the previous situation before commencement of project activities. Partners have provided various services including training for farmers and extension agents, support to on-farm demonstrations/field days/field visits, preparation and distribution of extension materials, farm inputs, information on markets, etc. Such services have helped farmers to improve crop production for food and household income generation.

4. Research Activities

The Pan African Bean Research Alliance (PABRA) provides a framework for collaboration between CIAT and the bean networks (Eastern and Central African Bean Research Network – ECABREN and Southern Africa Bean Research Network – SABRN) that involve countries in ASARECA and SADC regions, respectively. Project activities were conducted in collaboration with farmers, network scientists, NGOs and other stakeholders in target locations in Kenya, Malawi and Tanzania in the initial 3 years of the project. In the past one year, activities were scaled up at pilot sites and scaled out to Uganda with promotional materials shared with farmers and scientists in Rwanda, Ethiopia, Madagascar, DR Congo, Zambia, Mozambique and Sudan. The outputs from the project have been shared and promoted through the networks to several other bean and cowpea growing environments in eastern, central and southern Africa where BSM and BFB are important pests.

4.1 Output 1: Farmers perception of pests, traditional knowledge and pest management strategies determined and documented

Activities

1.1 Stakeholders' workshop to refine and finalise project activities and implementation plan. Several institutions have direct linkages with farmers participating in the project. A planning workshop involving project stakeholders was organised and held in Arusha, Tanzania on 29-31 January 2001. Workshop participants discussed and finalised the work plan and ensured co-ownership of the project. The workshop also ensured that activities were well targeted. The workshop helped in the identification of appropriate dissemination pathways and planned delivery strategies that would be used to achieve maximum impact. The 'face-to-face' brainstorming facilitated the development of personal contacts and experience sharing among collaborators that has catalysed easy communication and project coordination processes.

A mid-term project evaluation and planning workshop for stakeholders was organised and conducted on 11-13 November 2002 also at Arusha, Tanzania. Participants including site coordinators, farmer group representatives from Kenya and Tanzania, NGOs from Malawi and Tanzania, CIAT Africa at Kampala, Uganda and CIAT Arusha, critically reviewed progress in project activities and planned for future activities.

1.2 Understanding local knowledge systems and traditional IPM strategies. Some PRA to understand farming systems and general production constraints were undertaken through DFID projects R 7568 and R 7569, CIAT, AHI and the Bean Networks. Further PRA were conducted to understand farmers' problems and their perceptions and practices in relation to bean pests and their management, including the role of natural enemies. Special focus was on farmers':

- indigenous knowledge of pests and their management
- perceptions of conditions that lead to pest build up and outbreaks (e.g. environmental effects such as rainfall, drought, soil fertility, cropping pattern, etc.)
- interactions between pests and diseases e.g. BSM and root rots
- constraints on pest management e.g. availability and cost of inputs
- social and cultural variations in farmer perceptions and practices
- mapping out demographic characteristics of the different communities
- identification of research issues and needs with communities at each location

A selection of farmer communities or research groups was identified for more detailed participatory research on bean pest management.

4.2 Output 2: Socio-economic characteristics of community uptake of IPM technologies (within and between communities) determined and documented

Activities

2.1 A baseline survey of the socio-economic characteristics of the target communities. The study collected data on:

- Ethnicity and cultural beliefs especially with regard to pests, attitudes to investment in more productive agriculture, etc., social capital, community networks that could facilitate group action including IPM dissemination and control over inputs.
- Wealth status and ranks within and between communities. This included access to and ownership of land and farm size, access to affordable technology, education/knowledge status including the richness of indigenous technical

knowledge. These were related to characteristics of the IPM technology, e.g. weather:
    - -resource dependent e.g. application of external inputs such as chemical pesticides for BSM or BFB control,
    - -resource independent e.g. zero tillage for BFB management or earthing-up for BSM management,
    - -gender differentiation in the above characteristics or in indigenous technical knowledge
- Farmer/community behaviour in adopting or rejecting IPM technology was studied and documented during the promotion processes and comparisons made between technologies, dissemination methods and farmer categories. Socio-economic factors influencing IPM technology uptake and adoption/rejection of research results were better understood and documented.
- Knowledge about the socio-economic characteristics of the community was used to narrow down on the kind of technologies and dissemination pathways that suited end users best to appropriate technology targeting to farming communities for better adoption.

4.3 Output 3: IPM awareness increased at the village community level and among policy makers

Activities

3.1 Participatory monitoring and mapping activities. These were initiated to enhance farmers' understanding of factors influencing pest populations and pest problem development in general. This involved community study of pest biology and ecology and the effects of farming activities on pest population development. This activity contributed to increasing farmer awareness of BSM and root rots as well as other pests and diseases and the synergistic effect of their attack on bean plants.

3.2 Understanding the role of natural enemies in the system. Collection, culturing and preliminary evaluation of natural enemies: samples of the different stages of the target pests were collected at different sites during field activities. Interactions between natural enemies e.g. spiders, wasps, frogs, lizards, other insects, etc. and the target pests were discussed with farmers during field training, monitoring and evaluation.

3.3 Village Information Centres. Farmer group members sensitised their local leaders to set up Village Information Centres (VICs). The objective is to provide easy access to IPM information and other relevant materials to target communities within the village. Such information is in the form of extension materials about general agriculture with emphasis placed on pests and diseases. Such materials include leaflets, posters, field guides, handbooks, newsletters, various farmer activity reports, relevant information from various departments and information downloaded from the Internet. The information has been used to increase farmer's knowledge on pests, factors leading to pest incidences, capacity to develop management strategies and increase in their desire to seek appropriate technologies accordingly.

3.4 Sensitisation of policy makers. Policy makers at all levels were targeted through invitations to participate in farmer group training seminars and workshops, farmer field days, farmer group visits, stakeholder technical planning/monitoring/evaluation of project activities, etc. Efforts were made to invite the media to document stories on farmer activities and used the radio and TV to air programmes on bean crop production. Scripts were prepared by researchers and extension agents for this purpose. Copies of project promotional materials were shared with policy makers. These channels have

raised wide awareness and encouraged policy makers and partners to support IPM practice.

4.4 Output 4: Availability of IPM technologies for bean pests increased at the target sites

Activities

4.1 Training of extension staff (including participating NGOs) and participating rural school teachers of agricultural science in order to disseminate the IPM technologies appropriately. Project promotional materials (leaflets, posters, field guides, Videos, etc,) were used in training new actors.

4.2 On-farm participatory demonstration/ evaluation of IPM methods. IPM technologies under promotion were applied by participating farmers in collaboration with partners and other farmers were invited to view and discuss their observations during field visits, field days and farmer meetings. Some of the demonstrations were conducted at participating rural school and college gardens in collaboration with teachers and pupils/ students. Such schools also served as venues for farmer field days.

4.3 Cross village and across site visits. The visits have enhanced information sharing and exchange among farmers and encouraged farmer to farmer technology dissemination. Across location and cross border farmer visits (to root rot and other bean diseases research locations) were organised and have enhanced farmer understanding of insect pest/disease/soil fertility interactions.

4.4 Dissemination through rural schools. Rural schools and colleges with agricultural focus were involved as far as possible in Kenya, Uganda, Tanzania and Malawi. CIAT's experience in IPM technology dissemination through the Makiba Secondary School in northern Tanzania indicated that this pathway reaches more families as pupils and students take home what they have learned. It also enhances the capacity of future farmers to understand, generate and practice IPM more effectively.

4.5 Participatory monitoring and evaluation. Frequent monitoring and evaluation of project activities by stakeholders has been carried out at each target site during the crop growing season. At the end of season, each site group reviewed what was done and the relevance of the outcomes in relation to the project objectives and farmers' production targets for beans in general. Participants make the necessary adjustments to enhance efficiency and relevance of project products.

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6. Outputs

All the anticipated project outputs were achieved despite constraints beyond project management that included unfavourable weather conditions, staff turn over and delays in progress reporting by some of the project collaborators.

6.1 Output 1: Farmers perception of pests, traditional knowledge and pest management strategies determined and documented

The participatory approach and processes adopted in project activities enhanced the evolution of social capital in the form of farmer research groups. There are currently more than 250 active farmer groups with more than 50,000 active members at project sites in Malawi, Tanzania, Kenya and Uganda (Table 1.1). Scaling out with different partners in Rwanda and DR Congo in the past one year has generated some additional farmer groups. Over 60% of group members are women farmers who also play key roles in group leadership. The groups have been instrumental in planning and implementing major development activities in partnership with other institutions in their

respective communities. Group members have been very keen to learn by doing and sharing knowledge, exchange experiences, training other farmers and reporting their own research results (Appendices). Groups have engaged in group to group visits resulting in farmer to farmer dissemination of knowledge beyond the expectation of the project. During the project, researchers and extension personnel have developed a better understanding of the operation and needs of different types of farmers and farmer groups.

Table1.1 Number of active farmer groups and group members at project sites in eastern and southern Africa

Country	Total number of groups	Estimated number of active farmers in groups	Number of operational Village Information Centres (VICs)
Malawi	50	1,000	1
Tanzania	150	50,000	8
Kenya	40	4,000	3
Uganda	20	2,500	1
Rwanda			32
Total	270	57,500	45

Malawi

1. Bembeke Extension Planning Area (EPA)

According to farmers, the major pests on beans in Bembeke, Dedza district in central Malawi include bean stem maggots, aphids, bean foliage beetles, pod borers, bruchids and leaf diseases (Table 1.2). Traditional strategies that farmers experimented with included crude leaf extracts from *Tithonia* sp. (locally called Deliya), *Tephrosia* spp. (Local name Jerejere), crude tuber extract from *Neuratanenia mitis* (local name Teta), livestock manure, different combinations of these, bean + *Tephrosia* interplant and an untreated control.

Table 1.2 Major bean insect pests and existing control strategies identified by farmers and stakeholders at Bembeke extension planning area, Dedza district, Central Malawi

Common name	Scientific name	Local name	Control strategy
Bean fly	*Ophiomyia* spp.	Ntchenche, Chiwawu	Cultural practice- e.g. timely planting
Aphids	*Aphis fabae*	Nsabwe	Botanicals, e.g. Teta
Bean foliage beetle	*Ootheca* spp.	Kam'mbatchi	Botanicals
Pod borers	*Maruca* sp. *Helicovepa armigera*	Mphutsi	None
Storage weevils	*Acanthoscelides obtectus* and *Zabrotes subfasciatus*	Kafumbwe	Wood ashes
Pod suckers	*Clavigralla* spp, *Riptortus* spp., *Anoplocnemis*	Gongoni	None

	Nezara viridula		
Semi-looper	*Trichoplusia* sp.	Mbinimini	None
Cutworm	*Agrotis* spp	Chitukuza	Cultural practices

The work in Malawi started with 4 farmers from Bembeke extension planning area (EPA) villages near the Bembeke Agricultural Field Station in 2002/03. The following treatments were used:

1. Untreated control
2. *Neuratanenia mitis* + manure
3. Tithonia + *N. mitis* crude extract spray
4. Bean + *Tephrosia* interplant + *N. mitis* crude extract sprays
5. *Tephrosia* only
6. *N. mitis* only
7. *Tithonia* only
8. Livestock manure
9. *Tephrosia* interplant

Results

Field assessments were made on aphid infestations. The highest aphid numbers were scored in the untreated control and the lowest scores in plots where livestock manure was integrated with sprays of crude extracts from *N. mitis* tubers (Figure 1.1).

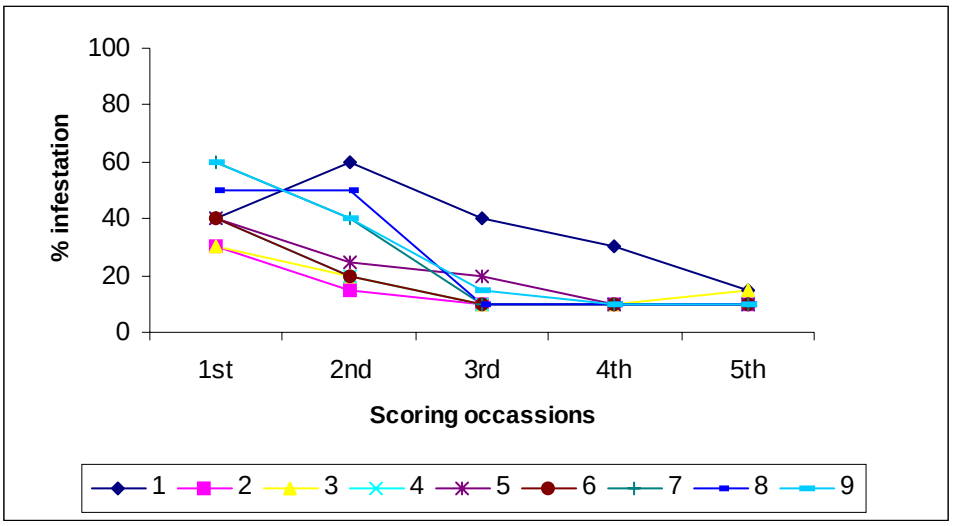

Figure 1.1 Bean aphid infestations in on-farm trials at Bembeke EPA, Dedza district in central Malawi during 2002/03 cropping season

Significant bean grain yield differences were recorded among the 9 treatments with least in the untreated control and highest where farmers combined *Tithonia* as green manure and *N. mitis* crude extract sprays to the bean plants (Table 1.3). The results indicated that botanical crude extracts were effective in the control of aphids and that a combination of botanical sprays or botanical sprays with manure gave the best levels of control. The results on *Tephrosia* and *N. mitis* were similar to results generated by farmers in the southern highlands of Tanzania where the 4 Malawi farmers had toured. The farmers in Malawi however, took a step further by testing the different combinations of botanicals and manure. The farmers expressed their

satisfaction in that their results were promising and they could detect the strategies to promote in their own fields.

Table 1.3 Effect of botanical crude extract sprays for insect pest control on Phaseolus bean grain yield (kg/ha) at four on-farm sites in Bembeke EPA, Dedza district, central Malawi during 2002/2003 growing season

Treatment	Farmer				Mean
	I	II	III	IV	
Untreated control	1587	1181	486	1111	1093 [e]
Bean/Tephrosia interplant	1667	2708	556	1041	1493 [de]
Livestock manure	2083	1319	1805	2638	1961 [cde]
Tithonia only	2013	2638	2222	2055	2232 [bcd]
Bean/Tephrosia interplant with N. mittis spray	2986	2069	1806	1875	2309 [abcd]
N. mitis spray and Manure application	2083	2361	2778	2430	2413 [abcd]
Tephrosia spray only	3056	3750	2500	2361	2917 [abc]
N. mitis spray only	3611	3888	2861	2708	3267 [ab]
Tithonia and N.mitis spray	4028	4097	3056	2083	3316 [a]
C.V.% Significance level LSD (0.01)					11.3 ** 1058

2. Kasungu district

The two project locations in Kasungu district (Bokosi Nyirenda and Chisewu) are almost 200 km away from Bembeke in Dedza district, central Malawi. When farmers in Bokosi Nyirenda were interviewed, they could describe the damage symptoms resulting from different insect pests on beans while those at Chisewu had local names for most common pests (Table 1.4).

Table 1.4 Common insect pests and bean crop damage symptoms at Bokosi Nyirenda and Chisewu villages in Kasungu district, central Malawi

Bokosi Nyirenda	Chisewu (Local names in brackets)
1. Beans dying and drying	1. Aphids (Nyinda)
2. Aphids and ants	2. Ants (Nyerere)
3. Fly	3. Fly (Ntchetche)
4. Swollen and split bean stems	4. Pod bores (Vibungu)
5. Leaf yellowing and drying	5. Bean foliage beetles (Lwenya)
6. Small maggots in stems	6. Swollen and split bean stems
7. Bean foliage beetles	7. Elegant grasshoppers (Mnunkhadala)
8. Elegant grasshoppers	
9. Pod bores	

Following discussions on the biology, life cycle, ecology and damage caused by the different insect pests, farmers prioritised the bean pests at the two locations (Table 1.5). Both villages seem to have similar pest problems. Farmers did not know bean fly damage and therefore, could not determine the cause of bean leaf yellowing, stem swelling and cracking in most of their fields. Bean fly was a major problem but farmers could not associate the damage to bean fly until the day they were interviewed. Because aphids were associated with the black ants, most farmers thought that the ants were as bad as the aphids and that they also deserved to be controlled. Most farmers from Chisewu village, a village close to Malawi/Zambia boarder bought their chemicals from Zambia and in general, they seemed to use strategies that were learnt from Zambian farmers.

Table 1.5 Farmers' ranking of major bean insect pests based on the level of importance at Bokosi Nyirenda and Chisewu villages in Kasungu district, central Malawi

Bokosi Nyirenda	**Chisewu**
1.Bean fly and plants with swollen stem	1. Bean fly
2. Aphids	2. Aphids
3. Bean foliage beetle	3. Bean foliage beetle
4. Pod borers	4. Pod borers
5. Elegant grasshoppers	5. Elegant grasshoppers

The existing control strategies for the different pests at the two villages according to the interviews are listed in Table 1.6.

Table 1.6 Bean insect pest control options used by farmers at Bokosi Nyirenda and Chisewu villages in Kasungu district, central Malawi

Bokosi Nyirenda		Chisewu	
Insect pest	Control option	Insect pest	Control option
1. Bean fly	Nothing	1. Bean fly	Nothing/avoid weeding during a dry spell
2. Aphids	DDT and Sevin	2. Aphids	Tephrosia (Local cultivar)
3.Bean foliage beetle	Late planting	3. Bean foliage beetle	Delayed planting
4. Pod bores	Nothing	4. Pod borers	Decis, Solubar (Boron)
5.Elegant grasshoppers	Physical killing	5.Elegant grasshoppers	Physical killing

Bean IPM activities were initiated by the project in partnership with Ministry of Agriculture and Irrigation in Malawi, CIAT Malawi and PLAN International (NGO) early 2004 with Kasungu farmer representatives making a visit to Bembeke EPA to share information and exchange experiences. The visiting Kasungu farmers toured

two Bembeke villages (Simuka and Kamgulitse) where group members had established the following demonstrations and learning plots:

1. Combining manure and *Vernonia* to control bean insect pests
2. Integrating time of planting and use of botanical (*Vernonia)* to reduce insect pest damage
3. Demonstration on use of botanical (*Tephrosia*) for control of insect pests in unimproved bean varieties.
4. Use of botanical (*Vernonia*) for the control of cabbage insect pests
5. Demonstration on integrating resistant bean variety and botanical insecticide application (*Neuratanenia mitis* -Teta).
6. Evaluation of 5 climbing bean varieties (RWV 1042-2-2, RWV 1940-3, RWV 1036-1, CAB 19, Farmers' local cultivar)

The Kasungu farmers were impressed by the activities and determination of their friends in Bembeke in management of bean pest problems. Visitors asked the following questions:

Q What type of botanicals do you usually use?
Answer: *Vernonia* (Futsa in Chichewa or Soyo mkulu in Tumbuka), *Tephrosia* (Jerejere in Chichewa, Mtetezga in Tumbuka), *Neuratanenia* (Teta in Chichewa, Chidindili in Tumbuka), Sisal (Khonje in Chichewa and Tumbuka), *Tithonia* (Delia in Chichewa)

Q Where did you learn about the use of botanicals for crop pest control?
Answer: This was passed to us from our parents and grandparents (ancestors)

Q How do you ensure that you have enough botanicals?
Answer: Botanicals such as *Vernonia* and *Tithonia* are found in the wild while most of the *Tephrosia* was provided by other projects for soil fertility improvement and is now readily grown by most households.

Q Why do you apply manure in beans and what type of manure do you use?

Answer: Our soils respond to manure application. When we apply manure we have vigorous plants which for no reasons seem to withstand most pest attack. We usually use compost manure made from plant leaves or debris.

Q How do you prepare the compost manure?
Answer: We dig a pit in which we throw all sorts of trash and waste. The trash and waste is applied as manure in the field when it is decomposed.

Q When do you start applying the botanicals and how often do you apply them in the field?
Answer: We start applying botanicals immediately after 100% germination and continue to do so once every week until crop maturity.

Q How do you prepare the botanicals?
Answer: We pound leaves (*Tithonia* or *Vernonia*) or root tuber (*Neuratanenia*), soak the pounded material in water and leave the mixture to stand over night and apply the following day with the aid of a broom to sprinkle the mixture onto the plant.

Q Since we use bean leaves as spinach, how long should we wait before plucking the leaves for consumption after applying the botanicals?

Answer: We normally wait for a period of one week.

The visiting farmers were impressed with what their hosts/friends are doing and expressed willingness to establish similar IPM activities in their communities.

Tanzania

Hai and Lushoto districts

The evolution of farmer research groups during the life of the project has been dramatic at some of the sites. Linking the activities of the bean IPM project and other projects (DFID projects *R 7568, R7569, R7564 and R7954, and others based with different institutions including AHI*) has enabled participating farmers and partners to gradually gain knowledge and awareness that helped them to increase their scope of experimentation. Such farmers gained capacity to address not just one but a number of multiple constraints that limit farm production at their locations using both traditional and improved strategies. For example, in Hai (northern Tanzania) few farmers started experimenting on the management of bean foliage beetle (BFB) in 1998. The pest is sporadic but very destructive when there are out breaks on beans, cowpeas and other legumes. It is locally called as "Kirombosho" in Hai and "Kiindi" in Lushoto and farmers knew that the adults cause "toboatoboa" (make holes) on bean and cowpea leaves (Table 1.7).

Table 1.7 Major insect pests on beans according to Lushoto and Hai farmers including other local names

Species name	Common name	Kiswahili	Local name at Lushoto (Kisambaa)	Other local names
Ootheca spp.	Bean foliage beetle	Mbawakavu wa majani	Kiindi	Kirombosho (Kichaga), Nasheve (Kipare), Nadolukunya (Kimaasai)
Ophiomyia spp.	Bean fly	Inzi wa Maharage		
Aphis spp.	Aphids	Vidukari	Kifizi	Kimamba (Kichaga)
Agrotis spp. *Spodoptera* spp.	Cutworms	Sota	Zukizi	
Acanthoscelides sp. and *Zabrotes* sp.	Bruchids	Vipekecha	Visaga	

Some farmers also knew about effective traditional options for management especially botanicals for non livestock keepers (e.g. Lushoto) and livestock products for livestock and mixed farmers (e.g. Arusha, Arumeru, Hai, etc.) (Table 1.8).

Table 1.8 Traditional materials tested for bean pest management by Lushoto and Hai farmers

Botanical spp./Other materials	Location of original use	Other local and traditional names
Vernonia spp.	Lushoto, Hai	Muhasha (Kiswahili), Mhasha (Kisambaa)
Pycnostachys spp.	Lushoto	Donondo (Kisambaa)
Tithonia sp. (Wild sunflower)	Lushoto	Alizeti pori (Kiswahili and Kisambaa)
Tetradenia spp.	Lushoto, Hai	Zaake (Kisambaa), Ikingili (Kichaga), Iduri (Kipare)
Euphobia spp.	Lushoto, Hai	Mnyaa (Kiswahili), Muui (Kisambaa), Mwasa or Maasa (Kichaga) and Mwasi (Kipare)
Euphobia spp.	Lushoto, Hai	Mnyaa (Kiswahili), Muui (Kisambaa), Mwasa or Maasa (Kichaga) and Mwasi (Kipare)
Wood ash	Lushoto, Hai, Arumeru	Majivu (Kiswahili), Ifwi (Kichaga), Nguruon (Kimaasai), Maivu (Kipare)
Neem oil/powder		Mwarobaini (Kiswahili)
Cow urine	Hai, Arumeru, Arusha	Mkojo wa ng'ombe (Kiswahili), Mkwedhu (Kipare)
Cow shed slurry	Hai, Arumeru, Arusha	Mfori (Kichaga),

Farmers did not know the effect of BFB larval feeding on bean and other plant roots. Activities in Hai district started in 1998 with only 12 innovative farmers experimenting on strategies for *Ootheca* spp. management strategies. In 1999, the number of farmers and constraints addressed increased. More farmers in the district became aware of the bean IPM activities and achievements and they organised themselves into groups which by 2004 cropping season, were addressing a total of 11 constraints or issues including market research, soil fertility factors and forages. Concurrently, the number of participating farmers, groups, participating, villages, learning/demonstration plots and partners also increased with time (Table 1.9).

Table 1.9. Progressive involvement of farmers and partners in project activities during 1997-2004 bean growing seasons in Hai district, northern Tanzania

Year	No: of villages	No: of farmer groups	No: of field demos	No: of farmers	Activities/Constraints addressed	Partners involved
1997	0	0	0	0		
1998	1	1	3	14	BFB	DALDO, SARI, CIAT-IPDM
1999	3	6	8	86	BFB, BSM, APD	DALDO, SARI, CIAT- IPDM
2000	5	10	17	278	BFB, BSM, APD, BPB	DALDO, SARI, CIAT-IPDM
2001	13	22	27	1786	BFB, BSM, APD,	DALDO, SARI,

					BPB, SP, BR	CPP, CIAT-IPDM, WV, ADRA
2002	26	48	54	2116	BFB, BSM, APD, BPB, SP, BB, PB	DALDO, SARI, CPP, CIAT-IPDM, WV, ADRA, SUA
2003	36	56	86	3518	BFB, BSM, APD, BPB, SP, BB, PB, CB, PMR	DALDO, SARI, CPP, CIAT (IPM&ERI), WV, ADRA, DED, SUA, PADEP
2004	52	77	102	5500	BFB, BSM, APD, BPB, SP, BB, PB, CB, PMR, Soil, Forages	DALDO, SARI, CIAT (IPM&ERI), CPP, WV, ADRA, DED, SUA, PADEP, AMSDP

Activity/Constraint acronym:	**Partner acronym:**
BFB- Bean foliage beetle	DALDO- District Agriculture and Livestock Development Officer
BSM- Bean stem maggots	SARI- Selian Agricultural Research Institute
APD- Aphids	CIAT- International Centre for Tropical Agriculture
BPB- Bean pollen beetle	CPP- DFID Crop Protection Programme
SP- Seed production	IPDM- Integrated Pest and Disease Management
BB- Bean bruchids	ERI- Enabling Rural Innovation
PB- Pod borer	WV- World Vision
CB- Climbing beans	ADRA- Adventist Development and Relief Agency
PMR- Participatory Market Research	DED- District Executive Director
Soil- Soil fertility/nutrient management	SUA- Sokoine University of Agriculture
	PADEP- Participatory Agricultural Development and Empowerment Project
	AMSDP- Agricultural Market Systems Development Project

The results from farmer experimentation in Hai district helped to build the confidence of individual farmers and gradually each participating farmer contributed to the publicity of technologies tested at their location. Farmers in Hai were ranked a wealthy (own >0.5 hectares of beans) and poor (own <0.5 ha of beans) and both groups chose the following IPM technologies for bean foliage beetle (*Ootheca* spp.) management in that order of priority:

- Use of cow urine
- Use of wood ash
- Use of commercial neem oil emulsion
- Use a mixture of soap + kerosene
- Use of commercial neem powder
- Crop rotation
- Post harvest tillage

Results: The results obtained by farmers indicated that cow urine, neem oil, neem powder, soap + kerosene and wood ash were effective in reducing the number of *Ootheca* on bean crop (Figure 1.2). On-station verification tests showed similar results.

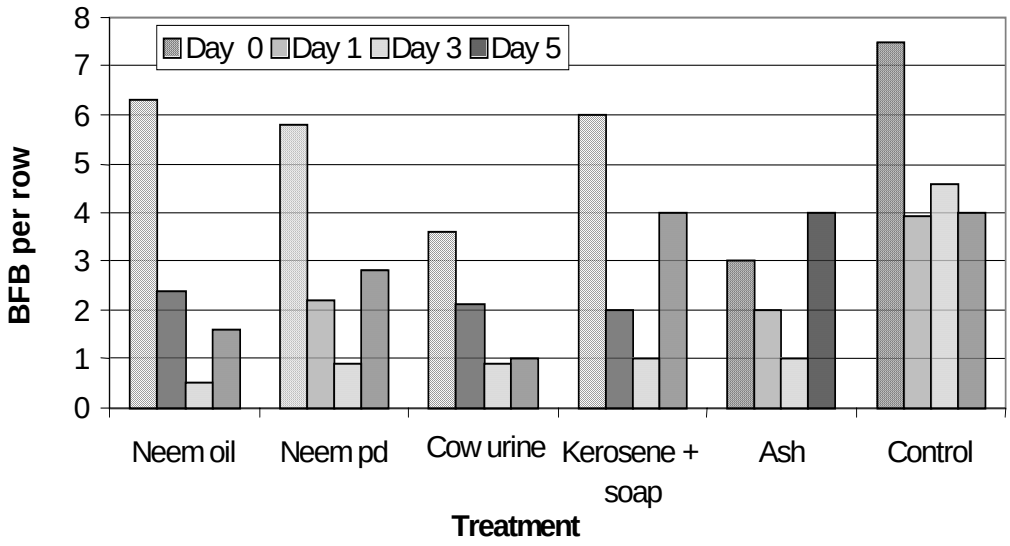

Figure 1.2 Performance of neem and other traditional treatments against BFB adults in farmers' fields

Further observations indicated that the treatments were effective but short-lived. Hence the frequent need for such applications for effective suppression of the pest population. The results stimulated farmers to select suitable strategies for application in their individual farms. The farmers also recommended dissemination channels and there was spontaneous farmer to farmer dissemination of information through demonstrations/learning plots, drama, songs, poems, radio, word of mouth, etc. Formal and informal training for innovative farmer representatives, extension agents, NGOs and other stakeholders were organised by the project stakeholders at project sites. Farmers selected preferred IPM dissemination channels according to their wealth (Figure 1.3). The selection of different dissemination pathways by large and smallholder farmers suggested that these groups had to be targeted with different approaches. During participatory monitoring and evaluation of field activities at the end of the cropping season, farmers opted for the promotion of multiple strategies and not single ones because different strategies would target different categories of farmers and related constraints.

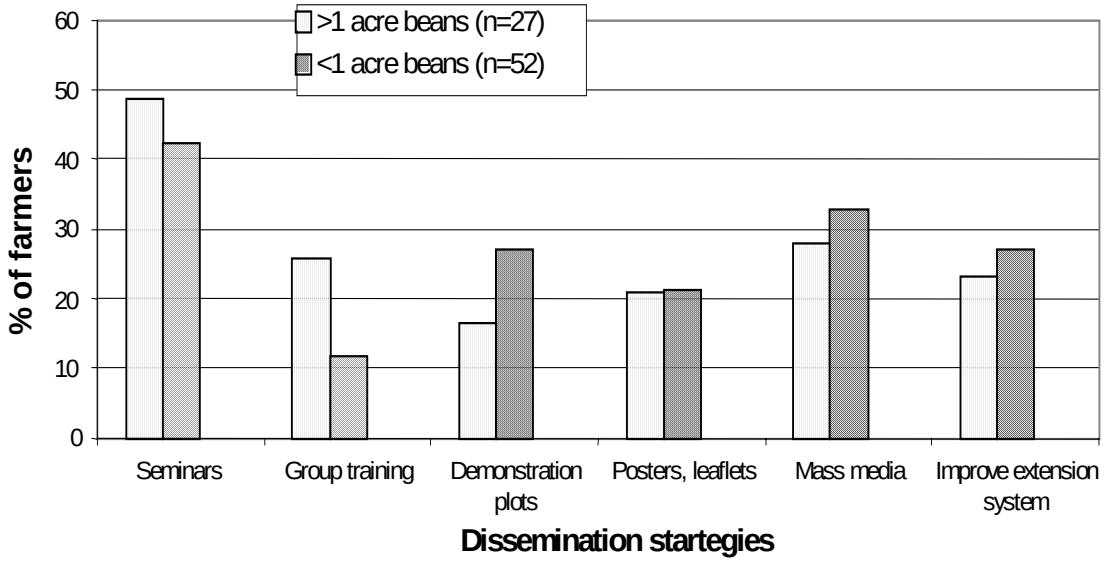

Figure 1.3: Selection of IPM dissemination channels by large- and small-holder farmers

Farmer groups at different villages in Hai district also studied the contribution of *Ootheca* spp. larvae to bean pod losses and noted that the pests affected the crop to different levels at three villages that are about 20 km from each other with more pod losses where larval population was high (Figure 1.4).

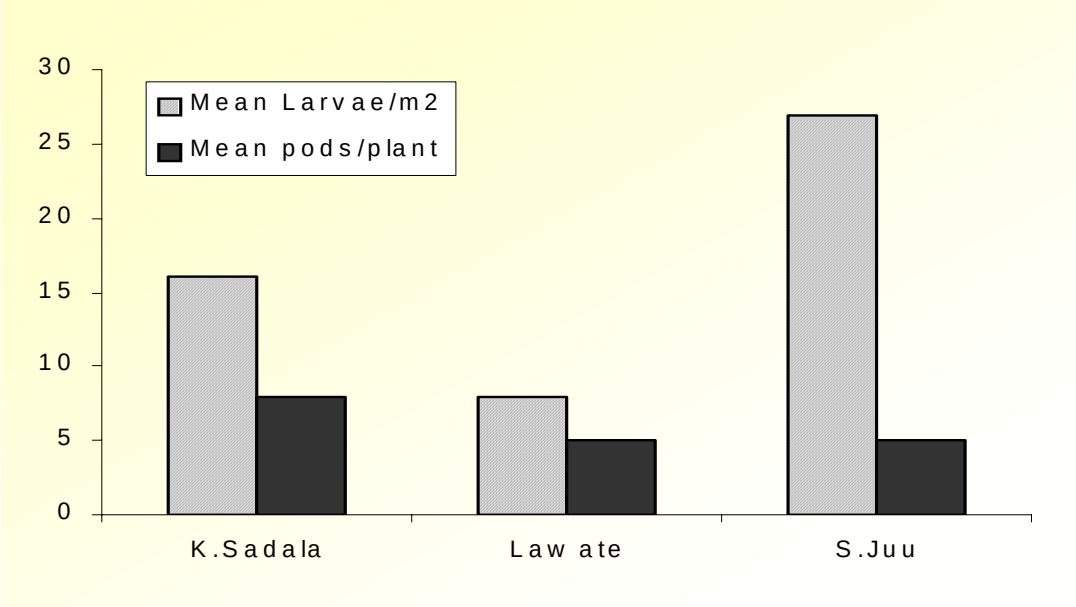

Figure 1.4 Contribution of *Ootheca* larvae to bean pod losses at three sites in Hai District, Kilimanjaro in 2002 long rain season

Southern highlands of Tanzania

The major field pests on beans in the southern highlands of Tanzania are bean stem maggots (BSM), aphids, pod borers and leaf diseases. Farmers in nine villages and

researchers at Uyole Agricultural Research Institute (ARI Uyole) experimented with the following strategies for:

1. Bean stem maggots
   - Insecticide (Dursban) + fertilizer (TSP and CAN at planting) + earthing up – (IFE)
   - Fertilizer + earthing-up – (FE)
   - Tephrosia + earthing-up + fertilizer – (TEF)
   - Earthing-up only – (E)
   - Fertilizer only – (F)
   - Untreated control

2. Bean aphids and pod borer control using botanical insecticides
   - Industrial insecticide – Dursban
   - *Tephrosia vogelii* crude leaf extract
   - Neuratanenia mitis tuber extract
   - Vernonia amygdalina crude leaf extract
   - Untreated control

Results

The incidence of BSM was very high during the experimental period. Reasonably good results were obtained with the above treatments although delayed spraying with insecticide resulted in high damage levels at four of the nine village sites. Earthing up was better than the untreated control but it performed poorly compared to the other treatments (Tables 1.10 -1.14). The performance of the treatments at ARI Uyole was good (Table 1.14). *Tephrosia* crude leaf extract applied within five days after bean emergence in fertilised plots appeared to be the best option for BSM management. Aphids and pod borer infestations were low in that season.

Table 1.10 Effect of insecticide, fertilizer and earthing-up on the damage caused by BSM on two bean cultivars (Uyole 96 and Sinon) at Nsongwi Village 2001/02

Treatments	Dead Plants/Plot		Bean Yield (kg/ha)	
	Uyole 96	Sinon	Uyole 96	Sinon
IFE	2.00 c	0.59 c	1067 b	833 ab
FE	4.00 c	3.50 c	1347 a	1000 a
Tephrosia + EF	3.00 c	1.00 c	943 b	1067 a
E	13.00 b	10.50 b	767 bc	467 c
F	7.00 b	3.00 c	867 bc	800 ab
Untreated Control	20.50 a	15.50 a	533 dc	500 c
Mean	8.25	5.67	920.67	777.83
LSD	8.06	4.72	230.08	329.11
CV %	60.65	56.03	28.92	30.043

Means followed by the same later are not significantly different according to Duncan Multiple Range Test

Table 1.11 Effect of Botanical Insecticides for Pod Borer Control on Beans at Nsongwi village 2001/2002

Treatments	Pod Borer Attack		Plants attacked by Aphids/Plot	Bean Yield kg/ha
	Bored pods per 10 plants	Damaged seed %		
Dursban	13.00 ab	5.00	3.00 ab	1200.00 a
Tephrosia	10.50 b	6.00	1.00 b	933.33 ab
N. mitis	23.50 ab	8.00	5.50 ab	1000.00 ab
V. amygdalina	26.00 a	12.00	4.50 ab	766.67 b
Untreated Control	20.00 ab	13.00	7.00 a	866 ab
Mean	18.60	8.90	4.20	953.33
LSD 0.05	13.07	NS	5.10	394.46
CV %	25.03	14.44	49.08	15.48

Means followed by the same letter are not significantly different according to Duncan Multiple Range Test

Table 1.12 Effect of Botanical Insecticides for Pod Borer Control on Beans at Mbawi village 2001/2002

Treatments	Pod Borer Attack		Plants attacked by Aphids/Plot	Bean Yield kg/ha
	Bored pods per 10 plants	Damaged seed %		
Dursban	14.00 b	2.06 b	3.67 c	1333.33 a
Tephrosia	15.00 b	4.37 ab	4.33 ab	1622.22 ab
Vernonia spp. (Ipasapasa)	17.09 ab	5.02 ab	7.48 b	1556.00 ab
Oyster nut plant leaves (Kweme)	16.67 ab	3.76 b	6.02 bc	1577.78 bc
Untreated Control	19.00 a	9.24 a	12.04 a	1223.00 c
Mean	16.87	4.89	6.72	1462.50
LSD 0.05	3.09	6.22	3.45	242.00
CV %	9.74	31.92	58.07	8.79

Means followed by the same letter are not significantly different according to Duncan Multiple Range Test

Table 1.13 Effect of insecticides, fertilizer and earthing-up on the damage caused by BSM between two cultivars (Uyole 96 and Sinon) at Inyala Village 2001/02

Treatments	Dead Plants/Plot		Bean Yield (kg/ha)	
	Uyole 96	Sinon	Uyole 96	Sinon
IFE	7.00 b	5.50 c	600.00 a	633.33 a
FE	13.00 b	100.00 c	246.67 ab	300.00 b
Tephrosia + EF	22.00 b	13.00 bc	313.00 ab	500.00 a
E	20.60 b	37.00 ab	200.00 b	204.07 b
F	12.08 b	14.00 bc	200.00 b	426.67 ab
Untreated Control	53.00 a	44.50 a	100.00 b	273.33 b
Mean	21.28	20.67	276.61	389.57
LSD 0.05	23.82	24.35	366.07	223.06
CV %	58.42	62.77	41.99	52.03

Means followed by the same letter are not significantly different according to Duncan Multiple Range Test

Table 1.14 Effect of insecticides, fertilizer and earthing-up on the damage caused by BSM between two cultivars (Uyole 96 and Sinon) at ARI-Uyole 2001/02

Treatments	Dead Plants/Plot		Bean Yield (kg/ha)	
	Uyole 96	Sinon	Uyole 96	Sinon
IFE	0.67 c	0.00 c	2103.33 a	1300.00
FE	7.506 c	1.00 c	1736.67 a	1180.00
Tephrosia + EF	3.04 bc	1.50 c	1960.00 a	1486.67
E	16.12 b	10.24 ab	920.00 ab	580.00
F	12.09 b	4.56 c	1623 ab	1293.33
Untreated Control	25.76 a	13.50 a	590.00 b	713.33
Mean	11.36	5.13	1488.89	1092.22
LSD 0.05	9.24	6.34	1367.72	NS
CV %	43.05	57.61	22.34	19.05

Means followed by the same letter are not significantly different according to Duncan Multiple Range Test

Kenya, Nyanza Province

Initial PRA studies in Kisii and Rachuonyo districts in the mid and late 1990s showed that bean farmers could associate bean plant losses due to different insect pests and root rot diseases (Table 1.15). Common and widespread insect pests include bean stem maggots (BSM), aphids, bruchids, *Ootheca* spp., thrips, pod borers, and pod sucking bugs.

Table 1.15 Farmer estimates for plant mortality (%) caused by different bean pests in Kisii and Rachuonyo districts, Nyanza Province, Kenya

Bean pest	% plant mortality
Bean stem maggots (BSM)	30
Root rots + BSM	51
Root rots	16
Other causes	3
Total	100

Farmers in collaboration with researchers and extension personnel studied the pest population dynamics and experimented with different strategies including:

- Pest tolerant bean genotypes
- Soil fertility amendments (reduced amounts of diammonium nitrate -DAP fertilizer (13kg P + 30kg N) + 5 tons farm yard manure – FYM/ha
- Seed dressing - Murtano at 3g/kg or Diaznon at 2mls/kg of seed
- Cultural practices (crop rotation, timely planting and weeding, mulching, ridging/earthing-up, early harvesting, etc.).

Participatory field demonstration, monitoring and evaluation of the technologies at selected sites enabled farmers to select or reject the options.

Results

Results from the field demonstrations indicated that rotation of beans with sweet potatoes was very effective in bean stem maggots management. Use of small

amounts of inorganic fertilizer and farm yard manure, mulching, seed dressing, earthing-up (ridging) and intercropping with maize effectively reduced BSM incidences and damage on the bean crop. Farmers were able to select suitable options that were adopted in their fields while a few strategies were rejected based on logical reasons from the farmers (Table 11.16).

Table 1.16 Farmers' choices for bean pest management strategies in Kisii and Rachuonyo district, Nyanza Province in Kenya

Strategy	Accepted	Reason	Rejected	Reason
Bean genotypes	G 8047	Early maturity, delicious, BSM and root rot tolerance	P 129	Black seeded
	CN 5513	Same	P 127	Same
	EXL 52	BSM tolerance, early maturity	P 13	Same
	EXL 55	Same		
	PAN 150	Drought tolerance		
	ARA 4	Early maturity		
Cultural practices	Fertilizers (DAP+ FYM)	Improved plant tolerance and yield	Ridging	Labour intensive
	Seed dressing	Improved plant tolerance	Mulching	Labour intensive
	Intercropping	Labour saving/improves soils	Rotation	Shortage of land at some sites

6.2. Output 2: Socio-economic characteristics of community uptake of IPM technologies (within and between communities) determined and documented

Participatory rural appraisals (PRAs) were conducted at pilot sites in Malawi, Kenya and Tanzania. Brief baseline studies were conducted in Hai district where the technology uptake studies being presented here were also conducted towards the end of 2004 by an MSc student with financial assistance from PABRA. The final MSc thesis work is in its final stages of preparation (field data and draft chapters are available).

The PRAs indicated that different farmer ethnic groups have developed different cultural practices for pest management capitalising on materials available in their surroundings. For example, the livestock production based communities traditionally used livestock products and the crop production groups used botanicals (Table 2.1).

Table 2.1 Traditional pest management strategies based on ethnic communities at project sites in Tanzania and Malawi

Ethnic group location	Cultural pest management practice	Effect of project activities
Tanzania		
North - Hai and Arumeru districts	Use of livestock products and a select of botanicals	Adopted use of additional botanicals
Northeast - Lushoto district	Intensive use of botanicals	Adopted zero grazing and use of animal products
Southern highlands - Mbeya and Mbozi districts	Intensive use of botanicals	Adopted zero grazing and use of animal products
Malawi		
Dedza	Intensive use of botanicals	Adopting livestock keeping and use animal products

Socio-economic characteristics farmers in Hai district

The socio-economic study in Hai district, northern Tanzania shows that 95% of the interviewed farmers attended formal education. Most of these farmers engage in agriculture crop and livestock farming basically for family food and generation of household income (Table 2.2).

Table 2.2 Socio-economic characteristics of bean IPM participating and non participating farmers in Hai district, northern Tanzania

Characteristics	Participating farmers		Non participating farmers		Total	% (N=236)
Education level	Male	Female	Male	Female		
No formal school education	2	4	3	2	11	5
Primary school education	49	58	35	47	189	80
O' level secondary education	9	11	7	3	30	13
Advance level secondary education	1	1	2	-	4	2
Diploma/degree level	-	1	-	1	2	1
Total	61	75	47	53	236	100
Marital status						
Married	61	59	39	44	203	86
Not married		7	6	4	17	7
Widowed		6	2	2	10	4
Divorced		3	-	3	6	3
Total	61	75	47	53	236	100
Age Composition						
21-30	2	9	6	11	28	12
31-40	11	15	12	17	55	23
41-50	15	31	14	13	73	31
51-60	14	17	6	8	45	19
> 61	11	2	8	3	24	10
Don't know	8	1	1	1	11	5
Total	61	75	47	53	236	100
Employment						
Teacher	2	2	1	2	7	3
Medical attendant	2	2	1	-	5	2
Local government employee	-	1	1	-	2	1

Self employed	-	1	2	-	3	1
Not employed	57	69	42	51	219	93
Total	61	75	47	53	236	100
Business						
Small business	11	13	4	12	40	17
Retail shop	5	3	3	4	15	6
Wholesaler	1	1	-	1	3	1
None	44	58	40	36	178	76
Total	61	75	47	53	236	100

Land ownership in Hai district

Land shortage is one of the major production constraints raised by farmers in the district. In all villages, hiring land to increase crop production is a common practice for most farmers. Survey data showed that only 5% of all interviewed farmers owned reasonably large individual fields (7-12 acres)(Table 2.3). The majority of farmers (54.2%) own small pieces of land that range in size between 1-2 acres which is insufficient for family needs. Consequently, farmers try their level best to hire land from other farmers within or outside their villages. A substantial number of farmers travel for 20-100 kilometres to cultivate far off fields to compliment production from their small household fields. Traditionally, land in Hai district is owned by men.

Table 2.3 Land ownership by farmers in surveyed areas of Hai district communities

Land size owned by individual farmers	Participating farmers		Non participating farmers		Participating and non participating farmers	
	No of farmers	%	No of farmers	%	Total	%
< 1acre	12	9	21	21	33	13.9
1-2 acres	68	50	60	60	128	54.2
3-4 acres	37	27	14	14	51	21.6
5-6 acres	10	7	1	1	11	4.6
7-8 acres	4	3	2	2	6	2.5
9-12 acres	4	3	2	2	6	2.5
Farmers without own land	1	1	-	-	1	0.4
Total	**136**	**100**	**100**	**100**	**236**	**100**

Livestock ownership in Hai district

Interviewed farmers mentioned cattle, goats, pigs, sheep and chicken as the common livestock animals in the community. The survey data showed that most farmers keep chicken, cattle and goats (Table 2.4). The interviewed farmers considered livestock to be as an important household asset/ investment that can be sold when there are critical family needs and also used as a source of food (milk, eggs and meat). It was observed that farmers prefer to save money in kind (e.g. by buying goats, chicken, pigs, etc.) rather than depositing it in a bank account. Community members considered chicken as a woman/wife's property. Women can sell chicken to obtain cash for purchasing food and other domestic requirements (salt, kerosene, matches, soap, etc.) without consulting their husbands, fathers or brothers. On the other hand, cattle, goats, sheep and pigs are owned by men and considered as family property. It is the man/ husband/brother/father who makes the final decision in the sale or disposal of these animals to address family problems that include payment of school fees for children, building or modification of family houses,

etc. The numbers of livestock heads per farmer are low because of land shortage and the zero grazing culture that farmers have adopted.

Table 2.4 Livestock ownership by surveyed farmers in Hai district, northern Tanzania

Livestock	Number of livestock owned by farmers										Total farmers	%
	1-3		4 -6		7 -9		10 -12		>12			
	P	N	P	N	P	N	P	N	P	P		
Cattle	61	38	27	17	5	3	3	8	-	-	162	69
Goat	32	23	24	13	12	5	3	8	7	6	133	56
Sheep	19	5	17	5	2	5	-	2	2	1	58	25
Donkey	2	2	4	-	1	-	-	-	-	-	9	4
Pig	14	10	7	6	2	2	-	2	-	-	43	18
Chicken	11	12	27	26	17	9	22	17	51	15	207	88
P= Number of participating farmers, N= Number of non participating farmers												

Farmers' ranking for food and cash crops in Hai district in 2004

Farmers in the surveyed areas ranked maize and beans as the first and second crop both for domestic consumption (Table 2.5) and household cash income (Tables 2.6). A high percentage of farmers in Hai district have opted to produce more maize and beans because the inputs are easily obtained in the community at reasonable prices and the products are easily marketed to any person from within or outside the community compared to traditional cash crops especially coffee.

Table 2.5 Farmer ranking for different food crops in Hai district in 2004

	Participating farmers (N=100)					Non participating farmers (N=136)					Total	%
Crop	1st Rank	2nd Rank	Score	(n= 236)	5th Rank	1st Rank	2nd Rank	3rd Rank	4th Rank	5th Rank	Score	(n= 236)
Maize	121	14	1	-	-	90	10	-	-	-	236	100
Beans	-	93	41	1		-	77	15	-	-	227	96
Banana	15	19	17	16	12	5	5	20	3	1	113	48
Sunflow		4	35	8	14	-	8	48	12	1	130	55
Veges	-	1	9	35	11	-	-	10	11	3	80	34
Paddy	-	5	7	3	-						15	6

Table 2.6 Farmers' rank for different cash crops in Hai district, northern Tanzania during 2004

	Participating farmers (N=100)					Non participating farmers (N=136)					Total	%
Crop	1st Rank	2nd Rank	3rd Rank	4th Rank	5th Rank	1st Rank	2nd Rank	3rd Rank	4th Rank	5th Rank	Score	(n=236)
Maize	65	21	-	5	-	65	31	13	4	1	205	87
Beans	8	49	26	1	-	7	51	31	9	1	183	76
Bananas	-	-	5	-	-	7	13	13	4	3	45	19
Sunflow	-	-	19	9	-	-	2	9	7	3	49	21

Veges	4	1	7	3	-	16	7	11	15	1	67	28
Coffee	26	15	4	5	1	12	4	3	2	-	72	31
Paddy	10	-	-	-	-	-	-	2	-	-	12	5
Legend: 1st rank = Most important, …… 5th rank = least important												

Farmers' perception of the effectiveness of IPDM technologies in Hai district in 2004

The data from surveyed farmers shows positive and negative perceptions from farmers on the effectiveness of the IPDM technologies. The three interviewed groups (participating farmers, non-participating farmers and group discussion) mentioned effectiveness as the leading and important factor in the adoption of the IPDM technologies. Farmers were also conscience of the cost, availability and safety (Figure 2.1). A number of farmers complained about the high prices for synthetic pesticides, weeding costs and time spent on the preparation and application of botanical products.

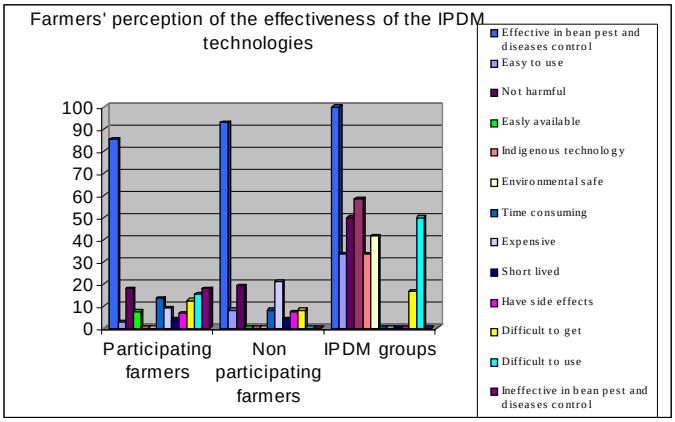

Figure 2.1. Farmers' perception of the effectiveness of bean IPDM technologies in Hai district

IPDM technology adoption rate by interviewed farmers in Hai district

The study in Hai district indicated that botanicals (including crude extracts from plants with pesticidal properties) and other farm products such as cow urine, cowshed slurry, wood ashes, etc. are the leading technologies adopted by a large proportion of project participating and non-participating farmers. Farmers narrated the reasons for adoption (Table 2.7).

Table 2.7 Farmers' ranking of reasons for adopting IPDM technologies in Hai district, northern Tanzania

Reason for Adoption	Ranking						
	1st	2nd	3rd	4th	5th	Total	Percentages (%)
Effectiveness of IPDM in pest control.	67	17	7	1	1	93	67
Availability of the technology/easy to get	4	13	10	1	1	29	21
Low cost/ cost effectively	19	28	12	1	1	71	51

Easy to use and maintain	0	7	3	0	0	10	7
Safety (Not harmful)	15	30	9	2	0	56	40
Knowledge of the technologies	28	34	3	4	0	69	50
**1st =rank most important, ……. …, 5th rank = less important							

The use of commercial chemical fertilisers and pesticides was the second option in crop management. Crop rotation, timely harvesting and storage hygiene were adopted by few farmers (Figure 2.2). The rotation of crops is almost impossible in the study area due to land shortage. Frequent thefts in the field force farmers to harvest on time and grain is mostly stored in air tight drums or synthetic gunny bags and secured in the house. There are no special storage structures with these smallholder farmers.

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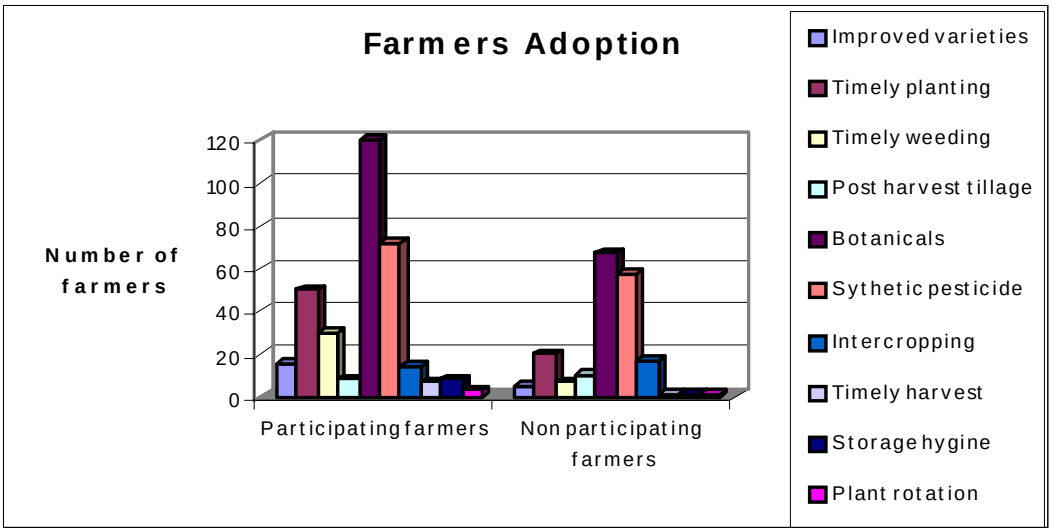

Figure 2.2 Adoption of bean IPDM technologies by participating and non participating farmers in Hai district, northern Tanzania in 2004

IPM technology modification by farmers in Hai district

A substantial number of farmers that were interviewed during the surveys indicated that they had modified the IPDM technologies after testing (participating farmers) or observing (non participating farmers) them at the demonstration fields during farmer meetings and training sessions. Such modifications were mostly made by farmers with formal education (Table 2.8)

Table 2.8 Modification of IPDM technologies by farmers in Hai district

Farmer's education level	Number of total respondents	Number of farmers who modified IPDM technologies	Percentages
No formal school education	12	0	0
Primary education	189	22	12
O' level secondary education	30	4	13
A' level secondary education	4	1	25
Diploma level	1	1	100

Benefits derived from using IPDM technologies

Increased bean production

Most of the interviewed farmers (86%) confirmed that the major advantage derived from using the IPDM strategies in their production system was increased production for beans and other crops (Table 2.9). The increase in bean production contributed to improved food security in individual families and increased household cash income among farmers in the community. Observations showed that beans are among the crops that have better price and better market opportunities compared to the other crops produced in the district. The increases in the production of beans have direct effects on the livelihood of smallholder bean farmers in the community. The other benefits of IPDM technologies include safety, easily available, relatively cheap and easy to use by smallholder farmers.

Table 2.9 Benefits associated with the use of IPM technologies in Hai district, northern Tanzania

Advantages	Frequency	Percentages
Increase in production	209	86%
Safe to use	43	18%
Relatively cheap	41	17%
Easy to use	12	5%
Easy to get	10	4%

The survey data showed that project participating and non-participating farmers understand the importance of having enough and better food for their households. Farmers used the income generated from surplus beans and maize to buy food to help them cope up with food shortages that frequently occur in the community due to drought, pests and other constraints. The idea of having extra and better food (food security) has direct and indirect effect on the health and behaviour of the people. Food insecurity contributes to household and community poverty by limiting personal thinking, productivity and becoming the source of conflicts among people/ communities.

The data further showed that there are slight differences in the expenditure of the income generated from sales of surplus beans by participating and non-participating farmers (Figure 2.3). While participating farmers invest some of their income from beans in children school fees, the non- participating farmers invest in agriculture. It is likely that the non-participating farmers were investing on pest control measures because they spend less time in their fields to monitor their crops regularly and take action at the required time.

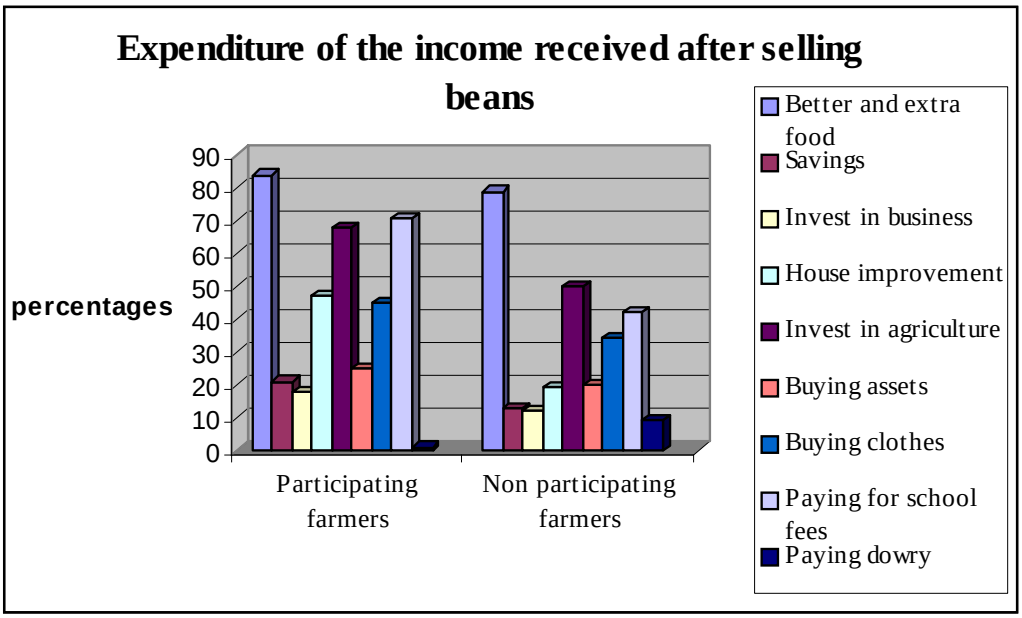

Figure 2.3 Expenditure of income generated from beans in Hai district, northern Tanzania

Community participation through the formation of IPDM research groups

Interviewed farmers stated that the community approach adopted by the project has facilitated closer links between local government, NGOs, other institutions and farmer groups. The process has empowered farmers and restored their confidence in traditional technology application. This has enabled farmers to initiate community development projects. With the support from various institutions including NGOs, the private sector and the government, farmers have organized themselves into groups and these groups have united to form and manage a community based organization in the district – the Union of Delopment Goups in Hai district (MUVIMAHA – Muungano wa vikundi vya maendeleo wilaya ya Hai) under the auspices of the district council and World Vision (Sanya Agricultural Development Project). MUVIMAHA has enabled farmer group members to access loans by offering collective guarantees and security.

The formation of IPDM research groups enhanced social life and provided linkage to different stakeholders for various services (Table 2.10). Based on survey findings, farmers were encouraged to form common interest groups based on the social dynamics to meet and share needs or resolve common problems. For example, several groups are based on income generating activities, others on savings and credits, some on health groups including HIV/AIDS affected farmers, etc.

Table 2.10 Advantages of membership in IPDM research groups in Hai district, northern Tanzania

Advantages	Frequency	Percentages
Agriculture training	104	76%
Loan and assistance	27	19%
Known and recognized by other stakeholders	16	11%
Social relation	16	11%

Community empowerment

Most of the activities for IPDM technology promotion have contributed to local community empowerment. The participation of small holder farmers (particularly the women) in problem identification, training, planning, implementation of demonstrations, monitoring, evaluation and dissemination of the technologies has influenced and increased the capacity of farmers in understanding and addressing agriculture problems in general and bean insect pests and diseases in particular. Farmers are now able to form and organise their own groups and search for solutions to address their problems. According to the MUVIMAHA leaders, there are 260 registered farmer groups in the district. The formation of these groups is one of the efforts of farmer members to address their problems of capital, market, improved crop varieties and animal breeds, other farm inputs, health and education problems, etc.

Capacity building for farmers

The participation of farmers in need assessment, planning, implementation, monitoring, evaluation and dissemination of technologies, capacity building through training seminars and workshops, demonstrations, field days, exchange visits, etc., all have greatly improved the knowledge and skills of the farmers and strengthened farmers' ability to identify and seek solutions to various problems in their community environment. The modification and application of the technologies beyond the level that farmers had learnt in the groups is another indication of the improvement in farmers' skills. Farmers have gained knowledge, confidence and skills in writing up reports and presenting their research results in village, district, national and regional meetings (Appendices). Extension personnel, other service providers and researchers have a better understanding of farmers' behaviour, needs and the way they would like new information and technologies reach them effectively for sustainability.

Farmers reported that, apart from using the IPDM technologies in the management of bean insect pests and diseases, they also use them on other crops (e.g. tomato, coffee, banana, vegetables, etc.), animal and human health problems. Up to 82% of the vegetable farmers surveyed in the present study use IPDM options in the management of insect pests, diseases and soil fertility problems. These farmers believe that, it is safe to use IPDM technologies because vegetables are short duration crops and therefore, using industrial chemical fertilizers and pesticides could have residues that are harmful to humans and the environment.

The status of women

The participation of women in activities on promotion of IPDM technologies including training sessions, on- farm trials, visits, etc. has helped them gain recognition and publicity from other women and men farmers and other stakeholders from within and outside the community. Participating women's confidence and capacity has improved substantially in all groups. The study revealed that a number of women farmers were holding leading positions in different groups and women farmers selected to attend training sessions and seminars to improve the performance of their groups and the community at large (Table 2.11). Leadership in the research groups has helped women to have confidence in discussing different issues especially those on household and community development.

Table 2.11 Bean IPDM group membership by gender and roles in Hai district, northern Tanzania

	Positions in the groups			Total
	Ordinary members	Group leader	Group Adviser	
Men	36	24 (15%)	1	61
Women	54	20 (18%)	1	75
Total	90	44 (32%)	2	136

The data shows that there is no significant difference between men and women farmers holding leading position in the groups. This situation allows for a balanced representation and participation of women in the planning and decision making at the group and community levels.

6.3 Output 3: IPM awareness increased at the village community level and among policy makers

Participatory monitoring and mapping

Site collaborators organised extension personnel at the district, divisional, village and other active local stakeholders to conduct public meetings at the villages in the targeted community to create awareness and enhance farmers' understanding of factors influencing pest populations and problem development in general. Posters and leaflets were used to train farmers and some were distributed to farmers. Farmer groups were encouraged to test traditional and improved IPM technologies for control of bean pests and diseases and soil fertility amendment. Farmers were keen to share the information with their neighbours. The attendance to awareness creation meetings was good at most sites, e.g. Hai district in northern Tanzania (Table 3. 1). Farmer training workshops/seminars, farmer meetings, setting up field demonstrations/learning plots, field days, followed up the meetings for awareness creation and cross visits. Some of these activities have been documented in forms of booklet reports. The numbers of these activities and stakeholders involved varied with time and location at the site.

Table 3.1 Attendance of farmers to bean IPM strategies awareness creation meetings in Hai district, northern Tanzania

Village	**Participants**			**Achievements**
	Female	**Male**	**Total**	
Magadini	6	40	46	Farmers were trained on four major bean pests, which are *Ootheca*, aphids, bean fly, pollen beetles and different methods of controlling them. **Note:** The attendance here was considered poor due to army worm out break, planting and weeding season (February-March)
Koboko	11	54	65	
Kwasadala	50	44	94	
Rundugai	20	43	63	
Lawate	6	10	16	
Foo	12	22	34	
Donyo	6	32	38	
Kimashuku	16	11	27	
Nshara	18	20	38	
Sanya Juu	42	19	61	
Total	**187**	**295**	**482**	

Understanding the role of natural enemies in the farming system

Recognition and identification of different natural enemies and their role in pest control were carried out during formal and informal training sessions, on-farm meetings and on individual farmer group needs during crop growth. Innovative farmers have collected and preserved some of the common natural enemies (e.g. Preying Mantids, Wasps, Coccinelid beetles, etc. that are preserved and often displayed by project participating coffee farmers in Hai district). A poster from previous DFID Project R7587 on "Farmers' Friends" was a useful tool in training farmers on the role of different natural enemies that are very common but not known by most farmers (Table 3.2).

Table 3.2 Common natural enemies and pests encountered but unkown to bean farmers in the farming systems at project sites

	Ecology/Pest association	Role	Farmers' knowledge
1.Natural enemies			
a. Insects			
Coccinelids	Aphids	Predator	Gap
Hover flies	Aphids	Predator	Gap
Wasps	Aphids, Caterpillars	Parasitoid	Gap
Preying Mantid	General	Predator	Gap
Lizards	General	Predator	Gap
Chameleon	General	Predator	Gap
b. Diseases			
Viruses, e.g. NPV	Caterpillars	Pathogen	Gap
Fungi	Caterpillars	Pathogen	Gap
2. Pests			
a. Insects			
Ootheca spp.	Larvae	Root damage	Gap
Ophiomyia spp.	Puparia in stems	Stem damage	Gap
b. Diseases			
Root rots	Stem rotting	Yellowing and plant death	Gap

Most farmers at project sites could not recognise the different developmental stages of the pests and natural enemies to be able to associate them with damage in case of the pests and benefit in case of the natural enemies. For example, farmers did no know that *Ootheca* larvae cause severe damage to bean roots in the soil or that the jelly maggots (Hover fly larvae) and black spotted or woolly larvae (Coccinelids) that they observe in association with aphids are beneficial organisms.

Village information centres

Farmers' empowerment through the formation of research groups and participation in various project activities at their locations enabled some of them to demand for easy access to information within reach of their villages. Farmer also wanted to retain the documents containing their traditional knowledge and research results as well as other extension (leaflets, poster, newsletters, etc.) and other relevant information within reach at their communities. Farmer groups were able to sensitise their local leaders to set aside some premises for stocking these materials. Such premises were referred to as village information centres (VICs) - small village/community libraries run and owned by

the community for stocking the extension (promotional) and other relevant reading materials from different institutions. Currently there are 43 operational VICs at project sites in eastern, central and southern Africa (Table 3.3).

Table 3.3 Number of village information centres at project sites

Country and location of VICs	Number of operational Village Information Centres (VICs)
Malawi (Bembeke in Dedza)	1
Tanzania (Mbeya, Lushoto, Hai)	8
Kenya (Kisii, Kabondo, Homa Bay)	3
Uganda (Kabale)	1
Rwanda	32
Total	45

The VIC in south western Uganda is in the same premises with a telecentre that was set up by the African Highlands Initiative (AHI) project. Farmer group members and other individuals are using the VICs to gain knowledge even in villages where access to other means of communication (electricity, good road, landline telephones, cell phone networks, etc.) is rare or non - existing. The promotional materials have been shared with non project participating national bean research programmes and scientists in Rwanda, Madagascar, Democratic Republic of Congo (DR Congo), Chile and India.

The VICs are used by all community members (project participating and non participating groups), visitors and nearby schools. The management of the VICs is determined by the community that appoints a library committee. The basic activities of the committees are to supervise records of daily users, borrowers (there is a register), cleanliness and maintenance, acquisition of new materials and equipment, etc. The project has provided leaflets, posters, booklet reports, etc. while the districts and other departments provide other relevant reading materials as requested by the target community members. The attendance records of users at the Otondo VIC in Kenya have been segregated by gender (Table 3.4).

Table 3.4 Attendance to VIC at Otondo in Rachuonyo district, Kenya in March to June 2004

Month	**Men**	**Women**	**Total**
March	64	23	87
April	45	25	70
May	69	40	109
June	Not noted	Not noted	149
Total			415

Sensitisation of policy makers

Policy makers at all levels were targeted through invitation to farmer activities including training workshops and seminars where they were assigned topics to cover, farmer technical meetings including those on planning and evaluation, farmer field days as participants and guests of honour, farmer visits and tours, visits by donor and other re-known visitors, district/regional/national agricultural shows, the media (radio and TV), etc. (Table 3.5). Such channels have created awareness among a number of policy makers particularly at the village, division, district, regional/province, national and regional levels. All these interactions have helped to raise farmers' morale and enhanced active policy changes at national level. For example, the Hai district council in northern Tanzania instituted in 2003 that all village extension officers should organise farmers into research groups, assist them to establish demonstrations/learning plots every season for new agricultural technologies, organise field days and invite district personnel to farmer events. When this worked well, the message spread to neighbouring districts in the region and to the ministry head office. The ministry endorsed this for the country and other ministries have followed the example in different rural community development projects. Malawi and Kenya have a similar policy for rural development.

Table 3.5 Farmer activity channels used for sensitising policy makers at project sites

Farmer activity	Type of policy makers involved	Position and responsibility	Role in farmer activity
Training	Extension officers	District planning	Training, Planning
Field demos	Extension officers	District planning	Technical backstopping
	CBOs/NGOs		
Field days	Extension officers	Planning	Technical backstopping
	Regional/Provincial directors	Planning	Policy/Admin
	Zonal/National directors	Planning	Policy/Admin
	District commissioners	Planning	Administrative/Policy
	District executive directors	Planning	Administrative/policy
	Divisional leaders	Planning and implementation	Administrative/Policy
	Village leaders	Planning and implementation	Admin, Policy, Technical backstopping
	CBOs/NGOs	Planning and implementation	Admin, Policy, Technical backstopping
Tours and visits	Extension officers	Planning	Admin/Policy
	District commissioners	Planning	Admin/Policy
	District executive directors	Planning	Admin/Policy
	Divisional leaders	Planning	Administration, Policy, Technical
Dissemination	All	Planning and implementation	Action planning and implementation

6.4 Output 4: Availability of IPM technologies for bean pests increased at the target sites

The key strategy adopted by the project in making the IPM technologies for bean pests available to farmers and other stakeholders was the participatory approach and processes/methods. Each active stakeholder participated at project sites and contributed to decision making at the planning, implementation, evaluation and dissemination of results. This empowerment process helped to create awareness and spread the information to community members.

Formal and informal group training

Formal group training sessions for innovative farmers, extension personnel and other service providers were organised and implemented at project sites in Malawi, Tanzania, Kenya and Uganda. Some of the training seminar and workshops have been documented as farmer activity reports (Table 4.1). During formal training, innovative farmers, extension personnel, researchers, local policy makers and other service providers were each allocated subjects to train the rest of the group. Such sessions were followed by group discussions and planning future group activities. Informal training of farmers and stakeholders was conducted regularly during field activities and in farmer meetings. Leaflets, posters, field guides, etc. including the ones prepared by project stakeholders were used in the training sessions.

Table 4.1 Participants in formal group training workshops/seminars for bean IPDM stakeholders at project sites in Kenya, Malawi and Tanzania

		Participants			**Expectations**
Location	Date	Men	Wom	Total	
Kisii	May 03	9	5	14	Wider dissemination of IPDM technologies using adult education teachers
Bembeke	Nov 03	16	17	33	Awareness creation and wider dissemination of IPM message using farmer to farmer channels with backstopping from extension agents and researchers
Lushoto	Feb 03	13	7	20	Awareness creation and wider dissemination through farmer to farmers learning process with backstopping from extension agents and researchers
Lushoto	June 03	16	16	32	Wider IPM message dissemination through strengthened farmer to farmer learning process with backstopping from extension agents and researchers
Hai	May 02			34	Awareness creation among extension personnel
Hai	Feb 03	15	16	31	Wider dissemination of IPM strategies and strengthened farmer to farmer learning with backstopping from extension agents and researchers

On-farm participatory demonstrations

On-farm demonstrations were conducted by farmer groups and active partners in different locations at project sites in each country (Table 4.2). Some of the results from these demonstrations are presented under output 1 above because the strategies used are from farmers' indigenous knowledge. In Hai district for example, the participating farmer groups in each of 52 villages has been setting up field demonstration/learning plots on IPM technologies during the main bean planting season in March/July each year.

Table 4.2 Locations for on-farm bean IPDM demonstrations/learning plots at project sites in Malawi, Tanzania, Kenya and Uganda

Country	Bean IPM Project site for on-farm demonstrations
Malawi	Dedza, Kasungu
Tanzania	Mbeya, Mbozi, Mbarali, Iringa, Njombe, Chunya, Nkasi
	Lushoto, Hai, Arumeru, Babati
Kenya	Kisii, Rachuonyo, Homa Bay, Kakamega, Vihiga
Uganda	Bushenyi, Kabale, Kisoro

The demonstrations have always included pest tolerant bean genotypes. Farmers have therefore easily accessed information on newly developed bean genotypes and varieties and acquired small quantities of the bean seed. Some of the farmer groups have embarked on seed multiplication for their own planting and for sale to improve their household income (Table 4.3).

Table 4.3 Improved bean seed multiplication efforts by IPM participating farmers in Malawi, Tanzania, Kenya and Uganda

Country	Bean genotypes/varieties on small scale seed multiplication
Malawi	Sugar 131
Tanzania, Southern Highlands	Uyole 96&98, URAFIKI, SINON, etc.
Tanzania, Lushoto	SUA 90, Lyamungu 85&90
Tanzania, Hai	Lyamungu 85&90, SUA 90, JESCA, etc.
Kenya	EXL 52, G 8047, PAN 150, CN 5513, ARA 4
Uganda	NABE 7C, 10C, 12C; SCAM, etc.

Cross village and across site visits

The project stakeholders at each site were facilitated by the project to organise and conduct farmer meetings, training workshops, field demonstrations, farmer field days and visitors' meetings. All visiting activities were associated with cross village and cross site farmers' visits at all project locations (Table 4.4). These activities enabled farmers to share knowledge and exchange experiences thereby enhancing farmer to farmer IPM technology dissemination.

Table 4.4 Examples of project activities associated with farmers' and stakeholder cross village and across site visits in eastern, central and southern Africa

Country	Date	Farmer activity	Type of visit
Malawi	Aug/Sep 2003	Familiarisation visit by farmers to Mbeya, southern Tanzania to learn about participatory IPM approach and processes	Across country/site visit
Malawi	April 2004	Kasungu farmers visit Bembeke to learn about participatory IPM approach and processes	Across site visit
Kenya	June 2002	Farmer field day, farmer meeting and inauguration of the First Village Village Information Centre (VIC) for the Bean IPM Project at Otondo	Cross village visit
Kenya	June 2004	Farmer field days and farmer/ stakeholder evaluation meetings to share knowledge and exchange experiences	Cross village and across site visit
Rwanda	Sept 2002	Rwanda scientists' meeting with farmer groups in Hai district, northern Tanzania	Across country familiarisation visit by Rwanda scientists and cross village visit by farmer groups in Hai
DR Congo	Feb 2004	ECABREN and Bean IPM Project Leader visit to Mudaka, Kavumo and Katana PRIAM and IPM farmers groups	Cross village visit for farmers at the 3 locations
Uganda	June 2004	NARO and Bean IPM Project Leader visit to Bushenyi and Kabale bean IPDM farmer groups	Cross village visit for farmers at different locations in Bushenyi and kabala districts
Tanzania	July 2002	Bean IPM farmer group annual day at Lushoto	Cross village for Lushoto farmers and Across site for Mbeya and Hai farmers
Tanzania	March 2003	DFID/CPP Deputy Manager meet with bean IPM farmer groups at Ubiri and Kwalei villages in Lushoto	Cross village visit by farmers
Tanzania	June 2003	Farmers' meeting for assessment of Science and Technology in Agriculture to prepare a regional workshop paper	Joint district meeting for all participating farmer groups in Hai district
Tanzania	Aug 2003	DFID NARSIS Database and Knowledge Manager meet with farmer groups in Hai district	Cross village visit by farmers
Tanzania	Nov 2003	CIAT Director General meet with farmer groups at 4 locations in Hai district	Cross village visits for Hai farmers, Across site visits for Mbeya, Lushoto and Arumeru farmers
Tanzania	March 2004	Farmer field day and evaluation meeting at Shari village, Hai district	Cross village for Hai farmers, Across site visit for Rombo, Arumeru, and Babati farmers
Tanzania	March 2004	DFID Crop Protection Managers' visit to bean IPM sites in northern and southern Tanzania for farmer field days and meetings	Cross village vist for Hai farmers. Across site visits for Arumeru and Babati farmers

Dissemination of bean IPM strategies through rural schools

Rural schools particularly primary and secondary schools in northern Tanzania and Kenya, and community polytechnic in Kabale, Uganda have participated in bean IPDM technology development and dissemination. This has helped the teachers and pupils/students learn about the biology and ecology of the pests that have enabled them to participate in the development of management strategies and dissemination of the results. In this way, IPM practice becomes familiar to the young farmers and the safety of IPM practices is taken home to the parents and the community through the children and the teachers. Examples of the participating schools in Hai district, northern Tanzania and the polytechnic in Uganda are indicated in Table 4.5.

Table 4.5 Rural schools involved in development and dissemination of bean IPM strategies in Tanzania and Uganda

Tanzania, Hai district	School	Activities	Achievements
Sanya Juu	Kilingi Primary School	1. Learning plots 2. Drama, choir, poems	1. Use of cultural methods, botanical crude extracts, biological wastes and other environmentally safe insect repellents were demonstrated to control BFB, BSM, aphids and pollen beetles. 2. During field days participants learnt and discussed the use of IPM strategies to control bean pests. 3. Through drama, songs and poems the pupils have disseminated bean production and IPM messages while entertaining different audiences. 4. Pupils and students trained on IPM strategies are expected to pass on the message to their followers, parents and the public in general.
Kimashuku	Kimashuku Primary School	Learning plots	
Machame Foo	Nkwarungo Primary School	1. Learning plots 2. Drama, choir, poems	
	Machame Secondary School	1. Training on identification of major bean pests 2. Some teachers and students conducted social economic baseline survey for the project	
Samaki maini	Siha Secondary School	1. Training on identification of major bean pests 2. Some teachers and students conducted social economic baseline survey for the project	
Longoi	Longoi Secondary School	1. Training on identification of major bean pests 2. Some teachers and students conducted social economic baseline survey for the project	
Uganda, Kabale	Rukore Community Polytechnic	1.Training on identification of major bean pests 2. Teachers and students host learning/demonstration plot for bean genotypes and IPDM practices	

Participatory monitoring and evaluation

Different stakeholders conducted frequent monitoring and evaluation of project activities at the different sites in each country. Site collaborators and their stakeholders used visits, meetings, telephone and electronic means to communicate. Such stakeholders included farmers, local extension personnel, village and district leaders, locally active NGOs, researchers and the private sector. The farmer meetings, field days, reports on tours and field visits, extension and researcher meetings, quarterly donor reports, regular CIAT reports, etc. were all used as tolls for monitoring and evaluating project activities.

The scientific community at national, regional, international and different donors have visited some of the project sites to monitor and evaluate the promotion of bean IPM technologies with farming communities (Table 4.5).

Table 4.6 Stakeholders participating in project monitoring and evaluation at different sites

Country	Site	Stakeholders
Uganda	Kabale	Farmers, Local government, NARO, NAADS, CARE, ECABREN, CIAT, AHI, Private sector, Other projects, DFID/CPP
	Bushenyi	Farmers, Local government, Extension service, NARO, ECABREN, CIAT, Private sector, Other projects, DFID/CPP
Kenya	Kisii	Farmers, KARI, Ministry of Agric., Private sector, Local government, Other ministries (e.g. Health and education), ECABREN, CIAT, DFID/CPP, Other projects, CMAD (Community Based Org), etc.
	Rachuonyo	Same
	Homa Bay	Same
Malawi	Bembeke, Dedza	Farmers, DARTS, Local government, Concern Universal, SABRN, CIAT, DFID/CPP, etc.
	Kasungu	Farmers, DARTS, Local government, PLAN International, SABRN, CIAT, DFID/CPP, etc.
Tanzania	Southern Highlands	Farmers, ARI Uyole, Extension service, Local government, Agricultural Trust Fund, Religious orgs., SABRN, CIAT, DFID/CPP, etc.
	Lushoto	Farmers, SARI, Extension service, Local government, AHI, Private sector, CIAT, ECABREN, etc.
	Hai	Farmers, SARI, Extension service, Local government, World Vision, FAIDA Mali, TechServe, Religious orgs., Private sector, Sokoine University, Other national projects, CIAT, ECABREN, DFID/CPP, etc.
	Arumeru	Farmers, SARI, Extension service, Local government, ADRA & Other Religious orgs., Private sector, Other national projects, CIAT, ECABREN, CIAT, etc.
	Babati	Farmers, SARI, Extension service, Local government, Farm Africa, Other NGOs and Religious orgs., Private sector, Other national projects, CIAT, ECABREN, CIAT, etc.

Promotional materials and information dissemination

The project catalysed the preparation of extension materials (leaflets, posters including picture posters of farmer activities, farmer activity reports in booklets, translation of bean pests field guide and seed manual to Kiswahili, etc.) that have been used in field group training sessions particularly when innovative farmers and extension agents participate (Table 4.6). These materials were shared with stakeholders who in turn distributed them to the target communities in their areas. Copies of the materials were also deposited at the operational village information centres for easy access by community members and to scientists within and outside Africa.

While the formal and informal training, meetings, demonstrations, field days and visits, and extension materials were key tools for information dissemination among the target communities, farmers at different sites developed their own dissemination channels. These included word of mouth, drama, songs, poems, shows and displays. The project linked national bean research scientists, farmers and CIAT Arusha staff to MEDIAE Company to set up Kiswahili radio programme series "Pilika pilika" in several local radio channels in Tanzania. The focus for the programme is on crop (beans) and livestock production. The programme has reached many farmers not only in Tanzania but also in Kenya. Some farmers in Hai district have also been supported by the district council to go on air in one of the local radio channels on the bean IPM activities in their community. Several video and few TV scripts have also been prepared with some farmer groups.

Table 4.7 Types of promotional materials prepared by project stakeholders

Type	Subject	Language
Booklets	Farmer field days	English
	Farmer visits and tours	"
	Farmer meetings/conferences	"
	Training for extension staff	"
	Training farmers and extension staff together	"
	Training for adult education teachers	"
	Traditional bean recipes for Hai farmers	"
	Visits by DFID, CPP, CIAT DG, CIAT scientists, etc.	"
	Soy bean production in southern Tanzania	"
	Soy bean recipes	"
Leaflets	Cultivation of climbing beans	English and Kiswahili
	Farmer participation in bean IPM technology dissemination	"
	Use *Vernonia* spp. for increased production	"
	Technology dissemination to farmers	"
Video	Farmer field days, Formal training, Farmer visits	Kiswahili
TV and Radio scripts	TV - Farmer field days Radio – Bean production and IPM (Pilika Pilika)	Kiswahili Kiswahili
Field guide	Pests, diseases and nutritional disorders of the common bean in Africa	Kiswahili version
Seed manual	Producing bean seed: Handbooks for small-scale seed producers	Kiswahili version
Farmers' own	Drama, Songs, Poems, Displays, Shows,	Kiswahili and Different local languages

7. Contribution of Outputs to developmental impact

The outputs of this promotional project will contribute to DFID's developmental goals in that its activities have involved the poor rural smallholder farmers in some of the very vulnerable farming systems of eastern, central and southern Africa.

Increased farm production

The project helped to bring out in a nut shell, the snap shot of the capability of the poor bean farmer in developing some simple and sustainable technologies which when combined with improved strategies (e.g. improved pest tolerant and high yielding bean genotype) have shown signs of increased production for food security and household income. This contributes to the direction of better livelihoods for the majority of smallholder farmers in the hillsides farming systems of the region.

Improved farmer skills and research capacity

Project participatory activities have clearly indicated that the participating farmers acquired skills which have helped them research on multiple constraints that affect farm production. Farmers opened up further as they worked in groups, visit other farming communities and meet with different stakeholders to train and discuss various issues affecting their social and economic well being. Farmers gained confidence and skills to train other farmers, extension agents and other service providers worked in harmony with the farmers and the respect for each other helped all participants to work as a team focusing on the improvement of the farmers' welfare. Experience from the project indicate that farmers are very capable of making decision on researchable strategies and actually identify the problem, search for solutions, test the solutions and monitor the effect, evaluate the effect and disseminate the results to other users. This process has sensitised farmers to demand various services including information on markets, credits, farm inputs, educational materials, etc.

Farmer (and especially women farmers) empowerment

The projects' participatory group approach and processes (methods) have enhanced farmer and other stakeholder empowerment to make decision and manage their own resources. Individual farmers including women at some of the project sites or example, have been able to invest the surplus income from increased bean and maize production in various developmental fields including purchases or hiring of additional pieces of land to increase production (e.g. Lushoto and Hai farmers in northern Tanzania), paying school fees for more children including the girl child, purchase of better food and housing materials, better clothes for their families, additional livestock heads, starting new enterprises (small scale bean seed production, poultry, piggery, oil pressing, etc.) or opening small shops, etc.

The participation of active partners (Farmer groups, Researchers, Extension service agents, NGOs, private sector, Universities, local schools, etc.) has helped these institutions understand better the needs of the poor farmer and the approaches and processes that enhance farmers to adopt technologies and achieve impact. Team work enhances the efficient utilisation of meagre resources (e.g. jointly sponsored training workshops and farmer visits) which single projects would not afford.

Identified promotional pathways

The project identified and used a number of promotional pathways. These involved, participatory group methods in constraint identification and search for solutions, group training, participatory testing of solutions in demonstration/ learning plots, participatory monitoring and evaluation (PM&E), community field days and farmer

group visits, participatory preparation of promotional materials, setting up village information centres, dissemination of effective solutions to community members within and outside of pilot sites, drama, choir, poems, radio, TV, videos, etc. These pathways and processes have greatly enhanced the spread of the message to the wider community and non-participating communities are keen to participate and have requested to be involved. More new farmer groups have been formed at target sites in each season during the life of the project.

Follow up action

The project outputs have reached a small proportion of the smallholder farmer community in the target regions. Further efforts are required to spread the message to the wider community for wider impact. Farmers have bean using crude extracts of a number of traditional materials ranging from botanical plant materials to various farm products including those from livestock (cow urine, cowshed slurry, etc.). Strategic and applied studies to determine the contents and appropriate doses for some the promising materials are required. More efforts are also required to strengthen existing partner linkages and seek further links with the private sector, academic institutions and non -governmental agencies in different parts of the region. Farmers' activities are the backbone to each of these institutions and appropriate linking with farmers would boost technology adoption rates and improve livelihoods of the rural poor communities.

Biometricians Signature

This project did not have a named biometrician. The relevant services were obtained from within CIAT project scientists (e.g. ERI) and biometricians based with the World Agroforestry Centre (ICRAF) in Nairobi, Kenya.

8. Appendices

8.1 Malawi: Poem on IPM from a farmer in Bembeke, Dedza

Written and read by
Ms Loleta Kadewere, Farmer, Bemeke IPDM farmer groups, November 2003 IPDM workshop, Dedza district, Central Malawi

"This poem is dedicated to all farmers who use IPM methods on Beans"

Title: "The Eye Catcher"

The eye catcher
The soul forgets not

The richer the memory
What is heard, settles down,
I have heard your name
To be IPM
What is heard never gets out of ears

The eye catcher
The soul forgets not

I will fight the good battle
The fight against hunger
The fight against poverty
The fight against enemies of farming
The fight to win good harvests

On our departure from here
Ladies and Gentlemen at home be ready
We will vacate from the house
The house will be honourably be called Resource centre or Village information centre for wisdom of IPM

Never will I go again to a local market at town
Off to buy sometimes expired chemicals for control of pests
For I will use environmentally friendly botanicals

For you my garden
If you ever invite pests
I will plant onion and garlic as an interplant
So that pests can be repelled
This is free knowledge given by Mr IPM

Please Mr IPM
Conduct vigorous awareness campaign meetings
Through you we have known *Tephrosia*, Cow urine, and Teta
Are free wisdom from Mr IPM

Mr IPM
Today is a good day
Winter beans, maize after harvest
One day all weevils will perish
It's a long time you have given problems
We now have *Tephrosia* and German thistle (*Vernonia* spp.)

The eye catcher
The soul forgets not

Now poultry chickens are saved
As announced by Mr IPM
The control of new castle disease
Pepper + *Tephrosia* + ash concoction
Make chickens drink

The eye catcher
The soul forgets not

As Christianity fights to meet the Holy Place in Heaven
I have also been encouraged to meet Mr IPM
Beans, tomatoes, Irish potatoes and vegetables
I have gathered courage to look at them

The eye catcher
The soul forgets not

There are a lot of challenges ahead!!

For my eyes are now open to meet Mr IPM
It is now my request that
You make frequent visits our Coordinators
To bestow us with wisdom

The eye catcher
The soul forgets not

8.2 Tanzania: Farmer group activity report from a Mbeya, Southern Highlands

Kikundi Cha Mbenya, Kijiji Cha Mbawi, S. L. P. 3127, Mbeya. Na Bwana C. Jimiston

Historia ya Kikundi:

Kikundi cha kilimo cha Mbenya kipo katika kijiji cha Mbawi Kata ya Ilembo, Tarafa ya Isangati, Wilaya ya Mbeya Vijijini, Mkoa wa Mbeya

Kikundi kilianza Disemba, 1999, kikiwa na jumla ya wanakikundi ishirini na tano (25), wanaume 13 na wanawake 12.

Kutokana na sababu mbalimbali wanakikundi wengi wlijitoa kwenye kikundi na kufikia mwishoni mwa mwaka 2001, kikundi kilikua kimebakiwa na jumla ya wanakikundi 16, wanaume 10 na wanawake 6

Baada ya kuona upungufu huo, kikundi kilitangaza nafasi za kujiunga kwenye kikundi, mwishoni mwa mwaka 2001. Mwanzoni mwa mwaka huu (2002) walijiunga wanakikundi wapya 15, mwanaume 1 na wanawake 14.
Kufikia Novemba, 2002 wamepungua wanakikundi 5, mwanaume 1 na wanawake 4. Kwa hiyo mpaka sasa kikundi kina jumla ya wanakikundi 26, wanaume 10 na wanawake 16.

Shughuli za Kikundi

Kikundi chetu kinajishughulisha na kilimo cha maharage, mahindi na ufugaji wanguruwe na mbuzi.

Kilimo cha Maharage

Katika kijiji cha Mbawi na Kata yote ya Ilembo, maharage ni zao la chakula na biashara. Zao hili hulimwa na wakulima wengi kwa sababu ndilo linatengemewa kuwapa lishe na kipato, pia hukomaa kwa muda mfupi ukilinganisha na mazao mengine

Matatizo ya Zao hili la Maharage

Tatizo kubwa linalowasumbua wakulima ni wadudu na magonjwa

Wadudu Waharibifu wa Maharage

Baadhi ya wadudu wanaoshambulia maharage ni:

- Selina- wadudu mafuta (Aphids)
- Funza- wadudu watoboao vitumba vya maharage (Pod borers)
- Inzi wa maharage (Bean Stem Maggot), hawa ni wadogo sana.

Udhibiti Wake

Katika eneo hili hapo awali wakulima walikua hawatumii madawa kwa sababu wadudu wanaoshambulia maharage hawakuwepo. Mwanzoni mwa miaka ya 1991 wadudu hao walianza kuonekana na kuathiri sana zao hili la maharage. Baada ya watafiti kuingia na utafiti wa dawa za asili tatizo la wadudu linadhibitiwa na:

- Utupa (*Tephrosia vogelii*)
- Ipasapasa
- Kweme
- Madawa ya viwandani kwa mbali (Hayatumiki sana)

Namna ya Kutengeneza Dawa Za Asili

- Chuma majani yaliyokomaa kiasi cha kilo 1.5
- Twanga majani ili kuyalainisha
- Tayarisha maji lita 20 katika chombo chenye mfuniko
- Changanya majini yaliyotwangwa na maji lita 20
- Acha kwa siku 3, kisha chuja mchanganyiko huo na kupulizia dawa hiyo shambani.

Dawa hizi zinatakiwa kupuliziwa shambani kila baada ya wiki mbili

Magonjwa ya Maharage

Magonjwa yanayosumbua wakulima wa maharage katika kijiji cha Mbawi na Kata yote ya Ilembo ni mengi. Baadhi ya magonjwa hayo ni:

- Zikushile- (Athracnose)
- Shisonta- (Ascochyta)
- Musimwa- Kutu (Rust)
- Madoa pembe ya majani- (Angular leaf spot)

Magonjwa mabaya zaidi katika kilimo cha maharage ni zikushile (Athracnose) ambao hushambulia mimea wakati wa mvua nyingi na husababisha hasara kubwa sana kwa wakulima wa zao la maharage.

Udhibiti wa Magonjwa

Hapo awli hapakuwa na njia yeyote ya kudhibiti tatizo hili la magonjwa. Lakini baadaye watafiti walifika na kufundisha baadhi ya njia ambazo zinaweza kusaidia kudhibiti magonjwa hayo.

Baadhi ya njia hizo ni:

- Kupanda mbegu bora zinazovumilia magonjwa
- Kupanda kwa wakati unaofaa
- Kupanda kwa nafasi inayofaa (mistari)

Maadhi ya mbegu ambazo zina ukinzani na magonjwa ni:

- Uyole96
- Uyole98

Mbegu hizi hupatikana Taasisi ya utafiti wa Kilimo Uyole.

8.3 Ripoti ya Ziara Mbalimbali Tulizoalikwa Wanakikundi wa Mbenya na jinsi Zinavyotusaidia

Tarehe 28/10/2002 hadi 10/11/2002

Mradi wa TARP II- SUA kupitia Taasisi ya kilimo Uyole ulikialika kikundi chetu kuwa miongoni mwa vikundi kutoka Iringa vijijini, Mafinga, Ludewa, Chunya na Mbarali kutembelea wakulima na wafugaji wa wilaya ya Mbozi
Kikundi kiliwachagua Ndugu Charles Jimiston (Katibu) na Theresia Yohana (Makamu mwenyekiti) kuwakilisha katika ziara hiyo

Tulichojifunza katika ziara hiyo ni:

- Ufugaji bora wa ngómbe na mbuzi wa maziwa na nguruwe
- Elimu ya mazingira kama utumiaji wa Bio-Gas na majiko sanifu

Tarehe 29/4/2002 hadi 3/5/2002

Kikundi kilialikwa na Isangati ADP Trust Fund kushiriki kwenye semina ya kuweka na kukopa na kilimo. Ziara iliyofanyika Ileje Rural Development Trust Fund mwanakikundi aliyetuwakilisha ni Kolnery Ntasamaye. Huko alijifunza yafuatayo:

- Uanzishaji wa miradi midogomidogo
- Mradi wa kuweka na kukopa
- Ufugaji wa kuku pamoja na umuhimu wa chanjo
- Ufugaji wa nguruwe
- Kilimo cha biashara

Tarehe 15/5/2002

Kikundi kilialikwa ARI-UYOLE na mradi wa promotion of bean IPM (Udhibiti Husishi wa Wadudu waharibifu wa maharage.

Walioshiriki ziara hiyo ni:

- Risi Ntuta
- Langison Mwakawala
- Telezia Raphael
- Damson Sheyo
- Kello Anania
- Charles Jimiston
- Lenifa Musa
- Yohana Magungu
- Kolnery Ntasamaye
- Theresia Yohana

Walichojifunza katika ziara hiyo ni:

- Udhibiti wa inzi wa maharage, Aphids na pod borers

- Uchanganyaji wa vyakula vya nguruwe
- Kilimo cha Soya- Lishe ya jamii
- Kilimo cha mahindi- aina mbalimbali za mbegu za mahindi
- Kilimo cha maharage kwa ujumla
- Kilimo cha viazi mviringo- aina mpya ya mbegu
- Jaribio la aina mbalimbali za mbegu za maharage kutafuta zinazo vumilia mashambulizi ya inzi wa maharage
- Baada ya kuangalia majaribio, vikundi vilivyoshiriki (kutoka Mbeya na Mbozi) vilipata nafasi ya kubadilishana mawazo

Tarehe 9/7/2002 hadi 12/7/2002

Tulialikwa na mradi IPM promotion –beans kushiriki siku ya maharage Lushoto, Tanga. Kikundi kilimchagua Kolnery Ntasamaye kushiriki ziara hiyo.

Tulichiojifunza katika ziara hiyo ni:

- Utunzaji wa ardhi- Kutengeneza makinga maji na kupanda nyasi za mifugo
- Matumizi ya mbolea za asili zinazotengenezwa kwa kutumia mti unaojulikana kama tugutu (hapa kwetu unaitwa Iporoto)
- Matumizi ya madawa ya asili. Kutumia mti unaojulikana kama Nyanywa (Kwetu umalila- Isyamu)
- Ufugaji bora wa ngómbe na mbuzi- kufugia ndani

Tarehe 10/9.2002

Kikundi kilalikwa na Isangati ADP Trust Fund kuhudhuria semina iliyofanyika Mbozi. Mwanakikundi aliyetuwakilisha katika semina hiyo ni Elizabeth Chachile. Tulichojifunza katika semina hiyo ni utengenezaji na utumiaji wa jiko sanifu

Tarehe 21/9/02 hadi 28/9/2002

Ofisa kilimo na mifugo wa Wilaya kupitia Afisa kilimo wa Kata ya Ilembo alikialika kikundi chetu kwenda kutembelea wakulima na wafugaji wa Arusha. Aliyewakilisha kikundi ni Taines Kolnery
Tulichojifunza katika ziara hiyo ni:

- Uvunaji wa maji
- Upandaji wa miti ya matunda,
- Utengenezaji wa chakula cha mifugo
- Matumizi bora ya mbolea
- Utunzaji wa vyanzo vya maji
- Ufugaji wa samaki

Majaribio Yanayoendelea Katika Kikundi

1. Udhibiti wa selina na funza kwa kutumia madawa ya asili kama:
   - Utupa
   - Ipasapasa
   - Kweme
   - Dawa ya kiwandani
   - Bila dawa

2. Mbegu bora za mahindi - Aina 54 za mahindi

3. Matunda (Maparachichi, n.k.)

Matarajio

- Kupata elimu ya kuendesha kikundi nafasi ikipatikana
- Kupokea elimu/mafunzo mbalimbali ya kilimo na ufugaji kutoka taasisi ya Utafiti wa kilimo Uyole na mashirika yasiyo ya kiserekali (NGOs) mfano Isangati ADP TF.
- Kujenga Ofisi ya kutunzia nyaraka za kikundi (V. I. C)
- Kuwafundisha wakulima wengine
- Kuongeza uzalishaji wa maharage yanayovumilia magonjwa ili kueneza mbegu.

8.4 Tanzania: Farmer group activity from Mbozi, Southern Highlands

Kikundi Cha Kazi Ni Mali, Kijiji Cha Shilanga, S. L. P. 385, Mbozi, Mbeya na Bwana B. Mwakapeta

Yah: Taarifa ya kikundi kwa ufupi

Historia fupi ya kikundi

Kikundi chetu kilianza mwaka 1990 kikiwa na wanakikundi 15, wanawake 7 na wanaume 8.

Kikundi kilianza na kilimo cha bustani za mboga, baada ya kuona kikundi kinajipanua tuliunda katiba ili kukiongoza kikundi chetu tukajiwekea sheria ndogondogo tukanunua vitabu mbalimbali vya ktuza kumbukumbu zote za fedha na shughuli zetu.

Wanakikundi wote tukajengeana nyumba za bati na kuchimbiana visima vya maji, kujenga nyumba mbili za biashara, kununua maksai na vifaa vyake jozi mbili kwa mapato ya shughuli za kikundi. Kikundi pia kinaeneza ngómbe wa maziwa kwa wanakikundi wate, tayari wanakikundi 10 wamepata ngómbe wa maziwa. Ili kudhibiti uharibifu wa mazingira kila mwanakikundi amejengewa jiko sanifu linalo tumia kuni kidogo linaloitwa mkombozi. Shughuli zetu zote bado tunaziendeleza.

Shughuli za utafiti

Kiundi chetu pia kinajishughulisha sana na utafiti wa kujipunguzia gharama ya uzalishaji na kuongeza kipato kinachotokana na shughuli zetu hivyo tunafanya utafiti wa mambo yafuatayo:

1. Mwaka 1995, kikundi kiliomba kwenye mradi ADP- Mbozi kufundishwa kuhusu matumizi ya mbolea za asili, tulianza kujaribia mahindi kwa ploti ndogondogo tukilinganisha aina mbalimbali za samadi, mboji bila kutumia mbolea za viwandani. matokeo yake yalikua mazuri na wanakikundi wote sasa tunatumia mbolea hizi kwenye mashamba yao ili kudumisha ubora wa ardhi na kupunguza gharama za mbolea za viwandnani.

2. Kikundi pia kiliomba msaada kwa Afisa Mifugo wilaya ili tuelewe shughuli yetu ya ufugaji kama ni ya faida au la, wilaya iliomba utafiti toka Uyole ambao walituwezesha kujipiamia gharama za ufugaji na tunaendelea na zoezi hili (2000-2002.)

3. Pia kikundi kiliomba msaada kilimo Wilaya kisaidiwe juu ya mazao muhimu ya chakula na biashara kama mahindi, maharage, matunda, jinsi ya kudhibiti wadudu waharibifu na magonjwa kwenye mazao hasa maharege majaribio haya tumeanza mwaka 2000/2001-2001-2002. Katika jaribio la udhibiti wadudu wa maharage tukitumia mbinu mbalimbali.

Dawa tulizotumia:
1. Dawa ya kiwandani (Dursban)
2. Utupa (*Tephrosia vogelii*)
3. Isogoyo (*Vernonia amygdalina*)
4. Plot ya bila dawa

Pamoja na dawa ya kiwandani kufanya vizuri zaidi katika jaribio hili, dawa za asili zilifuatia kufanya vizuri kuliko sehemu ambayo hatukutumia dawa yeyote.

Wadudu tuliopambana nao ni:
- Lwenya (*Ootheca*)
- Inzi wa maharage (Bean Stem Maggot)
- Wadudu mafuta (Aphids)
- Wadudu tobozi vitumba vya maharage (Pod borers)

Pamoja na mbinu hizi, pia kulikua na mbinu nyingine tulizo tumia kupunguza tatizo la inzi wa maharage.

Mbinu hizi ni:

- Kupalilia kwa kuinulia tuta kwenye shina la harage
- Matumizi ya madawa ya viwandani
- Ufugaji bora ili kupata mbolea yote
- Matumizi ya wanyama kazi
- Mafunzo ya jinsia katika familia

Mwaka 1997, mwenyekiti na katibu wa kikundi walialikwa na mradi wa SHDDP kwenda ziara Tukuyu ili waone jinsi wakulima wenzetu wanavyofuga mifugo yao. Ilikua ziara ya kubadilishana mawazo.

Mwaka 2000, kikundi kilitembelewa na watafiti kutoka Uyole kw ajili ya kutupatia semina mbalimbali za utafiti wa zao la maharage na jinsi ya kudhibiti wadudu waharibifu. Baada ya semina hizo tulipokubaliana kuweka majaribio ambayo matokeo yake yameanza kutupa matumaini.

Tarehe 15-5-2002, kikundi chetu kilialikwa na Taasisi ya Utafiti Uyole (Mradi wa kudhibiti wadudu waharibifu wa maharage) kwenda kujifunza kwa kuona:

Madawa ya Asili yanavyotayarishwa na kutumika shambani.
Kuangalia majaribio ya maharage, Alizeti, Mahindi, Ngano, Viazi mviringo, Ufugaji nguruwe, n.k.

Baada ya kuona hayo tulipata nafasi ya kubadilishana mawazo. Tulichagua mbegu zilizotupendeza.

Tarehe 11-7-2002, mwanakikundi mmoja alialikwa kwenda Lushoto (Tanga) na mradi wa Kudhibiti wadudu wa maharage kupitia taasisi ya Utafiti ya Uyole

Mafanikio katika utafiti
Tumefanikiwa kufahamu magonjwa na wadudu wa maharage tofauti na hapo awali tuliamini kuwa mvua ndio chanzo cha magonjwa ya maharage.

Tumeelewa namna ya kutayarisha dawa za asili na kuzitumia shambani kwa vipimo

Tumepunguza gharama za kununua madawa ya viwandani
Kipato cha maharage kimeongezeka hasa baada ya kutumia mbegu ya Sinon na Uyole96

Matatizo katika utafiti:
Hatuna vifaa vya kusindikia dawa za asili ili zitumike kwa muda mrefu zaidi hata wakati hazipatikani kwa urahisi.

Matarajio na mipango yetu ya baadaye:

- Kupanda dawa zote muhimu za asili kwa wingi
- Kupata vifaa vya kutunzia kitaalam
- Kuhamasisha watu wasio wanakikundi kuelewa elimu hii ya dawa za asili, faida na ubora wake ili kuwadhibiti wadudu pande zote.
- Kuendeleza utafiti zaidi juu ya wadudu waharibifu wa maharage na jinsi ya kukabiliana nao.

Mwisho
Tunapenda kuchukua nafasi hii kuwashukuru watafiti wetu wa Taasisi ya Utafiti Uyole kwa kutufundisha na kutushirikisha katika utafiti na kutuwezesha kufahamu mengi yanayohusu zao la maharage ambalo ni muhimu sana katika kila kaya na ukizingatia pia kwamba linapendwa sana na binadamu na wadudu pia.

Tunaomba mwendelee kushirikiana nasi ili siku ya siku tupate ufumbuzi hatimaye tupate kipato cha kutosha na hivyo sisi wakulima wa ngazi ya chini tuinua kipato chetu kupitia zao hili la maharage.
Ahsante
Bwana B. Mwakyusa
Katibu wa kikundi

8.5 Tanzania: Farmer group activity report from Hai, Northern Tanzania

Kilimo cha Maharage Wilaya ya Hai

Utangulizi (Na Bi J. Kyessi)

Zao la maharage ni zao muhimu sana kijamii. Umuhimu wake unataokana na kuwa kwa upande mmoja ni zao la chakula na upande mwingine ni zao la biashara. Zao hili hustawi vizuri sana katika mkoa wetu wa kilimanjaro na hasa katika Wilaya ya Hai, inaongoza ki-Mkoa katika uzalishaji wake.

Pamoja na mazao mengine tunayolima kuna mahindi, ngano, na mpunga, zao la maharage linachukuanafasi ya kwanza kwa umuhimu wke. Hii inatokana na zao hili hukomaa kwa muda mfupi yaani miezi mitatu tu na pia halihitaji mvua nyingi na kwa upande wa soko kibiashara linamuinua mkkulima haraka kutoka kwenye umasikini.

Kilimo cha maharage miaka ya nyuma wakulima hawakufahamu utaalamu au mbinu za kupambana na visumbufu vya mimea na hivyo mavuno yalikua duni. Tangu

mwaka 1999 tulielekezwa na wataalamu wetu wa kilimo DALDO Hai tuunde vikundi vya maendeleo ili tuweze kupatiwa mafunzo ya kitaalumu. Shughuli za vikundi hivi ni kujifunza mbinu za kilimo bora na cha kitaalam kwa njia ya vishamba mbalimbali vya mafunzo (Learning plots). Katika plot hizi wakulima wanahamasishwa pia kujionea wenyewe matokeo ya kutumia mbinu za kitaalamu kwa lengo la kuboresha maisha ya jamii ili kumtokomeza adui Umasikini.

Umuhimu wa zao la maharage pia unatokana na mbegu bora zilizofanyiwa utafiti kwa mfano, lyamungo 85, selian94, Rojo na SUA 90.

Tulianza kushirikiana na watafiti wa CIAT Selian Arusha tangu mwaka 1999. Kwa ushirikiano wa karibu kabisa wa wataalamu wa wilaya ya Hai, Bwana/Bibi shamba wtutulitembelewa na timu ya watafiti kutoka CIAT Selian Arusha ikiongozwa na Dr. Kwasi Ampofo, walitufundisha mbinu mbalimbali za kudhibiti na kutokomeza wadudu waharibifu wa zao la maharage na jamii ya mikunde pia mboga mboga. Matatizo ya wadudu waharibifu katika zao la maharage hasa ni Kirombosho, kimamba, Mbawa kavu wa chavua na maua. Wataalamu na watafiti walitufundisha mbinu zifuatazo

Udhibiti husishi wa wadudu wa haribifu (Intergrated Pest Management) na Bwana F. Mosha)

Mbinu:
1. Kutumia madawa ya asili
2. Kulima shamba mapema ili funza waangamie
3. Kufanya mzunguko wa mazao
4. Kupanda kwa wakati muafaka
5. Kuunganisha mbinu zaidi ya moja au mbinu shirikishi
6. Kutumia vipeperushi na mabango ili kuelimisha jamii
7. Kushirikisha jamii: Maigizo, nyimbo, na watoto wa shule

Mbinu za kudhibiti wadudu wa maharage:

1. Ushirikiano na wataalamu wetu katika vijiji, wilaya, Selian na CIAT
2. Kuanzisha vishamba vya majaribio na kutumia madawa ya asili mfano, Mkojo wa ngómbe, Majivu, mafuta ya taa yakichanganywa na sabuni, Mafuta na unga wa mwarobaini nk.
3. Kuanda shamba mapema
4. Kutumia vipimo maalumu wakati wa kupanda
5. Kupanda kwa wakati tofauti tofauti
6. Kushirikiana na wataalamu wetu kuandaa vipeperushi na mabango kwa ajili ya kuelimisha wengine zaidi
7. Kufanya siku ya wakulima (field day) ambayo hujumuisha wanakijiji wengi, wanafunzi, sisi wanakikundi pamoja na wataalamu wetu. Na hapa tunapata mawazo mbalimbali na kuyafanyia utafiti wa majaribio
8. Kubadilisha mazao
9. Kupanda maharage yanayostahimili ukame mfano Lyamungo 90

Mafanikio

Mzungumzaji aliyepita ametueleza mbinu mbalimbali tulizotumia kupambana na wadudu maadui wa maharage akiwepo Kirombosho. Mimi nitazungumzia chache na vipimo tulivyotumia – ambazo zilikuwa rahisi kupatikana, kutumia na kuleta ufanisi.

Matumizi ya dawa za asili na mbinu nyingine za kudhibiti wadudu (Na Bwana E. Sawe)

1. Dawa za asili

a) **Mafuta ya mwarobaini** – Dawa hii tulipatiwa na watafiti wa CIAT na tulitumia kiasi cah ml 15/lita 1 ya maji – tuliponyunyuzia ilionyesha mafanikio makubwa.

Aidha wakulima tulijitengenezea wenyewe kwa kuchuma mbegu za mwarobaini – chukua kilo 1 twanga na tukachanganya na maji lita kumi kuacha kwa Masaa 12 – tuliponyunyuzia ilitupa mafanikio makubwa ya kupunguza idadi na madhara ya Kirombosho na wadudu wengine wa maharage na mboga.

b) **Mfori (cowshed slurry) uliochanganywa na maji**
Tulichukua mfori lita moja tukachanganya na lita moja ya maji tukavundika mchanganyiko huo kwa wiki moja – mbili (siku 7-14). Tuliponyunyuzia na baadaye kukagua mimea (scounting) tuliona mafanikio makubwa. Dawa hii hupunguza madhara ya wadudu waharibifu na pia tuliona kuwa pale ilipotumika iliongeza viritubisho kwenye mimea.

c) **Mkojo wa ng'ombe (cow urine)**
Matumizi ya dawa hii yalikuwa kwa uwiyana wa lita moja ya mkojo na kwa lita lita mbili za maji (1:2). Mchanganyiko huu ulivundikwa kwa muda wa saa 12-14. Tuliponyunyizia huo mchnganyiko kwenye mazao yetu tulipata mafanikio makubwa.

d) **Majivu na mafuta ya taa**
Tulipotumia majivu yaliyochanganywa na kiasi kidogo cha mafuta ya taa tulipata mafanikio ya kuridhisha

2. Mbinu nyingine tofauti na dawa

- **Kupanda kwa Wakati**- tulipanda maharage nyakati tofauti. Mpando wa kuwahi – mpando wakati – mpando wa kuchelewa.
- **Mpando wa kuwahi** - ulipambana na idadi kubwa ya Virombosho walioyochomoza na hivyo madhara kuwa makubwa.
- **Mpando wa kuchelewa** – tulipambana na kimamba kwa wingi ambao pia walikuwa na madhara makubwa.
- **Mpando wa kati** – ulisaidia kukwepa vipindi vya madhara hayo na hivyo matumizi ya madawa kuwa kidogo iliyotuonyesha mavuno mengi.

3. Kilimo cha kubadili mazao

Tulipofuata ushauri wa wataalam na watafiti – tukalima kilimo cha mzunguko kubadilisha mazao na yale yasiyoliwa na Kirombosho e.g., Mahindi na Alizeti tuligundua husaidia kuharibu mzunguko wa maisha ya Kirombosho na pia idadi ya Virombosho wanaochomoza toka kwenye udongo.

4. Kulima shamba baada ya kuvuna

Kwa kuwa tulielekezwa na wataalam kwamba baada ya mavuno funza wengi wa Kirombosho hubaki kwenye udongo.
Pale tulipojaribu kulima baada ya kuvuna maharage – tuliona tofauti kubwa ya Virombosho kuwa wachache kulingane na sehemu ambazo hatukulima kiangazi.

5. Matumizi ya mbolea ya vijidudu – Rhizobia:

Mwisho tumeona mafanikio makubwa kwa ushirikiano wa wataalam na watafiti pamoja na vikundi vya wakulima kupitia vishamba vya majaribio ya tekinologia mbalimbali kumepelekea kuwashawishi wakulima wengi Wilayani Hai kufuata kanuni za kilimo bora na hivyo kuhamasika kutumia madawa ya asili kwenye mashamba ya maharage na mbogamboga na hivyo kupunguza madhara ya matumizi ya madawa ya viwandani ambayo pia ni ghali.

Kutokana na mafanikio ya matumizi ya Agricultural Practices na matumizi ya wadawa ya asili uzalishaji wa maharage Wilayani Hai umeongezeka kwa asilimia 60% yaani gunia 5-7 kwa akari 12002 tofauti na ilivyokuwa 1998 ambapo uzalishaji ulikuwa gunia 3-5 kwa ekari moja. Kutokana na mafanikio hayo tumejiwekea malengo.

Malengo

1. Kushawishi wakulima wengine kujiunga na vikundi mbalimbali ili waweze kupata huduma kwa urahisi zaidi
2. Kutoa elimu tuliyokwesha pata kwa wenzetu
3. Kuendelea kujifunza zaidi ili tuweze kuendeleza kilimo cha maharage na mazao mengine kwa utaalamu zaidi ili tuweze kujipatia maendeleo zaidi katika vikundi vyetu na nchi nzima kwa ujumla

Maombi

1. Tunaomba wafadhili wetu waendelee kutufadhili zaidi ili tuweze kupata elimu zaidi ya kilimo cha maharage
2. Pia tunaomba ikiwezekana tupatiwe ziara za mafunzo (ndani na nje ya nchi) ili tuweze kujifunza zaidi
3. Tunaomba tupatiwe soko la maharage pamoja na mazao mengine ili tuji kwamue kiuchumi

Shukrani

Tunatoa shukrani zetu za dhati kwa CIAT pamoja na wizara ya kilimo na mashirika mbalimbali kwa kutupa elimu hii ya kilimo cha maharage. Tunatoa pia shukrani zetu za dhati kwa wafadhili wetu walioandaa siku hii ya leo kwani wote tumeona jinsi tulivyobadilishana elimu bora ya maharage.